

CHALLENGES IN TEACHING DESIGN THINKING SKILLS TO NOVICE DESIGN STUDENTS

Raghavendra Reddy GUDUR
University of Canberra

ABSTRACT

There is a general assumption that teaching prescriptive “design methods” to novice design students will result in effective analysis of a problem that will result in an innovative solution. However, in reality, most students use “design methods” as a tool to present their resolved solution rather than use it to arrive at that solution. In other words, students mostly use traditional design methods taught as an effective persuasion tool to secure better grade. For this reason, we argue that we should encourage students to pick up appropriate design behaviour early in their course. By stressing practicing designers seldom apply design methods as described in the textbooks. In this paper we share our action research over a period of two semesters to investigate effective approaches to achieve this goal. Overall, initially students found it difficult to move away from traditional prescriptive design methods they were exposed to in their high school studies. Students’ feedback showed that they preferred a more structured and incremental treatment of the subject. Based on this feedback and students’ assessments outcome we have developed a pedagogical framework based on nudge theory to address their expectations and learning objectives.

Keywords: Learning, design thinking, abstract reasoning, teaching.

1 INTRODUCTION

Introductory courses in design thinking and research are intended to expose students to different methodologies of designing and processes of creative thinking during early years of study. However, most universities follow some sort of pedagogical structure that is derived from Blooms Taxonomy of learning domains [1]. Which states the early year students’ education should focus more on Knowledge and comprehension and less on application and synthesis. This stipulation encourages educators to concentrate more on prescriptive methodologies which helps students understand processes rather than on synthesis. However, this creates a serious problem for teaching design as it is very difficult to separate process from synthesis and application.

In short, it is assumed that novice designers (students in the first year of study) are not ready to grasp complexity of design problem and it falls under higher level of Bloom’s taxonomy of cognitive domain. This results in teaching traditional perceptive methods which does not reflect the real nature of design thinking process. However, as these methods are taught at foundational unit, students often take them literally and it forms basis of their knowledge for rest of their lives.

For this reason, we argue that – despite limitations we should still encourage students to pick up appropriate design behaviour earlier on in their course. By stressing that prescriptive design methods do not work and that practicing designers seldom apply design methods as described in the textbooks.

It is important that novice designers be made aware that current research in design thinking process has shifted the focus from prescriptive models to a greater consideration of design as a cognitive activity [2]. On the other hand, this approach to teaching puts lot more stress on how the subject content is structured to enable students with limited experience to appreciate the real issues in addressing a design problem.

Our research over a period of two semesters has investigated effective approaches to achieve this goal. We redeveloped a year one graphic design-thinking and research unit as a case study. Primary objective of this unit was to provide a strong foundation for design students in design thinking processes, methods and research. This unit is year one unit in Bachelor of Graphic design course. However, this is not a discipline specific unit and it is open to students from Industrial design, Landscape design and Architecture. Evaluation methods used were students’ end of the semester

feedback, their learning diary (formative assessment), design projects (summative assessment) and unstructured interviews to validate our observations. We excluded students whose participation was less than 50%.

As anticipated, biggest challenge we faced in this endeavour was age and experience of the students. Some novice students experienced difficulties in dealing with abstract thinking when compared with more experienced students. Overall, initially, both novice and experienced students found it difficult to move away from traditional prescriptive design methods they were exposed to in their high school studies. Student feedback showed that they preferred a more structured and incremental treatment of the subject. Based on this feedback and students' assessments outcome we have developed a pedagogical framework based on Nudge theory to address their expectations and learning objectives.

2 BACKGROUND

Before we redeveloped the Design thinking and research unit, the core of the unit was structured around a generic four step design process "Research, Ideate, evaluate and implement". Which students followed in a linear fashion to address a given design brief. The process of redevelopment involved considerable amount of literature review. This section briefly reviews the relevant literature that informed redevelopment process.

2.1 Design and design problems

Designing is defined as an activity that should involve preparation or formation of a prescription or model for an artefact in advance of its embodiment [3, 4]. In other words, designing involves a plan or model for an artefact before it is built or made, and the resulting outcome/solution is seen to be novel. It is generally accepted that a design problem is ill-structured [2, 5]. Furthermore, Rittel and Webber [6] refer to design problems as 'wicked'. Wicked problems do not have definitive formulation; the problem and solution are linked in such a way that to define the problem, a designer has to attempt a solution [3, 7]. Another characteristics of design problems is that there is no one definitive solution that can be termed as correct [2]. An ill-defined problem has several acceptable solutions, and designers settle for the one that they deem the most satisfactory [8].

This is core concept behind understanding cognitive process behind design activity. The most difficult concept to grasp for a novice designer is that problem solving in design is not similar to what most pick up during high school education. This problem is compounded by exposing students from high school to generic linear design methods.

2.2 Design methods

Over time, a large number of design methods or models have been published and are usually grouped under the term 'design methods' [3]. It seems that there are as many design methods as there have been authors and no two authors have agreed on a method [9]. Some models are descriptive, simply describing the sequence of steps in designing, and some are prescriptive, suggesting systematic processes to follow. The intention of prescriptive models is to bring rational procedure into the design process. Design methods are usually described in the literature through block diagrams, matrices, or network diagrams with boxes and arrows that closely resemble the flow chart of a computer programme [10].

After reviewing a large number of design method variants, Gedenryd [9] suggests that there is an underlying pattern that shows most of them share similar ideas. He examined a few prototypical methods and summarised their essence into four fundamental principles that make up the core of design method thinking as seen in Table 1.

Table 1. Core ideas behind design methods [9]

Idea	Description
Separation	Design process is separated into distinct phases, with each phase or activity being performed in isolation from the other.
Logical order	Specification of explicit order in which different activities are to be performed
Planning	Pre-specification or strategy for performing activities in an orderly manner within a phase
Product-process symmetry	Plan is organised in an order that makes the design process reflect the structure and the sub-components of the resulting product

The intention of design methods is to bring an amount of control in to the increasingly complex design and manufacturing process of products, to help in making sure that there are no costly mistakes due to oversight or omissions [3, 11]. However, many designers do not apply design methods because at times they are too formal, rigid and systematic [3]. There is a good reason behind this mistrust: design methods do not work [9]. A comment made by Alexander [12], in an interview on design methods, succinctly captures this point of view: ‘...my feeling about methodology is that there are certain mundane problems which it has solved – and I mean really incredibly mundane’ [12]. Furthermore, Alexander [12] comments on future directions in design methodology, stating that: ‘Until those people who talk about design methods are actually engaged in the problem of creating buildings and actually trying to create buildings, I wouldn’t give a penny for their efforts’ [12]. These and similar observations made on design methods have shifted the focus from prescriptive models of design to a greater consideration of design as a cognitive activity [2].

Over time, as students’ progress through a course realise the futility of using rigid design methods but still feel compelled to use it to justify their resolved problems. This perpetuates an unnecessary facade through most of their career. In addition, this also results in treating design process as a mystery that cannot be taught or captured. However, there is considerable amount of research done to gain insight into design process. Most of this research focus on cognitive process rather than explicit steps of designing.

2.3 Cognitive process of designers

Designerly ways of ‘knowing’ and communicating differ from scientific approaches [13]. In an interesting study, Lawson [14] compared the way scientists and designers find solutions to a problem. He found that scientists use a strategy where they systematically analyse a problem to find an optimal solution. In contrast, designers tend to explore the problem cursorily, and proceed to suggest a variety of solutions, and settle for one that is most satisfactory. In other words, scientists use problem-focused strategies and designers use solution-focused strategies [3].

Many cognitive studies on design observe that reuse of knowledge (from earlier relevant design experiences) through analogical reasoning is a central approach in design [2, 15-17]. Klein & Brezovic [18], in their research on the design process, found that designers seldom use systematic decision making strategies during practice. Visser [2] extends this notion by stating that design activity is mostly opportunistically organised. In other words, designers approach a design problem in a non-systematic and multi-directional way (could be top-down, bottom-up, in breadth or in depth). The direction they take is based on their subject knowledge, information at hand, their representation of design problems and the state of their design in progress.

Experienced designers solve design problems primarily based on their past experiences (i.e. intuitively). During the initial stage of a design process, they try to find earlier solutions that are similar to the present problem, proceed to fine-tune them and see if they could help them in their present situation. A study by Kim & Yoon [19] on the cognitive process of interface designers found that designers base initial design concepts on their prior experience, reusing elements from earlier designs that are relevant to the current task. They adopt opportunistic or bi-directional design processes when addressing issues in design problems that closely match their prior knowledge. Visser [16, 20] suggests that this opportunistic design process is a result of designers cognitively selecting the most economical actions in solving design problems. She also suggests that when an activity is

opportunistically organised, any system/method that imposes a hierarchical or structured design process will severely constrain the designer [20].

2.4 Design strategies

Most of the prescriptive design methods are not able to meet their intended objectives because designers seldom use systematic decision-making strategies during practice [2, 18]. In other words, suggesting any rigid external structure or rules may not produce the desired design outcome. This is the probable reason why most methods do not appear to have made any visible impact on the design learning.

3 DEVELOPING AND TEACHING THE UNIT

We have gone through two iterations of re-development of the design thinking and research unit. First iteration had completely new content based on the current understanding of the subject. The second iteration addressed the problems we identified based on students' feedback and observations. Overall 180 students enrolled into this unit over two semesters. Data from end of the semester qualitative feedback, learning diaries, design projects and unstructured interviews were used to validate our observations. We excluded students whose participation was less than 50%.

3.1 Iteration 1

In first avatar, the unit content was developed around problem definition. Students were provided a design problem to create a unique identity for a new coffee product. Since we had students from different disciplines they are free to choose an aspect that is close to their expertise. Architects choose space, industrial design students focused more on products/merchandise and Graphic design students concentrated more on visual communication aspects.

First two weeks were spent on getting their attention on what exactly happens in a designer's head when solving a problem. This was demonstrated by a studio activity where group of students solve paper bridge problem. Here they were asked to build a paper bridge spanning 50cm using just 4 sheets of A4 paper and 2 meter of string. While they were solving this problem they were asked to think aloud their thought processes. As one of the group members had to take notes to chart out thought processes behind problem being solved.

Following week, we looked at these notes to demonstrate that the process is not linear and it depends a lot on their prior-knowledge and opportunities presented by their experimentation. Based on this understanding, students started on their semester long project. All along students were encouraged to use opportunistic strategies while addressing a design problem. In parallel, we had lectures and discussions to help them understand the nature/wickedness of a design problem and strategies an experienced designer often employs to address it.

Although students enjoyed this version of unit thoroughly. Their feedback showed serious problems in the quality and depth of learning. The following are two main problems identified during this iteration.

1. Problem 1: We did not anticipate that many students were already exposed to design methods in high school as part for their arts and craft activities. Our drastic departure from familiar method has left many novice students completely perplexed during the first few weeks of the semester.
2. Problem 2: When 12 students in an unstructured interview were asked what they learnt in the unit. Seven of them struggled to articulate their learning experience clearly. However, some (3 students) not only managed to clearly articulate their learning but were also able to contextualise what they learnt with their own practice - A true indicator of meaningful/deep learning. Remaining 2 students could manage to describe what they learnt but were unable to contextualise with their own practice.

Further interviews also suggest that majority of students were lost mainly because they did not see a scaffold/content structure to weave their knowledge into. This resulted from our wrong assumption that- since most of the students are fresh out of high school, they would not be deeply ingrained with traditional, prescriptive design methods. However, almost all negative end-of-the-semester feedbacks we got stressed that they did not learn any "design thinking" or "design research methods". Indicating they already have formed an understating of what "design thinking" should be like. In short, they were expecting building on what they already knew and comfortable with. Since we departed drastically from their expectations they fell back on what they were taught as "foundations of design" methodologies.

This clearly showed to us that we can't expect students to completely reject their prior learning which most believed to be the foundation of design thinking process. Hence, we decided to use Nudge theory[21] in our next version of the unit. Nudge theory is a concept which argues that positive reinforcement and indirect suggestions can be used to influence decision making of groups and individual and push them towards right direction. It provides a way to minimise resistance and confrontation, which often arises from forcing a drastic change in people's belief or behaviour. In short, we decided not to thrust upon them drastic new ideas but provide them with a choice and encourage them to choose the right ones. Most importantly there will be no penalties for not doing so.

3.2 Iteration 2

During the second iteration the first thing we did was to provide a strong structure to the unit through use of a basic design thinking textbook [22]. The unit was split into the following 3 sections.

1. Out of 12 weeks first two weeks were spent in understanding different stages involved in design thinking. This was based on "design thinking" textbook [22]. However, stress was on using it as a descriptive process rather than a prescriptive process. They were encouraged to use different stages of design thinking listed in the text book based on the context of given problem space, and their own domain knowledge. At the end of week 2 students were required to write a short two-page reflective essay on their understanding of this process. This helped us gauge if we can proceed to next step or need to spend more time at this stage.
2. Project 1: Mostly research where students spent time to understand problem definition. And, how problem definition is intrinsically related to attempting at a solution. This is the phase where we covered contemporary understanding of design thinking and different methods of problem exploration.
3. Project 3: Student spent most time in designing, evaluation and implementation of the final outcome. Here students get to visit their comfort zone by reporting their final outcome in design method they learnt over the semester. In effect, we followed same content of iteration-1 but provided them a familiar structure to make sense of it.

This frame work worked quite well. By starting with what they are familiar with and pulling them away from traditional methods in Project 1 followed by bringing them back to their comfort zone in Project 3. In semester end feedback we did not see any signs of distress in term of being lost. Surprisingly, all 9 students who were interviewed could clearly explain what they were expected to learn and how they gained from it. However, majority (6 students) of them were still looking at "design thinking" in terms of traditional, structured, prescriptive, design methods. Only 3 students understood the nature of a design problem and subjective nature of a design process that is specific to a designer's prior-experience and cognitive skills. We take this as an improvement over our earlier version in that - all students we interviewed felt they achieved learning objectives of the unit.

4 CONCLUSION

There is considerable amount of research and progress been made in untangling design thinking process. Many eminent researchers [3, 11] in this area of study who in the past have advocated rigid prescriptive design thinking processes have summerly dismissed them. However, many foundation units in design disciplines still teach these archaic methods religiously. Although many programmes teach recent developments in design problem solving, they only do so in advanced years of a design degrees. Here we argued that they should be introduced much earlier in a course because critical skills are best introduced during formative years of a designer.

During the process of this effort we have gone through two iterations of developing a design thinking and research unit content. In the first iteration we realised that students found it hard to cope with drastic departure from their expectations of the subject. In the second iteration we have used Nudge theory to present students with a choice between current and appropriate theories of design thinking and traditional structured design process. This has greatly reduced the tension between their prior learning and what we were trying to teach. However, although students understood the importance and relevance of contemporary understating of the subject, some were unable to contextualise it with their own practice. This we believe will change as they gain more proficiency over time. A follow up students' interview next year will truly gauge effectiveness of our Nudge theory based strategy.

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