

Program for the Application of Innovative Design Thinking: Assessment of Product Opportunity Gaps of Classroom Furniture

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Abstract. The objective of this research was to investigate the different product opportunities related to innovative design thinking courses. The study was done at the teaching spaces in National Taipei University of Technology. 27 students were interviewed and their behaviors observed. Research results include findings on item storage, desktop space expansion, manual operation and light weighting. Our results show that the best scenario is to give lectures and encourage small group discussions in a flexible and private space.

Keywords: Design thinking · Work shop · Product opportunity gaps · Classroom furniture

1 Introduction

When companies do business or bring new products to market, they face stiff competition and complicated problems. They need to work with other cross-industry professionals to resolve those issues. For the past 20 years, Bill Moggridge, Founder of IDEO Design Consulting Company and Time Brown have developed various theories on innovative design thinking [1].

To address the challenges of our changing times, there are new teaching methods such as innovative design thinking courses and using existing furniture to organize workshops. These type of research normally target classroom furniture ergonomics and operations [2], not so much on course activities or space requirements for the various stages of classroom space equipment design. Liang You Zhou mentioned the need to learn from potential customers, foundries and end consumers. It is also necessary to potential problems from user's point of view and finds innovative product designs via different perspectives.

The objective of this research were to study students in innovative design thinking camps, the teaching activities at every stage, the methods used, user behaviors, the opportunities and demand importance for classroom space products.

2 Literature Review

2.1 Curriculum Theories

Courses have a 4-step curriculum: (1) Objectives, (2) Designs, (3) Implementations and (4) Evaluations [3]. They are designed for an entire teaching system or curriculum, integrated with systems and logic. Courses include behavior, actions and level learning.. Teachers must plan activities that allowing students to understand the purpose and value of learning [4]. All the courses and activities must complement available equipment, tools, materials, content etc. Normally, teachers will have a unilateral relationship with their students. There are fewer opportunities for the former to interact with their students.. It is advised to use case studies and innovative design thinking methods to guide students into the professional architectural design industry. This is to reduce differences stemmed from students' diverse backgrounds [5]. This research will study the opinions and attitudes of the different interior design course teaching methods and evaluation platforms.

2.2 Design Thinking

The structure and process of USA's Stanford University D School Innovative Design Thinking course is as follow: (1) Empathize, (2) Define, (3) Ideate, (4) Prototype and (5) Test. They teach via workshops, provide stationary paper, poster paper, pens, color papers and encourage projects etc. They also well-utilize university discussion rooms, space, tables, furniture and other equipment etc [6].

Innovative design thinking is a type of concept development, design concept and implementation process. (1). National Taiwan University of Science and Technology opened courses on innovative design thinking and teaching methods include lectures, small group activities, concept development, presentation etc., to achieve teaching goals.

The research also investigates ways to utilize design thinking concepts on consumer products, services, systems etc. There must be training to seek effective innovative thinking paths suitable for develop pattern design courses. This will help in the area of maximizing functionality. The challenge is creating an aesthetical but effective method [7]. In the area of print design, we must harness the power of design thinking knowledge to bring cross-industry professionals together. In the innovative model of artistic design. There are an increasing number of teachers who participate in workshops gearing towards more creation-oriented and imaginative presentations [8]. For example, there is a need to integrate more open teaching design workshop partnership models, cultivate students' development of innovative working capabilities. If we apply design thinking on architectural design and operations, we will be able to help students realizing and achieving outstanding results in space and construction designs [9]. We will be able to achieve innovation in teaching when we are aware of the positive impacts of innovative design thinking on print, artistic, architectural designs etc.

2.3 Space Allocation

The physical environment refers to the surroundings and things in a person's surroundings [10]. Space and time form the two basic elements of motion and matter. People have provided research on venues, interpersonal relationship distances. There are studies on logistical operations and adjacency analysis of space which involves flow lines, functional space abuts, humanity scale, furniture and equipment configuration [11].

It is recommended to have three to four classes for every topic. This helps in cultivating students' learning autonomy, collaborative learning ability, interpersonal relationships and creating a blissful and happy learning environment. [12] Spatial design can impact students' behaviors during learning activities and space will affect their comfort level. A multi-faceted learning group and resource group design can give a flexible and ergonomic teaching environment. There are several innovative teaching models: Breaking away from traditional spatial allocation, effectively utilizing space to incorporate classroom tables, chairs, discussion walls and using sounds to create atmosphere, encouraging privacy between small groups in discussion etc. These are important factors in encouraging interactive teaching and learning between workshop teachers and students [13].

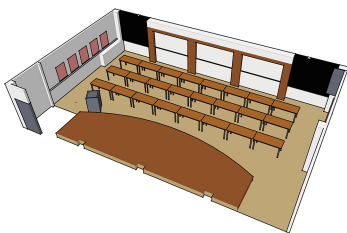
In view of the above, it is obvious that there is a positive relationship between innovative design thinking courses and an ideal classroom spatial arrangement. This includes organizing workshop learning activities, lectures, small group activities, concept development, product presentations etc. The relationship between the behaviors of users in classroom teaching activities and space and equipment is depicted clearly in the below table (Table 1).

3 Research Methods

The observation was adopted in this study Theresa L. White & Donald H. McBurney, [14], the targets of observation were the students participating in the innovative design-thinking program and the place was the multiple-function lecture hall of National Taipei University of Science and Technology. The students were members with background in design and engineering. There were 27 students (21 males and 6 females). The equipment for observation, 1. Camera; 2. Camera recorder, 3. Notebook, 4. Observation. These tools were adopted for tracking the behaviors of the students in the classroom. The original setting of this lecture hall was prepared for the students with design major and the chairs and desks are arranged in three rows (Fig. 1A). Now, this arrangement could not satisfy the needs of the activities of the workshop. The chairs and the desks were rearranged in the lecture hall for meeting the needs in the activities of the innovative design-thinking workshop, which was shown in the floor plan (Fig. 1B). The students were organized into groups of 6 to 8 persons for the workshop participation. They participated in the activities of the program, and the methods of teaching in the space.

Table 1. Observation of the relation between behaviors, space, and classroom furniture

Teaching activities	Space	Human behaviors	Demand for classroom furniture
Explaining of the theme	Students are scattered all over in the classroom	Teacher presents the lecture. Students make note at the desk.	Writing on horizontal plane, enlargement of the desktop size.
Group discussion and brain storming	Students are organized into groups in different areas of the classroom	Teacher gives instruction in motion. Students are either sitting or standing in the course of discussion.	Adhesive tape, writing on white board, vertical surface, plane surface, partition. Enlargement of desktop size.
Development of ideas	Students are organized into groups in different areas of the classroom	Teacher gives instruction in motion. Students are either sitting or standing in the course of idea development.	White board function, enlargement of desktop size.
Group briefing	Group briefing. Other students are sitting or standing as they listen.	Teacher gives instruction and evaluation. Group briefing.	Writing on plane surface, use of vertical surface, mobile.
Group briefing	Group briefing. Other students are sitting or standing as they listen.	Teacher gives instruction and evaluation. Group briefing.	Writing on plane surface, use of vertical surface, mobile.



B

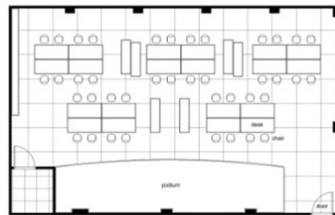


Fig. 1. The layout of the lecture hall before (A) and the layout of the lecture hall after (B)

4 Conclusion and Discussion

The research was done via semi-structured interviews and observations, and it helped us to understand the opportunistic demands of classroom spatial equipment. It was discovered that there are instances of untidy spatial planning and irregular wall

specifications, irregular distances between spatial equipment and tables and chairs, messy flow lines, tables, chairs, and furniture placed in class room were not suitable for small group student discussion, noisy atmospheres and no sense of privacy, stationary, papers, laptops placed messily on tables etc. **Result Findings:** Currently, there were transformations of student workshop activities in current classroom environments, spatial allocation, furniture equipment and wall usage. Previously, it was rigid and unable to fulfill workshop teaching and learning activity needs. Thus, furniture equipment design and spatial allocation could enable teachers and students to achieve their course goals and course structure, furniture design specifications must fulfill those purposes [15]. Regardless if it was static or dynamic environment spaces, it is spatial format transformation that defines them. There were furniture product opportunities, complementing workshop activities for learning and teaching, to elevate course effectiveness.

Limitations: Current research focuses only the current situations in National Technological University of Taiwan, their teachers and students' teaching and learning activities, space dynamics and case studies. Thus this study might be skewed and biased to some extent.

5 Result

This research studies innovative design thinking courses workshops, learning and teaching activities, space, furniture structure. We also observed human behaviors for example by monitoring teachers and students who participate in teaching and learning activities. We saw functional demands and opportunities in classroom furniture in the areas of writing, doing presentations, whiteboard functions, sticky notes, moving, enlarged table space, putting in a separator etc. Research results included findings on item storage, desktop space expansion, manual operation and light weighting. The best scenario was to give lectures and encourage small group discussions in a flexible and private space. Course curriculum's activities, methods, behaviors and classroom space is known to affect each other. Thus, there are demands on furniture and equipment. To maximize teachers and students' dynamics, activity space size, movement flow, physical static, it is best to arrange groups of 6 to 8 people. With storage capabilities, flexible change and compartment use, and internal space furniture during learning activities.

The results of the study recommends that future research can utilize corporate office environments and residences, to study opportunities in different environment space furniture products.

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