# TEACHING DESIGN THEORY: SCAFFOLDING FOR EXPERIENTIAL LEARNING

**Viktor HIORT AF ORNÄS[1] and Martina KEITSCH[2]**
[1]Department of Product & Production Development, Chalmers University of Technology
[2]Department for Product Design, Norwegian University of Science and Technology

**ABSTRACT**
A future in ever changing professions requires design students to become competent in engaging with different types of knowledge. This article argues that teaching students the ability to reflect on their own approaches opens up for combining design theory and practice for the greater benefit of both. Yet, there are challenges in promoting such a 'mixed approach' in design education. In a prior paper, the authors took Kolb's experiential learning model as a starting point for a post hoc comparison and evaluation of teaching design theory. The present paper describes the proactive application of this model in redesigning a course, given at the Norwegian University of Science and Technology spring term 2013. The course provides Concrete Experience through in situ-observations interviews, etc. Students are then requested to transform these into the generic requirements of a design brief (Reflective Observation), further interpret the brief in the light of theories (Abstract Conceptualisation), and finally convert findings into new design concepts (Active Experimentation). The paper discusses how learning models can be used proactively in design education, through three perspectives on learning: as Didactic staging-, Process driven-, and Reflexive independence.

*Keywords: Experiential learning, design theory, double loop learning, reflection, values, learning styles, teaching, learning*

## 1 INTRODUCTION

The designers of tomorrow are likely to act on markets characterized by innovation and constant variation, in professions undergoing continuous change, and hence need to be competent learners. "It has become increasingly common to make reference to the requirement for some form of meta-knowledge in relation to design. Typically, such constructions concern the ability of the student designer to decide when is the appropriate time to draw on different types of knowledge, and on specific pieces of information or specific procedures. Such ideas might refer to the development of the design discipline as a kind of meta-language for the process of designing, or to the development of 'strategic knowledge' in design students." [1, p.11]. This challenges education to restructure curricula to help students get knowledgeable with theory that can be instrumental in developing products and processes, as well as in communication. An education approach in design should provide a vocabulary to express one's choices and a taxonomy that supports reflections and evaluations. Preferably, students should eventually be able to question starting points, background, problem framings etc., and integrate these reflections in their learning process.

The roles of theory differ between design traditions such as engineering design [2], or art & design [3], but there are no strong traditions of teaching students to engage with and reflect on theory as such. Rather, there is a tension between the abstract and the traditions of design with theory is typically either treated as something foreign to practical work or as an instrument that can be applied without much understanding of underlying values or conjectures [4]. By framing problems one way or another students demarcate the solution space. A specific challenge framed in one way or another is likely to draw on different explanations and metaphors, leading to different interpretations and ergo solutions [5]. When the students recognize this, actively choosing between one framing or another, may open up solution space, giving them a wider range of possible solutions to start from. However, introducing theory within design curricula comes with some challenges regarding e.g. student motivation.

In a prior paper, the authors took Kolb's experiential learning model (see fig 1) as a starting point for a post hoc comparison of approaches to teaching design theory between two settings highlighting challenges in scaffolding for experiential learning by enabling students to engage with theoretical material and moving between concrete applications and abstract theories. With Kolb's [6] model, this can be described as a process moving between Concrete Experience, Reflective Observation, Abstract Conceptualisation, and Active Experimentation. The analysis lead to some insights regarding decisions concerning e.g. balancing priorities related to the scope of projects (e.g. moving through the learning cycle several time in short projects, or one more extensive project), and whether design tasks should be genuine or idealised and directly related to specific learning objectives.

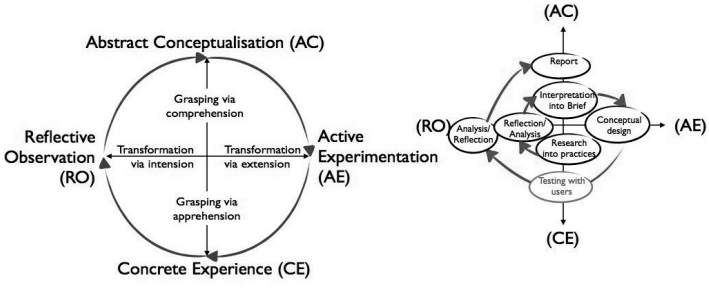


*Figure 1. Kolb's experiential learning model (Left). Phases in the student projects mapped onto Kolb's model (Right)*

This paper further elaborates the idea of integrating learning models into design curricula. More particularly, the goal is to present a case in which a course is redesigned using Kolb's learning model as a starting point and based on this, identify benefits and challenges with basing design curricula around learning models.

## 2 THE COURSE

Sustainable design (TPD4145/5100) is a course given at the Norwegian University of Science and Technology during the academic year 2012/2013. This year's course featured Kolb's model in planning different classroom- and project based teaching and learning activities. The course had been attracting 3rd year students from both design and engineering since 2007. To add to this diversity, the student group normally has a large proportion of international (exchange) students. Historically, the course has introduced students to industrial ecology, design for the environment, life cycle assessment and other technical starting points to reduce detrimental environmental effects by e.g. reducing energy consumption. However, an ambition had been to expand the focus of the course from technical starting points; moving beyond theory as something immediately applicable to solving a priori defined problems, towards inclusion of different stakeholder perspectives in eco-design, and consideration of alternative framings for the problems to be addressed.

### 2.1 The intervention/ redesign / approach

Behind the 2012/2013 revision of the course was an ambition to make students capable of addressing a wider range of issues, and deliberately engaging with problems differently by taking on alternative foci for problems and solutions (See table 1), and addressing these through designing either a product (A), a service (B) or an information system (C). A goal was to make the students familiar with theory that supports the ability to develop these perspectives.

Kolb's model suggests reasonable sequences of different types of learning activities. However, it is possible to envision different starting points. Students may for example be introduced to abstract concepts (theory), which they are to apply active experimentation. Alternatively, the students could be encouraged to introspectively reflect on prior experiences. To make theory meaningful through direct applicability it was decided to take concrete experience as a starting point, introducing theoretical concepts at a point where they were instrumental in relation to the students' projects. Decisions also need to be made regarding the scope of exercises and projects; or in other terms how many "learning cycles" the students should be taken through. Different theoretical concepts could be introduced separately, with several exercises covering different aspects, each taking the students through active

experimentation, concrete experience, reflective observation, and abstract conceptualization. The starting point for 2013 years course was instead to embed various issues in one larger design project, pedagogically structured as a set of moves between different types of learning activities (see fig 2).

*Table 1. Perspectives introduced in the course*

| Focus | Key idea | Strategy |
|---|---|---|
| Techno | Condition practice change through persuasive technology. | Reduce environmental problems via mechanistic product change. |
| Policy | Monitor and steer practice change through communication. | Strengthen legislation, information and dialogue among stakeholders. |
| Cultural/Use | Initiate practice change through individualized design solutions. | Focus on individual values, needs and user groups' inclusion. |
| Semantics | Increase awareness for practice change through product semiology and visualization. | Consider different perceptions and aesthetic appreciation of products and services |

### 2.2 The 2013 course

The course hosts 50 students from design (33) and engineering (17) who work with improving the sustainability of daily practices. The students work in teams consisting of 3-4 design students taking TPD4145 and 1-2 engineering students taking TPD5100. Students are expected to apply different design tools, develop a brief and a concept and finally a strategy to disseminate the improved practice to stakeholders. The concept should take into account criteria for sustainable design (environmental impact assessment, aesthetics, usability, functionality, economy and technology) into account and it should be underpinned by reasonable arguments for trade-offs. The course assignment is structured around the four phases of the experiential learning model:

1. *Concrete Experience*: Each group investigates different practices, chooses a particular practice and documents it with the help of film clips, short interviews, pictures etc. The documentation should relate to a) what, how and why the practice is performed and b) the environmental impacts of the practice for example emissions, energy, water, material use, waste generation. The group should then develop an initial plan how to improve the practice. Practices are for example: Cooking, laundry washing, personal hygiene and house cleaning.
2. *Reflective Observation:* They are then introduced to theory and methods, which they relate to their experiences and observations by applying abstract conceptualisation and reflection on non-sustainable elements in the practice, assessing these elements (e.g. with help of LCA or Eco-it). Both inductive observations and the utilization of theories and methods converge into a design brief that specifies generic requirements
3. *Abstract Conceptualisation*: They students interpret this into a design brief plus a list of requirements on how to improve the practice. The brief can relate to a physical product (A), a service (B) or an information system (C).
4. *Active Experimentation*: The group develops new design concepts using tools and methods presented in the course.
5. *Abstract Conceptualisation & Reflective Observation:* Finally the group analyses the concept and estimates its consequences in terms of improving the practice as well as possible unintended consequences and rebound effects. The group presents the concept in detail and argues for how it can contribute to make the practice more sustainable. The group develops a strategy to communicate the concept to either consumer/users or companies.

In the first lecture, students were introduced to Kolb's model, and the reason for applying it in the course. They were told that the model works as a mean to meet the different individual abilities and preferences of candidates as well as the different phases and requirements in a design process- of which some are more reflexive and some are more creative than others. In phase one the students went out and investigated daily practices at their homes, and in public spaces, further they collected

information from the web and articles and observed and interviewed different. Phase two was dedicated to explore evaluation and interpretation methods. At today's date the students have been working with assessing the practices' impact in the different phases of the life cycle and are about to present their final results. The chosen practices include personal hygiene and water use, waste bins in public space, coffee consumption, the life cycle of clothes and charging of personal PCs (see fig 2).


*Figure 2. Example of working material from a student group working with food procurement*

## 3 THE PROACTIVE USE OF LEARNING MODELS

Summarizing from the students comments and the teachers' experiences, it seems that integrating theory in a teaching cycle with help of with Kolb's model and being transparent about this didactic practice helped students to reflect on, and question their practice. However, the overarching role of the learning model as tool for students to reflect on their practice can be discussed and it may be that the model is more valuable for teachers than for the students.

### 3.1 Didactic outcomes

Students showed appreciation and sometimes surprise, that a deliberate approach considering their talents and interests was applied, and that they were informed and asked about their opinion on this. The students did seem to come to some awareness of their own needs. One student in the course expressed this: "It is equally important for me to know about myself and the areas in which I need to grow and develop as to know about the problem at hand". Furthermore, our impression is that the starting points have contributed to an increased discussion within and between the groups. The tutoring sessions indicate that the model fosters discussion on how the project work can be conducted by integrating different types of information from real life, theory and own expertise and when and in which ways this is appropriate. Reflecting on the students' communication in the course, it seems that using Kolb's terminology and comprehensive way of thinking thwarts the image of theory as a big, scary enemy that steals time the students could have used in the workshop.

In presentations and documentation, students link accounts of practical experiences to theoretical concepts. However, it could be questioned whether the students actually used the theories introduced to them, or if they just reportedly did so in order to comply. Furthermore, while drawing on various theories, the students only to a limited extent reflected on their own learning using the terms from Kolb's model. They also in some cases seemed to have difficulties to linking the methods taught in the course and the contents of the model with their assignments, e.g. few went out in real life to detect an unsustainable practice - they rather relied on information available by statistics and literature. If applying Kolb again, they have to be taken out literally in the active experimentation phase (e.g. watching coffee drinking practice).

### 3.2 A process perspective

Kolb's experiential learning model helped conceptualising the sequence of teaching and learning activities in a way that served as a scaffold for structuring, reflecting on and discussing the sequence of events in the redesign of the course. In the light of Kolb's model some challenges with the design of the course could also be identified. As an example; while the students actively experimented with creating concepts, and reflectively observed and discussed the process in abstracted terms the degree to which they could gain concrete experiences with their concepts' performance was limited due to

time constraints. Ideally participants would have drawn on real life experiences with prototyped solutions and feedback from stakeholders. With a longer course, the students could also have been given an opportunity to try alternative starting points, building up a repertoire of experiences, which could be compared and contrasted. Also within one and the same project activities could be staged to take students through several loops of learning; prototyping and refinement. Taking the experiential learning model as a starting point supports reasoning about how content should be presented to students.

### 3.3 Scaffolding & Content complexity

In planning the course, a central question was whether to leave the experiential learning model as a tacit scaffold behind the course, or explicitly bring it up. Being open may allow students to reflect using the model to comprehend the (design) process they are undertaking, as well as supporting reflections on their own learning process. However, expecting reflections questioning assumptions and critical scrutiny of their underpinnings may be asking a lot of the students who are faced with having to grasp a body of knowledge in relation to mastering e.g. models and taxonomies of their overall future profession (design), and course content related to sustainability. Problematizing starting points and the students own learning processes introduces another set of concepts and another set of phenomena to focus on, increasing content complexity which could be perceived as overwhelming, making it difficult for students to focus.

Another question concerns how controlled Teaching and Learning Activities (TLAs) should be. Here we see a spectrum of perspectives, with somewhat different sequences and loci of control (see fig 3). At one end activities can be didactically *staged* by a teacher in order to meet explicit á priori determined learning objectives, where students engage in determined activities to comply with course requirements. At the other end control is widely given to the students who, with *reflexive independence,* can autonomously engage in a search for seek new insights and expansion of knowledge, supported by an ability reflect on starting points and assumptions. This is in line with a vision of providing students with the ability to reflect in and on their own actions in order to develop a repertoire of skills and versatility in moving between alternative framings, reflecting an ideal for advanced students. In between these, process driven training, initiated by either teacher or learner, may allow for more contingencies than purely staged activities.

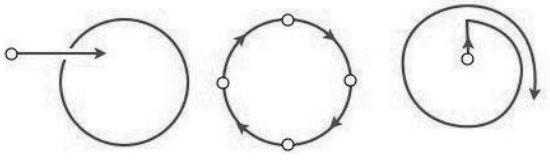

*Figure 3. Three types of staging of TLAs. Left; Didactic staging (Teacher driven), Middle: Process driven (initiated by teacher or learner), Right: Reflexive independence (learner driven)*

Which of the models to adopt is likely to depend on e.g. content complexity and what curricular stage the students are at. While a high degree of independence and critical reflection could be asked of students in the 2nd and 3rd cycle, newcomers may need to gradually be introduced to tools and abilities that enable them to cope with complexity and alternative perspectives, exposing students to challenges that are just within reach.

Active choices can be made in order to increase or decrease content complexity; e.g. helping students see underlying assumptions of different theories (see table 2). In the context of design reflections in and on actions has been extensively discussed drawing on the work of Schön [7]. While this reflection-in-action approach has its emphasis on doing, activities can also be arranged that help students reflect also on their starting point; what Argyris and Schön [8] referred to as Double loop learning. Students could also deliberately be introduced to certain framings, and certain concepts may support students in seeing the world a certain way. Meyer & Land [9] describe what they refer to as threshold concepts; focusing on certain key aspects that are more challenging to get a grip on, and can be anticipated. Conceptualising learning as crossing thresholds, the task lies in reducing content complexity; by prioritising information in line with specific predetermined learning objectives.

*Table 2. Three perspectives on learning*

| | **Threshold concepts** | **Experiential learning** | **Double loop learning** |
|---|---|---|---|
| **Learning as …** | … passing through a portal | … a process | … improvement of practices or re-conception of starting points |
| **Focus** | Concepts | Experiences & Abstract conceptualisation | Actions & Assumptions |
| **Benefits** | Focuses attention to key content, decreasing content complexity | Emphasises different types of learning activities | Problematizing underlying assumptions, increasing content complexity |

## 4 CONCLUDING REMARKS

By actively adopting different perspectives in arranging learning situations, the content complexity of different teaching and learning activities can be staged in a way as to meet learners' abilities. In scaffolding for experiential learning, decisions need to be made regarding the extent to which learning activities should be staged and well defined (reducing complexity) or problematized (increasing complexity) and open ended. Kolb's model highlights the nature of different learning activities and could help diagnose problems that may have occurred. It was here used as a way of structuring a design project but could also be applied proactively on a more detailed level focusing e.g. on a specific design activity such as ideation. It is useful as a conceptual tool for teachers to structure activities in a way that help students move beyond theory as something to recite, to being a natural part of their productive and professional design knowledge.

## REFERENCES


[1] McGipsey I. *A Review of Literature on Design Education in the National Curriculum*. RSA; 2011.

[2] Eder WE, Hubka V. Curriculum, pedagogics and didactics for design education. *Journal of Engineering Design*. 2005;16(1):45–61.

[3] Hickman R. *Research in Art and Design Education: Issues and Exemplars*. Intellect; 2009.

[4] Keitsch M, Hiort af Ornäs V. Meaning and Interpretation : An analysis of two theoretical perspectives in product design. In: Desmet P, Tzvetanova S, Hekkert P, Justice L, editors. *Proceedings from the 6th Conference on Design & Emotion* 2008. Hong Kong; 2008.

[5] Schön DA. Generative metaphor: A perspective on problem-setting in social policy. *Metaphor and Thought*. Second edition. Cambridge University Press; 1993. Available from:

[6] Kolb DA. *Experiential Learning: Experience as the Source of Learning and Development*. 1st ed. Prentice Hall; 1983.

[7] Schön DA. *The reflective practitioner : how professionals think in action.* Aldershot: Arena; 1995.

[8] Argyris C, Schön DA. *Theory in practice: Increasing professional effectiveness*. Oxford, England: Jossey-Bass; 1974.

[9] Meyer JHF, Land R. *Threshold Concepts and Troublesome Knowledge: Linkages to Ways of Thinking and Practicing within the Disciplines*. Enhancing Teaching-Learning Environments in Undergraduate Courses Project, Higher and Community Education, School of Education, University of Edinburgh; 2003. Report No.: 4.