An Analysis of Design Thinking Behaviors with Different Learning Backgrounds

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1. Introduction

Due to the popularity of higher education in Taiwan and under the trend of interdisciplinary integration with industry innovation, the graduate schools of industrial design in Taiwan non-id majored for admission is on the rise. Nonetheless, the supply for industrial design personnel in England and the United States surpasses the demand while the employment competition for this field has intensified accordingly. Hence, it is suggested that the fostering of industrial design personnel in Taiwan should cope with this phenomenon at early stage. The key issue faced by existing industry design education is to improve the difference of learning effectiveness in non-id majored students due to the different learning backgrounds in addition to improve their professional competency and competitiveness.

The study conducts motion analysis through design experiment, to discuss the difference of design behaviors in concept sketching, model-making and 3D computer graphics between non-id majored students enrolling in master program of industrial design and students graduated with a bachelor degree in industrial design, with the absence of training in core curriculum for practice. The study intends to propose learning suggestions and reference for non-id majored students with interests in the field of industrial design.

2. Process of Design Concept Development

In general, industrial designers visualize their concepts through 2D/3D graphics or model in the process of concept development to express their design concepts (Chen, W. L., 2003). The study divides the design experiment into the following three phases through the process of concept development:

(1). Concept Sketching: Designers frequently use sketches to convey their design concepts. Sketch can not only encourages creative thinking but also presents styling properties as the tools for communication coordination. It is an important and indispensable part of concept development phase (Tseng & Ball, 2010).

(2). Model-Making: Model-making is a part of design activity and also the best tool for designers to communicate and convey design concepts. Roberto Lucci and Paolo Orlandini (1990/translated by Zhang, W. F., & You, W. L., 1992) suggested that model is a highly essential design aid that prevents product design from falling into limitation in abstract description.

(3). Computer Graphics: Computer Aided Design is an indispensable part of product design process and also a key component of industrial design education today as well as the mandatory professional competency of industrial designers (Zhang, Z. M., & You, W. L., 2012).

3. Research Method

3.1 Design Thinking Coding

Mckim (1980) suggested that visual thinking is an integration of three activities, namely to see, imagine and draw. The behaviors of visual thinking can be divided into six types, including transformation, manipulation, concretization, abstraction, modification, and time scan. Due to the difference of individual learning experience and habits in visual thinking, the design thinking behaviors also vary accordingly. The motion coding of the study refers to the study conducted by McKim (1980) with the design thinking behavior coding organized as shown in Table 1.

3.2. Motion Analysis By Experiment

Motion Analysis by Experiment records the motions of respondents in different situations through filming in addition to organizing their design thinking behaviors in codes, using 15 seconds as a time interval to calculate the frequency of each motion appeared. The experiment also applies independent sample t-test to compare the difference of students with different learning backgrounds in terms of design thinking behaviors.

3.3 Research Process

First, the experiment objects of the study comprise 16 students, including 8 id-majored and 8 non-id majored students enrolling at the graduate schools of industrial design, respectively. The design experiment is carried out featuring a simple modeling speaker as the design topic: (1) Concept Sketching: The respondents must complete the design sketch on
Table 1. Design Thinking Behavior Coding

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<thead>
<tr>
<th>type</th>
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<td>time scan</td>
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<td>inspecting drawing</td>
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a sheet of A4 paper. (2) Model-Making: The respondents use PU foam to make the finalized sketch into a concept model. (3) Computer Graphics: The respondents build a model of the design result into 3D computer graphics in colors. The completion time for each phase is 1 hour. The experiment process records the respondent behaviors at each experiment phase through filming, followed by coding the motions with analysis and statistics. Finally, the outcome is applied with independent t-test to analyze the difference.

4. Outcome Analysis

The results of motion analysis by experiment are shown in Table 2. There is no significant difference at the concept sketching phase but a significant difference in the motion code in model-making phase. Particularly, motion code c shows highly significant difference (t(14)=4.321, p<0.001<0.01) since non-id majored students lack the experience in model-making and require more thinking (t) motions than id-majored students in model-making. Moreover, the increase in motions such as manipulation (p) and time scan (s) even surpasses behaviors of concretization (c). Additionally, motion code t shows significant difference in computer graphics phase, which indicates the unfamiliarity of non-id majored students in computer graphics leads to more thinking and searching motions than those of id-majored students. Nonetheless, the motion sequence of both id-majored and non-id majored students is identical, indicating that the sequence of motion frequency for computer graphics is irrelevant to learning background. The sequence of motion frequency at different phases is shown in Table 3.

5. Conclusion and Suggestions

(1) Non-id majored students have passed the examination for graduate schools and are equipped with basic sketching ability, therefore demonstrating slight difference in design behaviors compared with id-majored students.

(2) Currently, the examination for graduate schools of industrial design in Taiwan does not include the subject of computer graphics and hence non-majored students are likely to acquire more motions in thinking and searching commands than id-majored students due to unfamiliarity. It is suggested that such students should strengthen their skills in computer graphics.

(3) Due to the lack of experience in model practice, non-id majored students increase other motions and reduce motions in actual manipulation of models, who then show highly significant difference from id-majored students. It is suggested that non-id majored students take design practice courses from the undergraduate program to increase their experience in practices, thereby to improve self professional competency and competitiveness.

6. Reference


