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An Industrial Design Practice Application Assisted Design Teaching

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Abstract

This study aims to improve the learning outcomes of students in industrial design practice. Using service experience inquiry, this research discusses the lack and hidden demand of student in industrial design practice courses. Six service potential demands are described as follows. (1) TA actively caring students, (2) Recording class discussion, (3) Teaching environment improving (4) Offering a discussing platform for teachers and students, (5) Clear design specifications and scoring standards, (6) Product design progress management. Based on the above issues, an Industrial Design Practice (IDP) is designed for mobile devices with a combination of consultation interacting teaching features to improve students' effectiveness learning in design practical courses.

Key words: Industrial Design Practice Teaching, Service Contextual Inquiry, Smart Mobile Application Assisting Teaching

Introduction

In recent years, by the impact of globalization, Taiwan companies are facing big competition, enterprises are expanding their demand for talented designers in the design department. Various domestic universities also add design-related departments, and promote the results of domestic and international design competitions. Learning design is the dream of many high school students. This phenomenon has resulted in students from the Department of Industrial Design of the University of Science and Technology, whose background includes 70% of the art, design and interior design divisions of the design group. About 10-15% students in electronic and mechanics, and around 15-20% high school students never learned design-related education. Students have different backgrounds, such as their learning history, personality traits, interests, and sexual orientations are also different. However, industrial design is a multi-oriented professional skill, mixes both analytical and creative thinking [1], and the design problem is solved without a fixed scope or standard answers, which is different from other studies such as information, mechanics, electronics, etc. These students with different background and professional ability have various adaptation problems in the term of the teaching and evaluation methods of industrial design. Especially for the core courses of industrial design, such as product design and special topic design courses, focus on training students to do the visual expression abilities [2]. The progress of the course includes a design briefing, Concept sketches and mock-up, refined sketches and models, mechanical drawings, detail drawing, presentation drawings and prototypes [3]. Each step is a problem-oriented learning approach, and it is also a teaching method that integrates design and production teaching

Design Practice Teaching and Technology-Assisted Teaching

At present, the teaching of industrial design practice courses is inherited the 1919 Bauhaus's apprenticeship, and adopt one-on-one design discussion. Students learn design knowledge through discussion [4]. However, ratio of teachers to students in Taiwan's industrial design practical courses is 1:20, resulting in insufficient resources and uneven distribution of discussion time, which will have a negative impact on students' learning and understanding of design knowledge and reduce their confidence in learning. Deficiency of discussing time often leads to misunderstandings between teachers and students, including design term interpreting, notions and learning priorities. As a result, students often encounter setbacks in design and even give up learning [5].

In order to fully understand the teacher's guidance in the course discussion, well communication and interaction in the practical design course is very important. Therefore, teachers have set up teaching websites and published the discussing process and design presentation in audio and video recordings for students to review after class. Through review the course could improve the learning outcomes of learning retarded students [6]. With the progress of technology, due to the online interactive platform [7], compared to face-to-face interaction, interactive message discussion after class could make students more willing to speak. As an addition, the blog can use a variety of media to present, such as text, audio and video, pictures, and so on, to increase the richness and integrity of students' collecting materials in the design course [7]. With the development of smart mobile technology, teachers and students use social networking sites and communication software for instant conversation [8]. However, design discussions are limited to the current features of website and software, such as Facebook and line. Although teachers and students are able to discuss and share from anywhere and anytime, the information is stored based on timeline basis, which causes a difficulty to access and retrieve the data [8].

Based on the literature discussed above, the use of digital technology could help the communication between teachers and students in design practical course. By the popularity of smart mobile devices and its technology reduces the boundary of past learning method and strengthen the convenience, suitability, and immediacy of learning. Teacher and TA could immediately participate in student learning and through the internet to share information, interact, and communicate, so learning can overcome the limitation of time and space. And with smart devices, it really helps to improve learning outcomes and interest in learning [10]. Therefore, this study

used the structure of service experience insight to analyze the behavior of interactive communication between students and teachers during classes, identify the hidden needs that enhance communicating and learning efficiency and proposed the feasibility of the mobile device APP to assist in industrial design practice teaching.

Research Method

This study mainly applies for the service modeling program in the service value chain study to investigate the relationship between the industrial design practice courses and the service experience demand insight, by including all interested party as co-designers in the development process to develop service product that promotes communicating interaction between teachers and students [11]. The use of context insight can eliminate the subjective shortcomings of traditional qualitative research that only uses one method of data collection, and can complement the shortcomings of quantitative research that cannot deeply understand the research object.

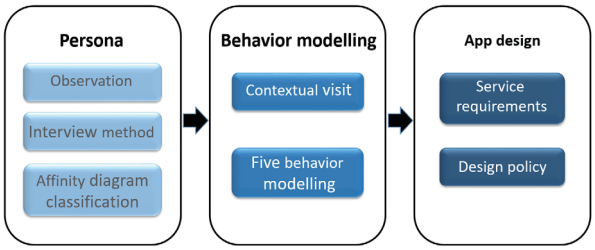

Fig. 1 Research process and method

Figure 1 shows the research method and process. In this study, we first did a field investigation on junior and senior students in Industrial Design Department of National Yunlin University of Science and Technology. Total of 20 students were taken the practical design course. Through semi-structured interviews, we tried to understand the learning situation of students in industrial design practice teaching, such as habits, needs, and expectations related to "learning status", "drawing ability", "design ability", "understanding ability" and "adapted to industrial design teaching" and so on, as the main indicators for persona construction. Then the data were analyzed by affinity diagram [12]. The information was carded, and the cards were grouped and named, and a chart was made. Through the above data collection and analysis, four types of learning styles were concluded by the affinity diagram, and then the persona records were established [13]. Then, by cultural probes and contextual inquiry, and in-depth interviews on participants were conducted. Then via four kinds of learning patterns in the characters-divergence type, adjustment type, accumulation type and assimilation type, we selected the target students and conduct a context investigation. After further exploring the students' learning and interaction patterns, the collected data were sorted and classified by affinity diagram method. Finally, students' behavior was shaped by flow model, sequence model, cultural model, artifact model, physical model, and depth-interview data [14]. Furthermore, the data are discussed and summarized in focus groups through the affinity graph method, which integrates the service needs and opportunities to enhance students 'learning efficiency in practical teaching of industrial design, and serves as the design basis for developing the assistant teaching of intelligent action device (APP).

Research Findings and Analysis

A. Learning styles and behavior analysis

The interview mainly consists of two purposes. The first is to understand the current learning habits and behavior patterns of the students. The second purpose is to understand the communication and interaction between students and their stakeholders (teachers, teaching assistants, classmate). We interviewed 12 third year undergraduate students in the department of Industrial Design at Yunlin University of Science and Technology. Based on the observation and interview data, the students' learning behavior, events, objects, field of activity and stakeholder in the practical teaching of industrial design were classified. We found that, students were either on campus or off campus they conduct activities that related to design practice and related to function of the field, such as computer classroom for computer drawing, factory for model creating, library for information searching, etc. Only in the classroom or student rented house, more diverse activities and behaviors were occurred, such as drawing, discussion with teacher or classmate, or searching for information. At rented house, they also using social media or chatting application to discuss with classmate, teaching assistant, or with teacher. Most of students have smartphones and through internet access, student learning and interactive discussion are not limited by time and space.

B. Persona

After observation and interview, through affinity diagram, we summarized key factors of differences, namely learning status, drawing ability, design ability, understanding ability, and adaptation to the degree of industrial design teaching. Those five factors were used as the main indicators of typical screening, and through the affinity diagram, we summarized four types of students as follow: Learning stable - The learning situation and academic performance are very good and stable; Lack of effort - The learning situation is still good and stable, the ability is good, the level of effort is insufficient, and more work needs to be done; insufficient - Learning preparation is not enough, learning is becoming unstable, and efforts are not enough; Abnormal learning -Learning and instability, have a casual reading habit, performance of the course is good and bad.

Industrial Design Teaching Practice Service Demands

After data collection, affinity diagram was use to analyze and summarize the data. The potential needs of students and teachers in industrial design practice teaching was exposed. Six service demands are described as follows.

1. TA's actively caring about the student's design progress can improve the efficiency of the course. The interviewed students believe that the discussing time with teachers during the class is too short. TA should arrange the discussion before and after the class to help teachers confirming the discussing focus or design modification

scope, and improving the learning outcomes of students.

2. Recording the content of the class discussion can enhance students learning effectiveness and understanding. Classroom discussion process is recorded by video and uploaded to the shared cloud. According to the discussion topics, sketches, sketches, fine models and classified archives, after-class browsing is provided to enhance communication and understanding between teachers and students, and can be shared with other students with similar progress for reference, thereby enhancing students' learning motivation.
3. Improving teaching environment can enhance the learning atmosphere. The school environment should increase friendly learning facilities, such as a stable network, good projecting screen equipment, working table and chairs for design.
4. An immediate discussing platform between teachers and students can improve student learning efficiency. For students who behind schedule, a discussing platform can keep them learning about design after the class and improve students learning efficiency.
5. Clear design specifications and scoring criteria. Clear design specifications and scoring criteria can make students who are not familiar with the design process have a basis to improve their learning.
6. Product design schedule management. Through the design progress management platform, students are provided the publication time and content of each stage of the semester, so that students can prepare in advance, and provide the poster output of various manufacturers, 3D printing, model material costs, etc…

Industrial Design Practice App

A. Concepts of IDP

Based on above potential requirements, this study aims at improving students ' learning efficiency in the teaching of the industrial design practice course. An industrial design practice (IDP)App is proposed for improving communication and interaction between students and teachers, and learning efficiency of students. The IDP includes administration part, for teacher and TA, and user part, for students. The main concepts of IDP are as follow:

1. Cloud storage database system (CSDS). The system includes a public access platform, individual course discussing recording and homework uploading platform.
2. Design schedule management system. This system let students able to set the product design progress and time, and set the reminder function.
3. Fund management system. Fund management system. The system let students estimate the cost and expenditure, so they can prepare in advance, and provides service information for relevant third-party and off-campus vendors, such as poster, 3d printing, CNC or model making, material sales and other information.
4. Message interaction system. Students can use the platform after the class to ask the teacher or teaching assistant instantly. The teaching assistant can confirm before or after class about class contents, check the progress of design works, etc.
5. Consultation Interactive Teaching (CIT). Consultation interactive teaching has similar situation as when visiting a doctor, while waiting, a medical assistance will conduct pre-consultation investigations. We adopted this method combining with IDP app in teaching. The Key points of Consultation teaching: (1) Students should clearly express the design problem. (2) Communication between teachers and students should be problem-oriented communication. (3) TAs are the communicating bridge between teachers and students. In addition to reducing the burden of teaching, TAs also help in clarifying design problems. Fig 2 shows the CIT's implementation method combined with IDP app .

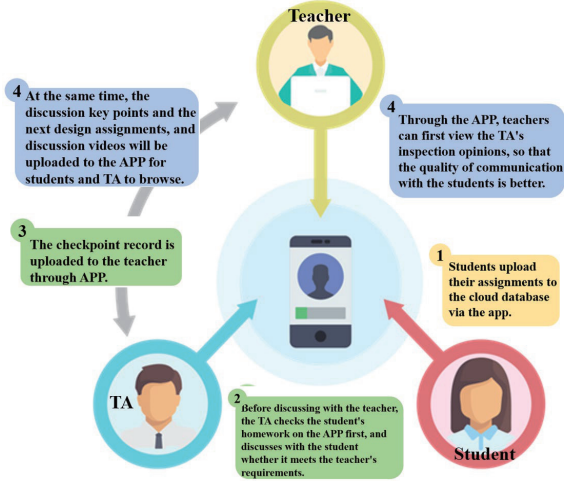

Fig. 2 This is a sample figure. Captions exceeding one line are arranged like this.

B. Design of IDP

The interface design is classified into three parts, namely: schedule, fund management, and information. And according to the user's perspective, it divided into the student part and the teacher part, so that mobile device applications more in line with the needs of learning and interaction. The program design part of this research includes the design of mobile device application using interface program and cloud database, as shown in Table 1.

TABLE 1
IDP's interface programming and cloud database

	App software & program	Cloud database – design schedule, design matters, fund management
platform	Android Studio(Android) and Xcode(iOS)	XAMPP
language	Java(Android) and Xcode(iOS)	php SQLite
functions	1. loading screen 2. user account login 3. SQLite embedded database access 4. multi fragment dynamic interface design (sliding, tabbed, pagination and composite interface) 5. Adapter dynamic data sheet design 6. MPAndroidChart chart data collation 7. cloud data real-time	1.Xampp platform establishment 2. establish MySQL data sheet 3. setting up PHP communication data location 4. PHP upload data table content 5. PHP modify the contents of the table 6. PHP update table contents 7. PHP download the

	download and display 8. cloud data real-time update and debug.	contents of the table 8. php search table contents

B. IDP Interface Programming Design

IDP assists students in the study of industrial design practice teaching. The interface design is classified into three parts, schedule, fund management, and information. And according to the user's perspective, it divided into the student part and the teacher (teaching assistant) part. Teachers and teaching assistants have the highest authority to enter the student's design schedule, fund management and message function. The following are the functions of the student.

(a). Design schedule. The entire design process can be divided into different design phases. Each design phase is divided into different design projects to perform, So the process is divided into three levels, main task, subtasks, and suggestions.

(b). Fund management. Let students estimate the cost and expenditure and prepare for their finished products in advance.

(c). Message. After class, students can leave messages to ask teachers to make up for the lack of class discussion time.

IDP Prototype Verification Experience

A. Experimental Design

The experiment process was performed twice a week, once for the classroom, and once for the after-school. We conducted six tasks over a three-week period. Each task took about 40 to 50 minutes. The participants were asked to design a product for the future of mankind, for testing the IDP App in classroom and after class. Another 1 teachers and 2 assistant teachers were invited to join the experiment.

B. Results of Experience IDP

After the semi-structured interviews, experiments were carried out. In order to understand the problems of students, teachers, and assistants in using the IDP. A participatory observation method was used to observe and record the seven-week design practical tasks, and the interactive model was compiled. The interaction model is analyzed with the four roles of students, peers, teachers, and assistants, which derived the DIP's obstacles and deficiencies. The results of the IDP experience have two parts:

The benefits of using IDP's in teaching: (1) APP effectively enhances after-class interaction between teachers and students. (2) Consultation teaching method effectively reduces the burden on teachers. (3) Consultation teaching method can improve communication and understanding between teachers and students. (4) Design references and specifications help students understand the quality of design presentation. (5) The message platform helps students get closer to teacher-student relationship.

Design improvement for IDP Features and Interfaces: (1) Increasing upload flow of IDP. (2) Recording materials can be stored in the database for students to browse, not just in Youtube. (3) File format for uploading. (4) A discussing platform for teacher and TA. (5) IDP's interface need modified. (6) Desktop version. (7) IDP used Offline uses for IDP.

Conclusion and Discussion

This study mainly used the service model procedure of the service experience engineering method to investigate the relationship between the course of industrial practice design and insight into the needs of service experience. Then use interaction, tools, artifacts, and entity models to integrate behavior patterns. The stakeholders, teachers, assistants and students are regarded as co-designers in the development process. From the perspective of service design comprehensiveness, this paper examines the main points of students 'problems in designing practical courses, and combines technology and consultation (inquiry-based) teaching method to improve the innovative products and services of students' learning effectiveness in practical teaching of industrial design. The combination of IDP and consultation teaching method can increase the interaction and discussion between students and teachers. Learning is not limited by time and space. It can help students to improve their progress and learning situation, and help them in timely manner. In the future, IDP2.0 version can be put forward to help more students based on the deficiency of previous verification results.

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