Using the Interpretive Structure Model to Design the Department of Industrial Design Curriculum of the Interdisciplinary Ability

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Abstract
Scholars believed that only by focusing on cultivating students with multi-knowledge integration learning and problem-solving ability to be able to face changing environment. To become cross-disciplinary talents with the ability to solve today's complex problems, the cross-field talents cultivated in the school must not only specialize in design professional knowledge, but also learn a variety of knowledge and skills. Therefore, curriculum content planning in design education is very important for cultivating interdisciplinary talents. This study takes the Department of Industrial Design as the object and conducts the construction and evaluation of cross-field ability courses. By using the Interpretation Structural Model (ISM) to discuss the correlation between courses, find out the cross-field courses suitable for the Department of Industrial Design. The results show that course design should focus on developing operational and institutional interdisciplinarity capabilities and usability. Curriculum design should match the problem base learning method to adjust the proportion and sequence of course credits. The arrangement of the courses should first allow students to understand the problems to be solved, and then assist them to build integrated concepts, so that students not only can have vertical and in-depth professional knowledge, but also think in horizontal, diverse and comprehensive ways. By increasing the diversity of design methods and knowledge as well as the opportunities to practice (such as internship) into course design, let students capable to understand the skills of adopting their knowledge and further build their interdisciplinary ability.

Keywords: Interpretive Structural Modeling, Interdisciplinarity Ability, Industrial Design, Curriculum Construction

1. Introduction

According to the survey of「2019 Taiwan Design Capability Report」, the top three important competence is interprofessional integration (54%), leading (53.2%) and problem solving (50.4%) on the manager's view; and the most practitioners consider problem solving is the top important competence they should have (Taiwan Design Research Institution, 2019). Many scholars have discussed the competence that college students should possess when facing complex problems. In the past decade, a great number of interdisciplinarity research has published, many studies proposed that college students should have innovative and interdisciplinarity skills and knowledge in order to face today's rapidly changing economic, environmental and social changes (Frodeman, 2013；Repko & Szostak, 2020；Yaghoubi & Banihashemi, 2010).

Design is the foundation of industrial innovation and a method to benefit mankind. Therefore, the training of designers should also develop in multiple fields and prepare designers with interdisciplinarity knowledge integration abilities to solve complex problems innovatively.

Hammick, Freeth, Koppel, Reeves, & Barr (2007) point out that the interprofessional ability is the collaboration ability of working/learning with/from different professions. Interprofessional education enables knowledge and skills necessary for collaborative working to be learnt. With this interprofessional competence, members (students) can enhance their learning as well as professional knowledge mutually, and understand each other's tasks, roles, and skills. Interdisciplinarity talents not only have personal professional skills, but also could understand different professions in order to integrate multiple professions to solve problems and adjust their cognition and cooperation mode in the team at any time to adapt to different professional environment.

OECD published " The future of education and skills education 2030" in 2018 to propose the vision of future education. The knowledge that students should possess in the future is no longer a single subject major but includes related knowledge in different fields of disciplines, cognition, and procedures. The concept of competency involves the mobilization of knowledge, skill, attitudes and values that can be used to solve problems in the future. In order to face the complex environment, students will need broad and specialized knowledge. Besides disciplinary knowledge, to think across different disciplines is also significant.

Self & Baek (2017) believed that interdisciplinarity training facing global economy can provide college graduates with the skills and competences to perform innovative contribution. Therefore, focusing on cultivating students with multi-profession integration learning methods and interdisciplinarity problem-solving abilities are crucial issues to equip the graduates to face the dramatic changing workplaces. Slaughter, Slaughter, & Rhoades (2004) believed that the technical disciplines are related closely, so the talents with product development and interdisciplinary knowledge will be needed during team works. Design is a field of doing, making and creating products and services the fulfill human needs. To find and solve problems, designers need to understand people and society and capable to integrate different professions. The findings of social sciences and engineering are strongly needed to be emphasized into the theory and practice of design; therefore, design education must merge science and technology, art and business etc. (Norman & Klemmer, 2014). The cross-domain design thinking nature of designers should be trained by bring up interdisciplinarity problem solving ability (Kimbell & culture, 2011; McDermott, Boradkar, & Zunjarwad, 2014).

This study starts from listing the discipline of design by analyzing curriculums of all the Department of Industrial Design in Taiwan and interviewing with the industry experts to discuss the cross-field core competencies required by the design industry, especially for the consumer electronics products design. To create the value of cultivating talents in design-related industries, clarify important core competencies and deconstructing current courses should be an important topic. And the results of the study can be referred while design interprofessional education of design. The study began from literatures review and then interviewed with 3 senior electronic consumer product designers to understand the process between product development and interdisciplinarity collaboration. Furthermore, 19 young designers who work at 4 different electronic consumer product design company were interviewed to understand the difficulty of interdisciplinarity communication. At last, a questionnaire survey based on Interpretive Structural Modeling (ISM) was conducted to 7 scholars and 8 industry designers. ISM is a methodology for developing graphic representation of system structure and identifying relationships among specific factors which define a subject (Attri & Sharma2013). The advantage of ISM has considered as follow: 1. The process is systematic and efficiency, 2. Participants do not need to know about the process but understand the topic discussed, 3. it leads and records the results of group discussions on complex issues in an efficient and systematic manner, 4. It produces a structured model of graphical representation of the current issues that makes different individuals can communicate more effectively to each other, 5. It increases the quality of interdisciplinary and interpersonal communication, etc. (Watson, 1978). Alias, et al., (2013) pointed out that the ISM method can not only clarify the relationship between the elements of complex problems, but also apply the Hierarchical Digraph in Graphic Theory to present the vertical and horizontal and the overall correlation structure to reflect the complex issues between various factors and hierarch. ISM proposed by John N. Warfield in 1976 can convert the complex relationship between individual factors into the interaction situation and diagram of the factors between various hierarchies. By ISM, the overall associate structure of complex elements can be comprehended easily. Therefore, this study adopted ISM to explore the relevance of the newly added interdisciplinarity courses in the Department of Industrial Design to find out the best course for talents cultivation.

2. Results

From the outcomes of the interviews with experts, there are 3 professions, management, design and mechanism respectively, was included in the process of product development. That is, management and mechanism are two interdisciplinarity ability that required to cultivate industrial designers. The questionnaires then were analyzed by the software of ISM and a Hierarchical Digraph of interdisciplinarity courses for the Department of Industrial Design was obtained. Total 40 courses were included in the questionnaire. By integrate expert opinions, there are 4 hierarchies, “General Basic”, “Interdisciplinarity Concept”, “Design Profession” and “Integrated Practice” in the digraph. After analyzing the results obtained from questionnaires, some courses were deducted and only 29 courses were listed in the Diagraph shown as Figure 1.

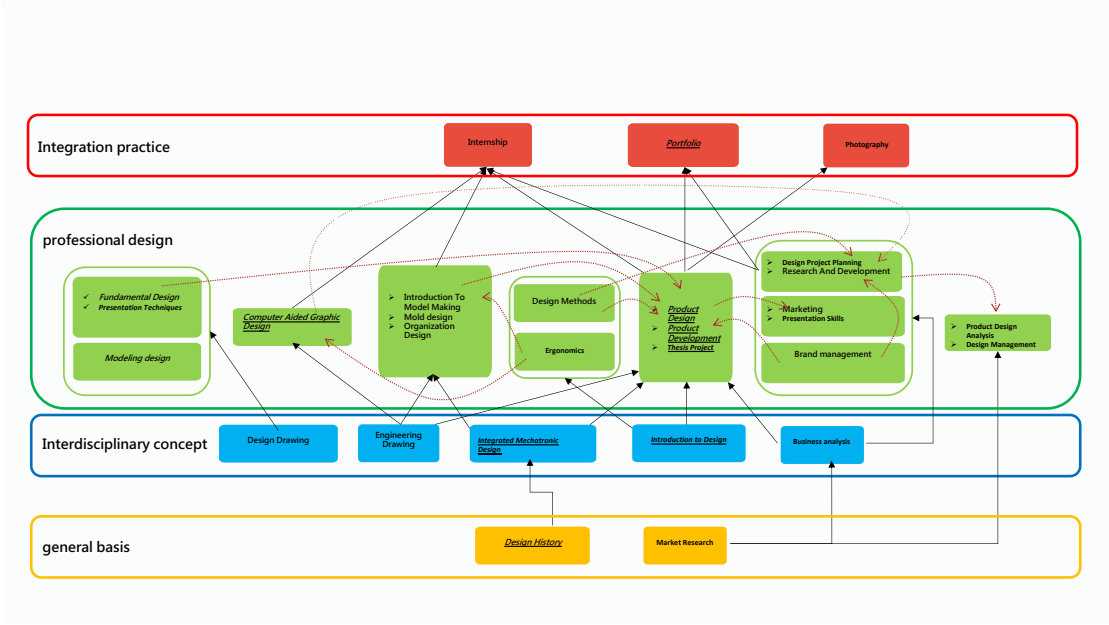

Figure 1. Course Modules for Interdisciplinarity Talents in the Department of Industrial Design Suggested Experts and Scholars

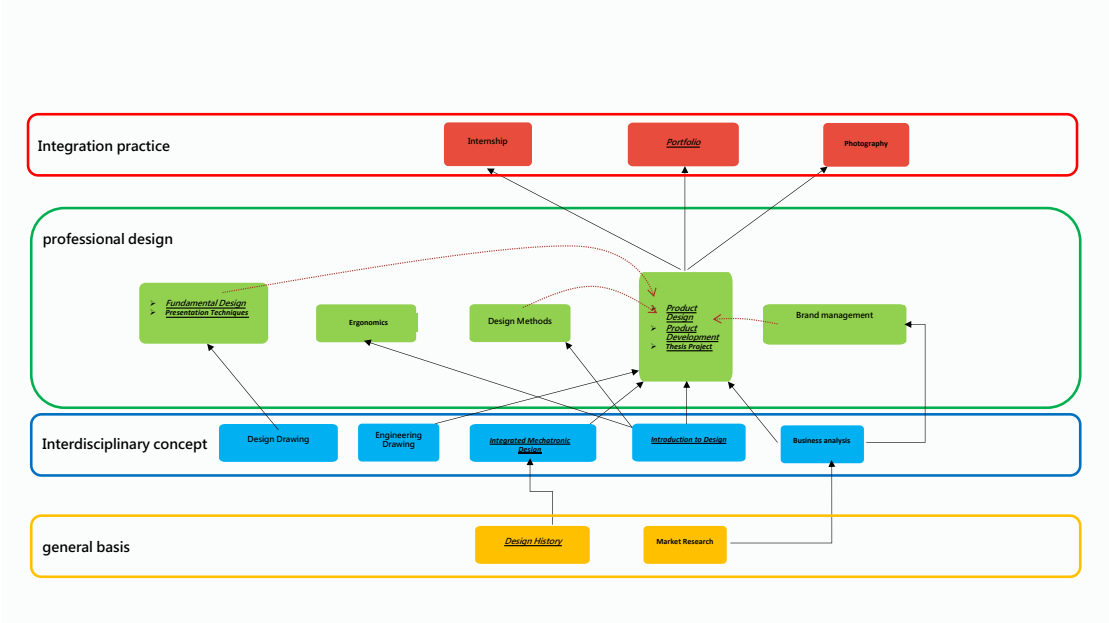

Figure 2. Core Competence Course for Interdisciplinarity Talents in the Department of Industrial Design

Most of the experts believe that “Design History” and “Market Research” are classified in “General Basis” of interdisciplinarity curriculum. Through the investigation of market research and the cultivation of design history knowledge, students' interest in product development can be increased. The investigative orientation of market research enables students to discover design issues through problem-based learning. The study of design history can increase students' observation and sensitivity to the aesthetics of product design, which is helpful for the study of other design majors and interdisciplinary courses.

In “Interdisciplinarity Concept” level, “The Introduction to Design” and “Business Analysis” can lead the students to understand the issues concerned within product design deeply.

“Design Drawing”, “Engineering Drawing” and “Integrated Mechatronic Design” are the courses cultivating students with other interprofession fundamental ability. Those courses are not only to cultivate designers' basic hand-painting ability and knowledge of product structure, but also train designers on the feasibility of product design ideas and product space acumen. By those training, the perspective of product design and the application of product structure and materials can improve, and more creative designs on appearance and mechanism can be produced.

In the level of “Design Profession”, the professional knowledge and skills of design are educated. Based on the training of the prior level, the learning efficiency can be improved in the current level. Among all the courses, “Product Design”, “Product Development”, and “Design Project” courses apply most of interdisciplinarity concepts which needs to integrate “Engineering Drawing”, “Integrated Mechatronic Design”, “The Introduction to Design” and “Business Analysis”. “Fundamental Design”, “Presentation Techniques”, “Ergonomics”, “Design Methods” and “Brand Management” are regarded as the basic courses of design majors.

Finally, “Internship”, “Project and Design” and “Photography” are the integrated practical courses of the course modules of the interdisciplinarity talents of the Department of Industrial Design. Through the knowledge learned from prior three hierarchies, students can improve the internship experiences effectively and conduct their job efficiently after graduate.

After qualitative interviews and curriculum structure analysis, this research understands the interdisciplinarity collaboration that designers need in the process of consumer electronics product development which includes “market research” and “business analysis” in administration profession and “mold design” and “Introduction of Mechatronic” in mechanism profession. By learning interdisciplinarity courses, designers can build knowledges to perform problem-based design to clarify user needs and improve their cross-field design capability. By integrating administration knowledge and skills, designers can transfer marketing terms into design ideas clearly and product characters that user preferred. Designers can design products that fulfill user needs and increase company’s profits by educating students with this interdisciplinarity curriculum.

3. Conclusion

The research commences by examining the curricula of all the Departments of Industrial Design in Taiwan to compile a comprehensive list of design disciplines. In addition, industry experts were interviewed to explore the essential cross-functional core competencies demanded by the design industry, with a particular emphasis on the design of consumer electronics products. The insights gathered from the expert interviews indicate that industrial designers need to cultivate two interdisciplinary abilities, namely management and mechanism and there are four hierarchies, “General Basic”, “Interdisciplinarity Concept”, “Design Profession”, and “Integrated Practice”, included in the digraph.

Following qualitative interviews and analysis of curriculum structures, this study has identified the interdisciplinary collaborations required by designers in the development of consumer electronics products. Designers can enhance their cross-field design capabilities and address user needs through problem-based design by taking interdisciplinary courses.

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