

# A framework for the development of online design learning environment

Wenzhi Chen\* and Manlai You\*\*

\* *Department and Graduate Institute of Industrial Design, Chang Gung University, Tao-Yuan, Taiwan, Graduate School of Design, National Yunlin University of Science and Technology, Yunlin, Taiwan, wenzhi@mail.cgu.edu.tw*

\*\* *Graduate School of Design, National Yunlin University of Science and Technology, Yunlin, Taiwan youm@yuntech.edu.tw*

**Abstract:** The advancement of information technology has had an enormous impact on design practice and education, therefore, it is crucial to teach and train design students new design methodologies and skills. The online learning environment (OLE) is pivotal in providing the functions and tools for new types of learning and teaching through information technology. This paper demonstrates a framework for the development of online design learning environment (ODLE). First, by literature review, questionnaires, and online observation, important information was collected and analyzed. Key issues relevant to OLE were then discussed with design teachers and students. Finally, a framework of online design learning environment was proposed. In the framework, four basic components are integrated with the online design learning environment: Course, Instructor, Learner, and Internet. The relationships between these components and the ODLE were further identified as Delivery, Organization, Process, and Access respectively. Based on the framework, the ODLE was prototyped with a three-level platform: Community, Classroom, and Studio. Community provides the site users an open space to exchange opinions about design. Classroom provides various asynchronous design courses. Studio provides synchronous tools for communication and discussion in design studio activities. At the end, the possible improvement of the proposed ODLE framework and its prototype was further discussed.

**Key words:** *Design Education, Online Learning Environment (OLE), Online Design Learning Environment (ODLE)*

## 1. Introduction

The development of information technology (IT) has made great changes in design practice. For example, computer aided drawing and video conferencing are common design tool and communication method nowadays. Under such circumstances, design practice is becoming featured in specialization, delegation, distribution, and cooperation [1]. It is necessary to develop a new approach to teach and train students to adapt to the new design tools and methods.

Similarly, IT also influences the development of the education discipline. The proliferation of computer media and networking has the potential of making functional change in the methods, models, and techniques employed in education. There are many concepts and works proposed to represent this new development in education. E-learning, Web-based learning/instruction, online course, and virtual university/classroom are some examples. The learning theories and practice, online learning environment, and digital contents are the most considered issues in using the IT for learning and instruction [2-7]. Among them, the online learning environment (OLE) is

the most essential. Online learning environment is defined by Dringus & Terrell [4] as

*...a distinct, pedagogically meaningful and comprehensive online learning environment by which learners and faculty can participate in the learning and instructional process at anytime and any place. OLE manifests a variety of technical tools that support instructional delivery and communication in online formats. In addition, dynamic structures are embedded to enhance the instructional, learning and communication processes taking place.*

There are already many OLE packages developed by universities and IT companies, for example, the Virtual U, WebCT, BlackBoard, LearningSpace. However, how adaptable these packages are to the need of design education remains to be checked.

Design education requires special strategies as it has its own feature. According to Chen & You [8], the main features of design education are listed as –

1. a combination of theory and practice;
2. art as well as science;
3. team work and collaboration;
4. problem-solving process with creative thinking;
5. multimedia materials and contents.

Consequently, instruction strategies of design education would be different from that of other domains. It seems that the constructive and collaborative learning theories are the most useful and suitable to design education. Meanwhile, the problem-based approach is applicable in design project courses, where students learn design by doing design. Throughout the design process, students have to integrate different knowledge domains, such as engineering, business, and aesthetics, in order to solve the problem creatively.

Recently, many researchers have proposed various models of online design learning environment (ODLE) [9-14]. For example, Simoff & Maher [12] combined a web-based virtual design studio and WebCT system and proposed an integrated web-based design education environment featuring in collaborative design. Craig & Zimring [9] used web-based online environment for unstructured collaboration. Haymaker et al. [1] proposed a method for negotiating architectural design across domains.

The authors have used the Internet to mediate design courses since 1998. In developing the ODLE, a framework has been formulated and the ODLE prototype has been constructed. This paper describes this framework and introduces the prototype of the ODLE.

## **2. Methods**

Action research method was conducted to develop the ODLE. Action research is an umbrella terminology that describes deliberate use of any kind of plan, act, description and review cycle for inquiry into action of a field of practice. In education, it is a study conducted by colleagues in a school setting of the results of their activities to improve instruction. In this study, it is used to improve the online design course and the ODLE.

This research's participants included the authors, students who participated in the experimental course and project team members. The project used the Internet to mediate the design course since 1998. Initially, the ODLE that designed and built was intended to provide solely course contents. However, following development of IT, the interactive and communication functions began to integrate into the ODLE, and the experiences of using such a

method as a teaching tool made the authors cognizant of the fact that a good ODLE is needed and very important.

In order to develop a new ODLE that would erase the problems found in a series of experimental courses, a series of actions and related studies were conducted to collect data. The actions included conducting an experimental course, a series of projects, assignments and processes. Subsequent data was used to evaluate the ODLE and courses. The results of these evaluations and participants' suggestions were used to plan ensuing cycles of experiment courses.

Concurrently, other related studies were conducted. The first study conducted was to investigate possible difficulties and their solutions in online courses of design education. With a discussion-oriented design course as an example, the study explored the interaction behavior of class participants in online discussions. This study applied 'data mining technique' to analyze the participation of students in online class interactions and the students' subjective responses were also collected. Special emphasis was placed on the aspect of design communication and discussion in order to investigate the possible difficulties and their solutions in online courses of design education [15, 16]. In developing a framework to develop the ODLE, the results of the actions and the first study were integrated, and with the assistance of a literature review of related framework developed for OLE, proposed a prototype of the framework for development of the ODLE. This framework consisted of six components including the instructor, learner, design education theory, information technology, instruction theory/practice and learning theory/practice [8]. In addition, an online observation study was used to study the online learning environment and understand the application of online design learning environment in Taiwanese design education. This study discussed the evaluation of the online learning environment, and then compared several OLE software packages. Finally, three types of application of ODLE in Taiwan were introduced and discussed [17].

After a one-year ODLE usage period, a new survey was conducted to investigate the subjective opinions of the online design course, and pedagogies and media used in design courses. The results evidenced that the design practice course was combined with the knowledge-based and technique-based course. The discussion pedagogy that is most used and most important in design course, and then, the content materials are almost multimedia, such as graphic and physical or virtual 3D models [18].

Following this, the integration of experiences regarding the experiment course and results of related studies facilitated the prototype framework's modification and the ODLE reconstruction. This new framework and prototype will be introduced in the following section.

### **3. The framework of online design learning environment**

The framework for the development of ODLE has been formulated through a series action research and related studies. The components of the framework of ODLE are identified and the factors concerning these components are presented in this section.

Fig. 1 shows the framework of ODLE. There are four framework components - Course, Instructor, Learner and Internet. All components had three key factors that were considered along with the relationship between component and ODLE. The detail variables of each factor are listed in Table 1.

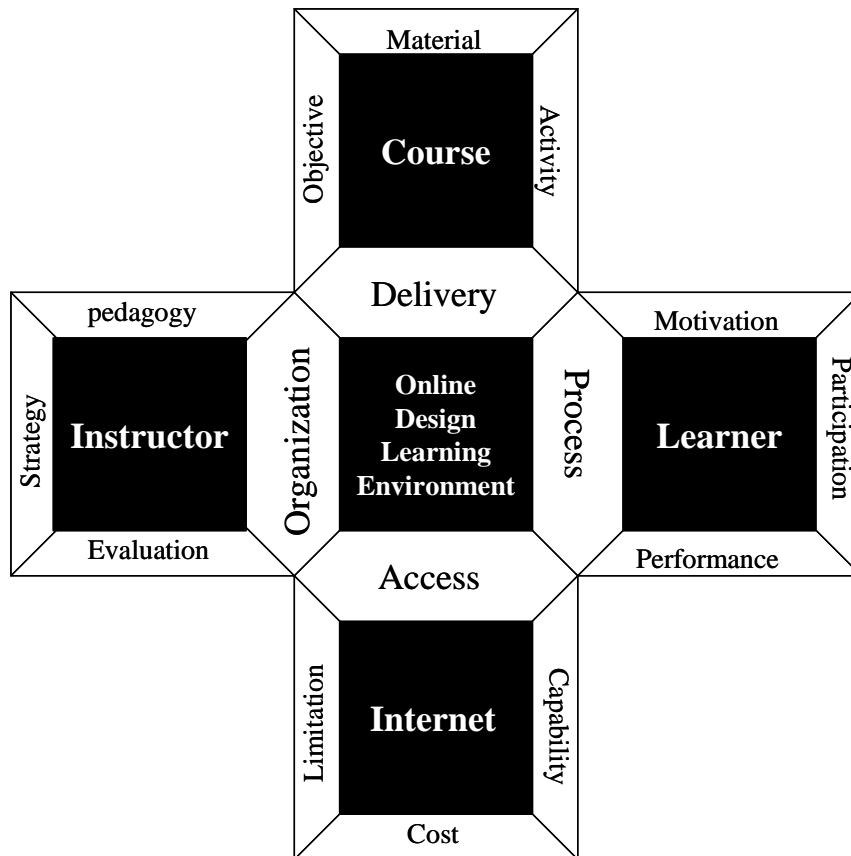


Fig.1 The framework of online design learning environment

Table 1 Components, factors and variables of ODLE model

Components	Factors	Variables
Course	Objectives	Single, compound ...
	Materials	Text, graphic, audio, video, interactive multimedia ...
	Activities	Lecture, discussion, presentation, practice...
Instructor	Strategy	Project, workshop, cooperative project ...
	Pedagogy	Cooperative, constructivism ...
	Evaluation	Personal, group ...
Learner	Motivation	Degree of the intention ...
	Participant ion	Present, log times, duration ...
	Performance	Quality, creative, innovation, finish ...
Internet	Cost	Money, time, infrastructure ...
	Limitation	Bandwidth, stability ...
	Capability	Bandwidth, information ...

### 3.1 The considerations of components and factors

According to the ODLE framework proposed in this study, the following components and factors must be considered carefully in advance.

**Course:** there are many factors to be considered in the course component. The key factors are the objectives, content materials, and course activities. Design courses can be categorized into three types – knowledge-based,

technique-based, and comprehensive which is a combination of knowledge and technique-based learning. These courses have their own particular objectives, content materials, and activities.

- *Objectives:* these are diverse and according to course type. The objectives of the knowledge-based course are to teach students theories and related knowledge about design. Technique-based courses train students in practice and technique, thus endowing them with the correct skills for design, for example drawing skills and modelmaking techniques. The comprehensive course fosters students with a professional attitude and ability in design practice.
- *Materials:* the content materials are dependent on the course type and needs, and they range from literary text, to graphics, drawing, audio, video and multimedia, even physical and virtual 3D materials - the materials used in design courses are multiple and abundant.
- *Activities:* there are many types of activities used in design courses, for example, formal lectures, discussion, presentations, practice and creative thinking. All these activities and requirements should be considered in the development of the ODLE.

**Instructor:** for the instructor, strategies, pedagogies and evaluation are the key factors that should be taken into account when teaching a course. Design has its own special knowledge and techniques. The teaching strategies of design should reflect the specialties of the discipline. Moreover, the design instructor always has their strong personal design style that will be reflected in their instructional style.

- *Strategies:* cooperative learning, problem-based learning, learning ‘by doing’ and teamwork are strategies usually employed by a design instructor.
- *Pedagogies:* the choice of pedagogy is usually dependent on course type. The lecture pedagogy is typically used in knowledge-based design courses, practice pedagogy used in technique-based design course, and discussion and presentation pedagogies in design studio courses.
- *Evaluation:* this is an important problem in design education. It is often a complex issue to evaluate the design work of one individual without subjective bias; therefore, group evaluations are usually practiced in design course evaluation.

**Learner:** design students are usually sensitive to and curious about novel things. Hence, design education is not just about teaching students theories and knowledge, or training in skills and techniques. It also aims to cultivate a professional attitude, analysis abilities and data synthesis. For this reason the motivation, participation, and performances of students are the key factors that must be considered.

- *Motivation:* this is the key factor that influences learning performance. Highly self-controlled students tend to have a better performance so methods of increasing those students’ motivation that are involved in an ODLE are vital.
- *Participation:* because this is difficult to control in an ODLE environment a record of participation is a good method of encouraging students to join online design courses.
- *Performance:* design student performance is very important. If a student feels successful then he/she will be encouraged to make more contributions.

**Internet:** The Internet provides the protocol and interface for running online design learning environments. Its capabilities, limitations and cost will influence the design and use of ODLE. Design courses as a rule employ multimedia content, and the discussion pedagogy for instruction, therefore the need of the Internet’s capabilities are more than other disciplines.

- *Capabilities*: bandwidth is crucial to an ODLE environment. An ODLE requires a wide bandwidth to provide a high quality of file exchange and communication.
- *Limitations*: apart from bandwidth, the stability of the Internet is also central.
- *Cost*: for using the Internet to mediate a design course, the cost of the equipments and Internet usage fee must be considered.

Four components and their related factors are briefly discussed above. The relationship between these four components and ODLE itself are also described.

**DELIVERY** – Course Delivery Methods

Suitable delivery method is important so that it can permit course materials and activities to be conveyed to the learner and achieve course objectives.

**ORGANIZATION** - Course and Students Organization and Instructor Management Methods

Good interface and function organization sanction the management of students and course materials.

**PROCESS** – The Learner’s Learning Process

Flexible design learning processes coupled with highly self-controlled students makes learning ODLE easier.

**ACCESS** – ODLE Access

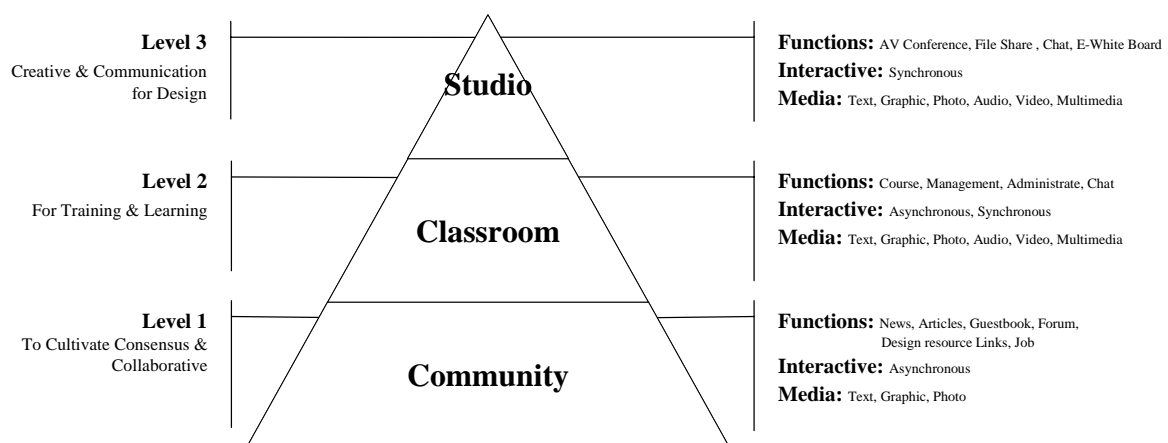
ODLE access method of is very important, particularly authoring and security as this influences the stability and the reliability of ODLE usage.

**3.2 Application of the ODLE model**

The ODLE prototype (<http://thinkdesign.cgu.edu.tw>) was built based on the framework proposed by this study. The aim of this ODLE was to provide a good online environment for design education, and then to act as a resource for future research. The ODLE’s structure is shown in Fig. 2.

There are three levels in the ODLE – Community, Classroom and Studio. Fig. 2 demonstrates the main aims, functions, interactive type and the media used in each level. Each level’s details are described below.

The first level, **Community**, provides the site users an open space to exchange opinions about design. This is an open forum for everyone and provides a space for both learners and instructors to interact and communicate with individuals from outside the formal course. Based on collaborative learning theory, the aim is to cultivate the



**Fig. 2 The levels, functions and interactive media types of the IMDC OLE prototype**

ability of presentation and communication, and to increase the interchange of design and motivation/s for learning.

The second level, **Classroom**, provides various asynchronous design courses. This is the main space for learning and several tools are provided for course learning and management. This level provides an asynchronous learning approach for knowledge and technique-based courses. File format is not limited and learners and instructors can upload and download course material and assignments, share, submit and exchange course material. In addition, the text-based chat room provides the chance for interaction.

The third level, **Studio**, provides synchronous tools for communication and discussion in design studio activities. This is designed for the design studio course. Chat room, video conferencing, file exchange and electric white board have been integrated into this environment, allowing the learner to do design collaboratively. An archive of design activities was recorded into the database for reviewing and research purposes.

#### **4. Concluding remarks**

Through a series of actions and related studies, this paper has presented a framework for the development of the online design-learning environment to meet the needs of design education. This framework may be used to guide development and evaluate online design learning environments. The ODLE framework consisted of four components - Course, Instructor, Learner and Internet. Each component contained several variables that were reduced to three key factors. The framework, based on design education features facilitated the development of the prototype of an online design-learning environment. This platform was structured by three levels, Community, Classroom, and Studio. Individual levels have different functions and purposes. Issues such as interface design, usability and page design surfaced in the design of the ODLE prototype. Future research areas will focus on the evaluation of this ODLE, methods, models and pedagogies of design studio courses in order to provide a guide for development of the ODLE and teaching design courses.

#### **Acknowledgment**

This research was partly funded by the National Science Council of the Republic of China under grant number NSC90-2218-E-182-004.

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