FRIENDLY ALIENS ENCOUNTERED: MAJOR PROBLEMS AND PRINCIPLES IN DIGITAL DESIGN TEACHING

SHANG-YUAN CHEN, MAO-LIN CHIU
Department of Architecture, National Cheng Kung University, Taiwan
shangyuanc@pchome.com.tw, mc2p@mail.ncku.edu.tw

Abstract. Because of the recent opening of the Kunsthaus Graz and the later coming digital design projects, those so-called friendly aliens brought more concerns on the prospects of digital design and especially the impact on architectural education. Should we stop to teach CAAD or to reconcile ourselves to the status quo in schools? This paper proposes a more compatible and feasible "Design-Oriented CAAD teaching Class (DOCC)" to transform the function of CAAD in design studios. We surveyed various CAAD teaching pedagogies in the past and also observed the status quo in Taiwan in order to develop an analytic framework for DOCC. Those investigations help us to decide strategies and understand their constraints, when CAAD is taught as a foreign language. The teaching principle and process is introduced in the undergraduate courses at NCKU. The design cycle, in which a design methodology engaged, is divided into tree stages: prototype, transformation and adaptation. A design project is implemented to demonstrate the rationale and raise later discussion.

1. Introduction

Like as its breakthrough ancestor Frank Gehry's Guggenheim Museum 1997 for its city Bilbao, the Kunsthaus Graz called "Friendly Alien", designed by architects Peter Cook and Colin Fournier, now has become a new architecture symbol for city Graz in Austrian. The opening of the building on October 2003 was in time to catch the end of the Austrian city's tenure as European Capital of Culture. For the recent emergence of free form project, it has been brought more concerns on the prospects of digital design. The phenomenon also spread in Taiwan. Their descendant, Guggenheim Museum designed by architect Zaha Hadid may drop onto the city Taichung.

Regardless the complexities and the high cost of construction, these free form geometric projects mushroom into cities. In addition, these eye-

catching aliens will not only become an outstanding digital design style but also regarded as a resemblance of a progressive country and of a global city. Meanwhile, friendly aliens encountered, it does not only form our urban landscape but also shapes our new city culture. In addition, it will bring deep impact on architectural education.

Apparently, the recent emergence of free form projects or virtual architecture gives students the impression about how forms should look like, and accompanying with them are the more than curiosity about how to shape forms by digital media. Eventually, new educational missions are coming. But accompanying with them, questions are raised from the coming shift of CAAD pedagogy. The following sections will review previous development of CAAD teaching and Design studio learning in Taiwan.

2. The Shift of CAAD pedagogy

In order to develop an analytic framework, we have studies various approaches in teaching CAAD in the past, and especially CAAD studios for examples：Electronic design studios, Virtual design studios, Collaborative design studios, or Digital design studio.

2.1. ELECTRONIC DESIGN STUDIOS

It started an experimental “Electronic Design Studios”, taught during Fall 1988 at Carnegie Mellon University. Stressing on computer “aiding” with design studios after awareness of obsolete idea of computer “replacing” human designers, Akin (1990) explored the potential to radically change the CAAD pedagogy which is composed of three fundamental ingredients: student, instruction, and instructor.

2.2. VIRTUAL DESIGN STUDIO, COLLABORATIVE DESIGN STUDIO

Beginning in 1993, small groups of students of architectural design at different institutions around the world participated in collaborative design projects using a variety of tools, including CAD, Internet and teleconferencing. Stressing on collaboration via cyberspace, this program was known as the “Virtual Design Studio (VDS)” (Wojtowicz, 1995). The idea of a VDS now refers to a team of designers from various locations for which communication is computer-mediated; essentially, the studio is distributed across space and time and information is represented electronically. (Gero and Maher, 1996) A variation of VDS was experimented in as Collaborative design studio (CDS). (Chiu et al., 2002)

These CAAD pedagogies mentioned above has different focuses varied from technical, methodological, and social aspects. However, they are time-consuming Problem-based design studios with computer support, or regarded as CAAD teaching in Design. Design is a whole, but CAAD teaching is in parts. Different with them essentially, my intension and contribution here is to develop a "Design-Oriented CAAD teaching Class", which is Design in CAAD teaching. CAAD teaching is a whole, but Design is in parts. The class will be applied to an undergraduate and must be efficient for not only command- training but also integrated design learning within constrained two hours per week one semester. In addition, the mode should be more compatible for such a situation：a remaining divorce between CAAD teaching and Design Studio learning in most architecture schools Taiwan.

2.3. DIGITAL DESIGN STUDIO, OR SOMETHING ELSE

Although digital media became a focus of learning subject in architectural education, yet there is a call to stop teaching CAAD (Kvan, 2003). In fact, the call is not a contradiction between teaching and learning, it would rather be regarded as seeking a broader way to integrate digital design into all aspects of architecture education, or fundamentally, as a sequence of his speaking " Teaching CAAD is more than teaching commands" (Kvan, 1996). The call reminds us again that get rid of teaching CAAD to be skillful draftsmen and so too does the technology demand a reconsideration of the process, the instruction and the interaction of teachers and students. It has become a shift of CAAD pedagogy from an isolate command-teaching course into design communication. From another viewpoint, we could also observe the change from design studios.

To look back, Akin, Omer has told us in 1990: "If the computer is going to be more than a passive instrument in design studio, then design pedagogy will have to be changed, fundamentally." And the articulation of education between CAAD teaching and a design studio will be truly rare consequently.

Despite their purpose is the same, seamless conjunction of Design learning and CAAD teaching, to distinguish a "CAAD studio" from a "Design-Oriented CAAD teaching Class (DOCC)" is very important. A "CAAD studio" is CAAD Teaching in a Design Studio, while a "Design-Oriented CAAD teaching Class" is design in CAAD teaching class. They are different from each other relatively, and need varied strategies according to their constraints.

3. Status quo：Remaining Divorce between CAAD teaching and Design studio learning in Taiwan

In the last decades, most of architecture schools in Taiwan are hesitate or reluctant to change the way in teaching CAAD as a tool in the undergraduate program. Our survey indicates that there are only two of sixteen architectural schools, which provide CAAD design studios, or called digital design studios. Most of the programs are opened for the graduate, and there are only six of sixteen schools offering the elective courses. It is the result by few reasons. First, for qualified teachers who are both acquainted with digital media and design, are still rare. Another reason is the courses start to teach or learn CAAD just few years ago actually. And the other reason is all design studios at the same degree is demanded opening reviews, not for every time but at least for midterm and final, therefore, it cause a hard existence of an independent CAAD studio, especially for junior undergraduate and even higher. The result is not the lack of competition of a CAAD studio with the others but is the requirement that all studios have to share and meet standardized pin-up regulations in order to avoid an unfair or an isolated critique. Of course, compared with a CAAD studio, a "Design-Oriented CAAD teaching Class" shall be more feasible and compatible for an independent training; both command teaching and design learning.

It is true that is not necessary all design disciplines depend on even ubiquitous digital tools. However, it would be a merit, a remaining divorce between CAAD teaching and Design studio learning. And at least, it may allow opening another choice both for each other.

4. New Curriculum Framework

It is quite clear now. There is a call to revive teaching CAAD, not only for the relief of anxieties about alien coming but also for interlocking the disjunction between digital media and design. Of course, the CAAD teaching pedagogy should be changed after the revolutionary "Electronic Design Studio" and hold it until an evolutionary digital design studio age.

Doubtless, running an independent DOCC shall be more compatible and feasible. Nevertheless, constraints and difficulties remain, if without any strategy or principle.

4.1. CONSTRAINS AND STRATEGIES

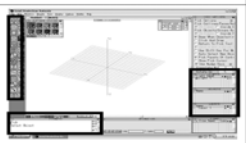
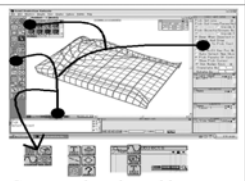
A "Design-Oriented CAAD teaching Class" is composed of command-training and "aiding" a design cycle. Although we have been acquainted with what and how a command teaching is, yet the design cycle part is still

at a loss. Compared to a conventional Design studio that is composed of a few team members, normally 8 to 12 per team, but time-consuming, normally 8 to 16 per week, a DOCC will be consisting of a number of classroom's students, normally 25 to 50, and time-limited. Eventually, a design cycle must be a defined scope, and teaching commands should be packaged.

4.2.MAIN PRINCIPLE：TEACHING CAAD AS A FOREIGN LANGUAGE

On the other hand, another question raised, How to put them together? Can we teach CAAD as teaching a foreign language? Digital design curriculum reflects the need to build up the media communication skills gradually (Cheng, 1996). The whole course should be divided into tree phases that have different focus according to students' three learning levels, Table 1. At beginning, it focuses on an introduction of commands of core software and its peripheries individually. Students then get basic skill training in this phase. At the intermediate level, a design cycle engaging with a design methodology will be provided. Commands that have been introduced at the first phase are rearranged and composed as several command packages according to the need of design cycle stages. Students begin to learn how to manipulate commands to interact with their design thinking. Once they have passed through these levels, students can freely use the methods for advanced design and explore the other possibilities. There is a final review after the design cycle finished. We invite the other tutors to give them critique and discussion as a conventional design studio. The critique will help them to open more and more possibilities about design in CAAD learning. The assigned design cycle just gives them a platform for further exploration. Eventually, the whole process is quite similar to the process of learning a foreign language such as building vocabulary, understanding syntax and grammar, and performing conversation.

TABLE 1. Curriculum Framework

LEVEL	BEGINNING	INTERMEDIATE	ADVANCED
COMMAND TEACHING VS DESIGN LEARNING	 Command introduction by Attribution individually	 Command packaged by stages	 Pin up Presentation And Critique
PROJECT TYPE	Short Exercise in classroom	One Design cycle assignment	Final Review
FOCUS	Command skilled-training	Command packages Vs. Design thinking	Fluent Use and Further Exploration

5. Implementation

The implementation for DOCC is a 16-week 3D-modeling class for the 3rd undergraduate students of NCKU in fall 2003. They have been trained 2D drawing by AutoCAD and graphic editing by other software before. Nevertheless, they use them only for presentation generally but hard to engage with their design thinking process. There will involve diverse roles of people in this class：a teacher, a teaching assistant, 28 students, two invited critics, and a real client. The class is divided into tree phases, command introduction (7 weeks), one design cycle (9 weeks), and a final review (1 day).

FormZ is adopted as a tool for 3D modeling and its peripheries including Photoshop and Powerpoint for presentation. After command teaching, an assignment “Noodle shop” engaged with a design methodology is provided for running a design cycle. When the cycle is finished, a final review is conducted to examine not only what we have done but also find Why, How and where we are going to the next step.

5.1. COMMAND INTRODUCTION

There are two ways to introduce commands in parallel manners. The first one is introduce them according to a typical arrangement of elements, toolbars, of the window. The second one is introduce them the following tutorial lessons by detailed explanations. We select some important commands as modules and conduct goal-oriented exercises.

5.2. DESIGN CYCLE: AN ASSIGNMENT ENGAGED WITH A DESIGN METHODOLOGY

The design cycle provided is an intensive assignment engaged with a design methodology for interlocking the disjunction between command learning and design thinking. It would be scheduled carefully rather than a time-consuming, ill-defined design process. The design cycle focus on manipulating those introduced commands to solve serial defined issues. We cut this assignment into tree stages, including prototype and transformation as well as adaptation. We will go further illustrate them. All the students in this class must submit their two intermediate briefings for the front two stages, prototype and transformation, and present them in classroom. The teaching assistant will help me to join their discussion. However, it announces an attention to design in CAAD learning.

5.2.1. Assignment: Noodle Shop Design

The Noodle Shop is located at the corner of an old street, Fun-Chung Street, and its lane in central city of Tainan. The street is in front of the East Gate of Great Achievement of Confucian Temple, a historical landmark in the city, Figure 1. The location should be a site for a commercial used shop. Unfortunately, It is cut into two parts by a café plaza. The first part is a ground-floor rectangular cube (4.5m x 22m x 4.5m), which is belongs to a two floors row house, and the second part is a trapezoid, 2 floors shed shop (2.5m~0.8m x 16m x 7.2m).

The owner of the noodle shop wishes to renovate his unique shop through two phases, while his business keeps going. The first phase is to renovate the rectangular part. And the later, an event happened, because of the successful renovation and business of the first part, the keeper get a loan, therefore he wishes not only to renovate the two floors trapezoid shed but also reconstruct it. It makes us not only to consider shop's interior but also the impacts from its outside environment. The functional requirements of this shop are cooking area, seats area and one toilet as well as circulations.

In addition, there remain several challenges, including urban context, city culture, and the need of connection of two parts, atmosphere of a Noodle cooking as well as reflection of keeper's identity, background and viewpoints. In order to solve problem efficiently, a design methodology is engaged within.

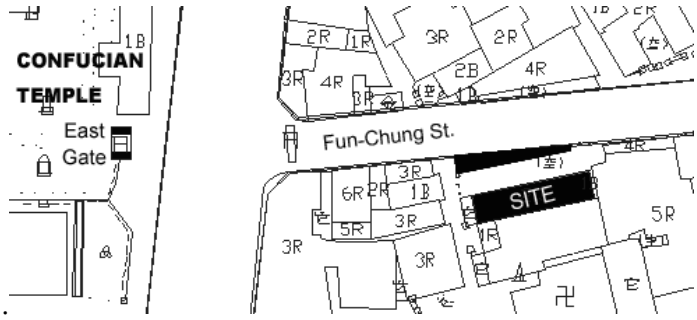


Figure 1. Site

5.2.2. Design methodology: Creation rather than Production

A design would be a creation rather than a production, and a design process would be regarded as a life cycle rather than a production line. A design methodology promotes a designer to generate ideas and to create a design step by step. As a result, it is a system of methods and principles for explaining a design cycle, and a different "kind" of design modes may have a varied one. Therefore, design generations would be more like as organism reproduction than as manufacturing productions, which could support variation and evolution.

On one hand, a design cycle is regarded as information processing of problem solving (Newell, Shaw and Simon 1957, 1967). On the other hand, it needs articulated stages and a well programming, and avoids an endless growing decision tree. Therefore, a revised problem-solving model, the design cycle, is related to the decision-making circle (Asimow, 1962).

The design cycle, in which human and computer involved, hence at beginning, could be divided into two parts, Figure 2. The first part belongs to human cognition; the design thinking of a designer, and the second part belongs to a machine computation, the hardware and software on which the designer gets ready to work. While the third part, connected once they interact and communicate with each other, were those packaged commands and their generative diagrams.

An analogical model that helps us to understand how they function together is a DNA molecule, which is a twisted double helix. While in order to explain their relationship easier, we loosen them as two parallel lines at beginning.

One helix, human cognition, is composed of building blocks, which are Requirement, Concept, Preference, Event reaction, Solution, and Creation. Another helix, machine computation, is composed of building blocks, which are Input, Prototype, Transformation, Adaptation and Output. The keys to link building blocks of both two helixes, on one hand are consisting of diverse command packages but on another hand are certain type generative diagrams. In addition, here existed torsion to screw up the two helixes tightly and to move forward simultaneously is a designer's intension of problem solving in which FBS exist. (Function-Behavior-Structure) (Gero, 1990).

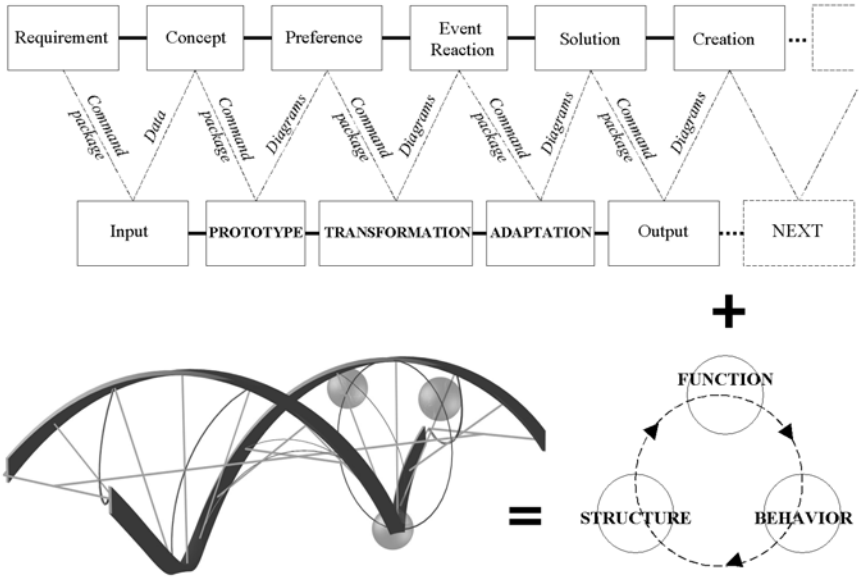


Figure 2. Design Cycle

There are two remained incomprehension need to be clear. The first one, the in filled components of the helixes, the building blocks, could be varied depending on varied "kind" of design and on varied decision-making process as well as on capability of machine computation. And so do too command packages and generative diagrams. Components may be changed, but however, the support, the structure remains. The DNA structure's two helixes complement each other, and so do too the human cognition and machine computation. And the Second, the length of a design cycle could be lengthened or shortened. It would be regarded, as an organic life in an open system rather than as an inorganic production after exhausted to become a closed one.

5.2.3. Prototype, transformation, Adaptation and their command packages as well as generative diagrams

The assignment "Noodle shop design" is articulated by three stages, Figure 3. They are prototype, transformation and adaptation ranked according to the capability of computation, which diagrams are presenting on, decoding from and simultaneously waiting for encoding in. In addition, the interpretive language here is composed of command packages.

- Prototype：A design prototype brings together the requisite knowledge appropriate to a specific design situation (Gero, 1990). In this stage, design requirement is provided and output as database, like as site depictions and

environmental images etc, and later, designer's concept generated. They engaged with each other, and as a result, prototype is built.

Requirement： Primitive FBS in the first phase renovation for Noodle shop ground-floor rectangular one.

Concept： It could be derived from urban context and city culture as well as reflection of keeper's background and viewpoints.

Command packages：(a) Module/ working units, point snap, height, mesh. (b) Function/ 3D extrude, primitives, select, surface style. (c) Behavior, like as circulation/ difference, un-ghost. (d) Structure, like as column, frame or wall/ Synthetic command operation.

Transformation ： According to specific constrains or preference, variations of prototype are transformed.

Command packages：(a) Edit/ copy, mirror, move, scale. (b) Boolean/ union, intersection, difference. (c) Random section/ contour, select segment. (d) Free form/ c-mesh, displacement.

Adaptation： There are two approach ways in this phase:

(1) Top-down process：Regarding a building shape or a site is caused by outside environment, urban context and city culture etc. So do too the forces from outside like trim or revolution impact and influence its inside organization and components.
(2) Bottom-up process：The process is from interior components or units to integrate a work.

In the last stage, an event makes it necessary to re-build the two floors trapezoid. The layout from the rectangle one needs to be adapted into the trapezoid one. We approach it from both sides, top-down and bottom-up.

Command packages：

(1) Top-down process：(a) Force/ trim or split, difference, revolution, scale, deform. (b) Macro.
(2) Bottom-up process： Synthetic command operation

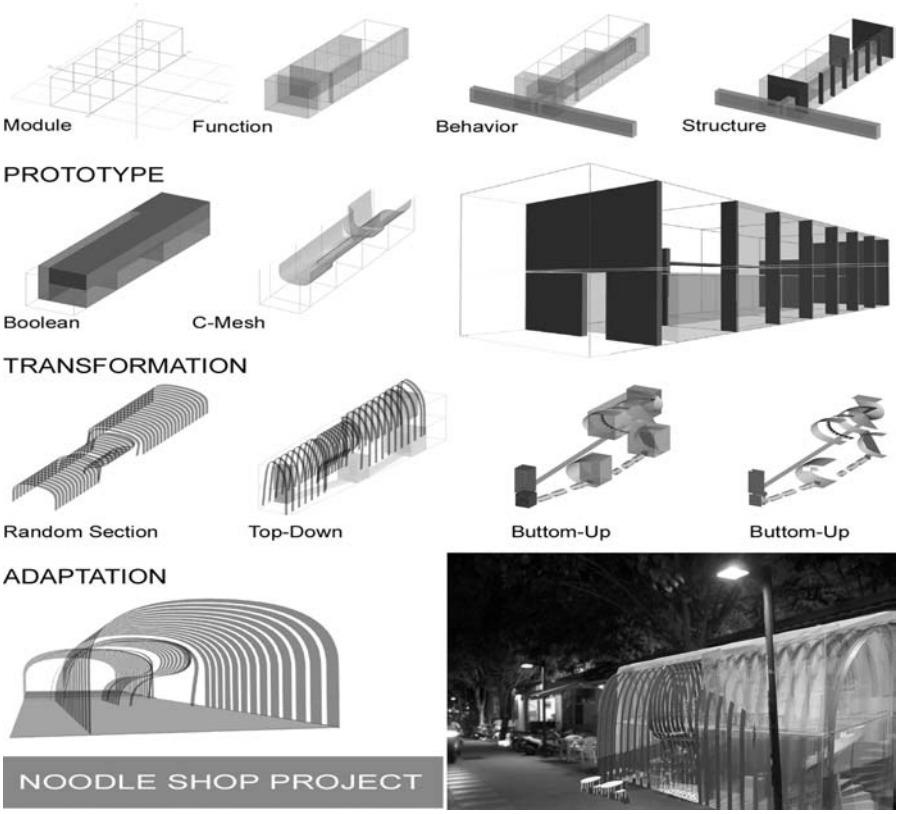


Figure 3. Sample Assignment

5.3. FINAL REVIEW: QUESTIONS RAISED

The last stage of a DOCC is a one-day final review on site, Figure 4. Students have to prepare pin-ups and present their design. We invited two jurors who both teach CAAD and Design Studios. Several important questions and issues are raised in discussion as below:

- Design evaluation: How to evaluate design performance? The outcomes of DOCC are designs in contrast to conventional CAAD assignments. Design evaluation is based on the clear transformation of ideas into operational studies. Design critiques are called upon how the process can be creative or effective for transformation.
- Prototype development: Why adopts the prototype approach? While it is debatable, we feel that the study of function, behavior, and structure should be brought into the development of prototype. Therefore, the design knowledge or methodology can be derived when a prototype is developed.

- Concept teaching: What should be taught in DOCC? In most exercises, students learn about commands instead of concepts. We feel the exercise becoming trivial without concept introduction. While we have primarily taught transformation in DOCC, the other design concepts include: Skeleton-Kinematics application in MAX, Scenario-Design approach in Director MX, Dynamic-particle system in MAYA and Morphing principle in Flash, Event- Reaction in XSI and so on.
- Teaching aids: How helpful is the teaching aids? From our views, it is more important in DOCC than conventional CAAD course with a dedicated teaching assistant who assists situated learning in addition to prepare tutorial, print handouts, assist evaluation, and especially answer students' questions after classroom hours.
- Course constrains: How to manage the schedule? The time constraints of classroom hours make DOCC hard to deal with a complex or large-scale design program with a diversity of digital media. Although there are web-cameras and e-mails for daily communication, yet, compared with a conventional design studio, face-to-face conversation is not enough for addressing hard questions.

Figure 4. The Final Jury on Site

6. Discussion

The shift of digital design is clearing open a new dimension for teaching as well as research. The review of previous CAAD development and the exercise serves the foundation for the following discussion.

- Next steps: Although, compared to a CAAD design studio, DOCC have been proved a better way both to compromise the status quo in Taiwan and to relieve the anxieties and curiosities of digital design aliens' coming, yet the constrains remain. The time-limited classroom hours make it hard to deal with complex or large-scaled design program so does a diversity of digital multi-media training.

- Problems and solutions: The learning obstacles are because of limited face-to-face contacts and teaching aids are not online. We feel that the role of learning more important than the role of teaching in digital design because the altitudes are different. That is to say, classroom teaching can be a time-limited with defined mission, while a student's learning after class is time-consuming, a trial-and-error problem solving process. The problems raise the potentials for developing a web-based learning platform with intelligent teaching assistants will make it possible a seamless conjunction of digital media and design. Therefore, learning could happen at anytime and anywhere, especially for skill training and design thinking.
- The role of instructors and teaching assistant: While an instructor can setup the teaching framework, students would prefer seeking a friendly teaching assistant rather than a teacher for asking questions after class. But a teaching assistant is difficult to answer most of questions. Therefore, asking and answering become intermittent unless a role of both instructors and teaching assistant exist. On-line instruction will serve this function essentially.
- The cue: Especially in digital media learning, students need an instructor who can respond a student' wrong actions automatically and give him a hint or guild actively. While the situation remains further investigation.

The agent-based research is initiated from the AI concept from 1990s (Wooldridge, 2002). Agent-based systems have been applied to design in many aspects such as assisting users to search information on the web or perform design tasks. Agent-based interface is becoming popular in web-based shopping or learning environment. Prospectively, a web-based DOCC engaged with an intelligent teaching assistant agent will make it possible, a seamless conjunction of CAAD teaching and design learning. Hopefully, a next alien encountered, strangely but friendly. The future learning platform is envisioned as shown in Figure5. Future experiments will be conducted based on the new platform.

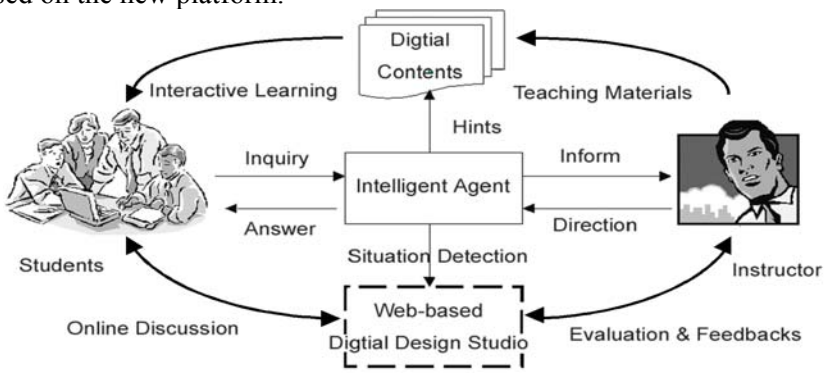


Figure 5. Vision of Future Design Studio Acknowledgements

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References

Akin, O.: 1990, Computational Design Instruction: Toward a Pedagogy, The Electronic Design Studio, The MIT Press, pp. 301-316.

Bradford, J.W, Cheng, N. and Kvan, Tomas: 1994, Virtual Design Studio, eCAADe, Glasgow, pp. 163-167.

Cheng, N.: 1996, "Teaching CAD as a Foreign Language", proceedings of CAADRIA 1996, Pp 11-20.

Chiu, M.L.: 1996, Prototypes, Variation, and Composition: A Formal Design Approach in Urban Housing Design with Computer Assistance; Proceedings of CAADRIA 1996, Hong Kong, pp 287-298.

Chiu, M.L., S. Yamaguchi, M. Morozumi: 2001, Supporting Collaborative Design Studios – Scenarios and Tools, Proceedings of The Sixth International Conference of CAADRIA'2001, Sydney, pp. 125-132.

Chiu, Y.C. and M.L. Chiu: 2003, "Right Tools for Design Free-form Geometry More than Representation and Manipulation", Proceedings of CAAD Futures 2003, Kluwer, pp. 433-443.

Cigolle, M. and K. Coleman: 1990, Computer Integrated Design: Transformation as Process, The Electronic Design Studio, The MIT Press, pp. 333-345.

Gero, J. and R. Sosa: 2002, "Creative design situation", proceedings of CAADRIA 2002;pp 191-198.

Kvan, T.: 1996, "Two Views through the Binoculars", proceedings of CAADRIA 1996

Kvan, T.: 2003, "Reason to stop teaching CAAD", in Chiu M.L.(ed.), CAAD TALK 3, Garden City publishing Ltd, pp.66-81.

McCullough, M., W. J. Mitchell, and P. Purcell (eds.): 1990, The Electronic Design Studio; The MIT Press.

Mitchell, W.: 1990, The Logic of Architecture: Design, Computation, and Cognition, The MIT Press.

Wojtowicz, J (ed.): 1995, Virtual Design Studio, Hong Kong University Press

Wooldridge, M.: 2002, An Introduction to MultiAgent System, Chichester, England, John Wiley and Sons.

Zhang, L.: 1996, "The Design of Test Program for Basic Design", Proceedings of CAADRIA 1996; Pp 253-267.