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BRIDGING DESIGN THEORY AND PRACTICE IN DESIGN ENGINEERING EDUCATION

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ABSTRACT

Over the past three years, staff at the Department of Product Design, the Norwegian University of Science and Technology, has developed and practiced a new course in industrial design engineering specialization. Students choose a subject of interest within industrial design engineering, and prepare a review article of theory on that subject. The theory is then tested and/or verified in a practical project, or the theory is developed further. The most important result we see from this course is that the students have acquired a better skill in theory identification, evaluation and application, which in turn seems to have made them more mature and secure. This has been particularly obvious in a quality improvement of their master theses. It also provides an extensive knowledge base for academic staff and students at the department, a knowledge base that is extended and updated yearly.

Keywords: Industrial Design Engineering, Education, Specialization

1 INTRODUCTION

In 1993, the Norwegian University of Science and Technology (NTNU) started a 4 _ year curriculum in Industrial Design Engineering that leads to a Masters degree. The curriculum was extended to 5 years in 1997. Now, approximately 20 students are admitted to the program yearly. The main objective of the curriculum is to provide Norwegian industry with engineers that also possess competence in industrial design engineering.

Naturally, one of our main objectives is to provide our students with knowledge and abilities that represent state-of-the-art within industrial design engineering in *today's* industry and academia. But a major challenge is, as for most other professions, that the speed of development of the profession and its related aspects is high, and/or driven in many different directions. This is true for approaches to industrial design engineering, in technology, and in our understanding of products' impact on, and interaction with humans and society. Therefore, much of the knowledge we today provide for our students may be out-dated or improved many times throughout their career, by future research. This requires that industrial designers need to 1) continuously keep up-to-date on research relevant to their profession, 2) assess the relevance and quality of research, and 3) apply relevant research findings to their practical projects wherever necessary.

Through extending the curriculum by one term, we were given the opportunity to introduce a new course where the objective is to train our students in this, and thus stimulate them to a life-long learning, also within the theoretical aspects of the subjects that interest them as practitioners in industrial design engineering. The result is a 5th year (9th term) course called Industrial Design Specialization. As the last course before

students embark on their master thesis, it also serves as an opportunity for our students to specialize within a field of interest. It is this course that we wish to present and discuss in this paper.

2 COURSE DESCRIPTION

The specialization course was first given three years ago (when students admitted to the 5 year curriculum in 1997 reached their 5th year), and has been held yearly since then, with several changes based on the experience that we have gained. Over the last two years, 20 students have attended the course each year. The course accounts for 2/3 of full term credits.

2.1 Objectives

When we established the specialization course, we had the following objectives in mind:

- Each student is given the chance to develop her/his own knowledge and skill on a specific subject of interest to the student.
- The student is supposed to be up-to-date on the state-of-the-art in theory within his/her field of interest, and if possible, contribute to further development.
- The course forms a solid theoretical basis for the master thesis.
- The course output must be publicly available (from our web-server – see references [1], [2] and [3]), and should serve as an inspiration for younger students at our department.
- The work done within literature review by the students serves as a yearly update of theory development within many fields, also to the academic staff.
- The work should provide a solid foundation for research and development within our department.
- The project must be based on theory. It might be a design project, or any kind of testing or verification of theory.

2.2 Course Structure

The course is divided into two parts. In the first part, accounting for 1/3 of the course credits, students are required to write a theoretical review article, and are expected to reflect on the theory, and relate it to their subsequent project. Students are free to choose their theme of specialization within the following subject areas:

- Aesthetics
- Eco-design
- Man-machine interaction
- Technical analyses and methodology
- Design management and organization

In the second part, accounting for the remaining 2/3 of the course credits, students are supposed to apply the theoretical knowledge, either in further theoretical work, or in a practical development project.

The initial activity in the course is the preparation of a project description, where the students describe the theory area they want to focus on in the review article, and how they expect to demonstrate this knowledge in the subsequent project part of the course. Fairly immediately after the course start-up, reading circles are established within the subject areas. These are tutored by academic staff at the department. Reading circles

also function as a discussion forum between students and between students and the academic staff. Students are free to participate in several groups on the condition that they contribute with literature input to the reading circles. In this manner we ensure information exchange between students in an efficient manner, as there is often an extensive amount of literature at hand. The quality and appropriateness of the literature is commented upon by the tutor.
Also, early in the course, students are lectured in efficient literature search and how to write scientific papers. As some of the students want to write their papers in English, lectures in technical English language are also provided for the students. Course details for the autumn 2003 are shown in figure 1.

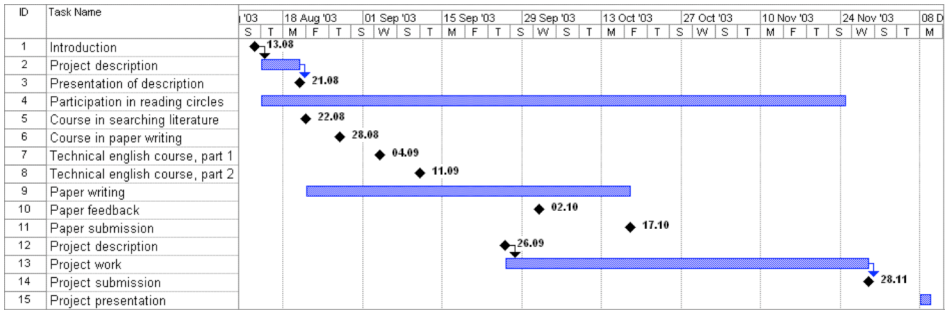

Figure 1. Course plan for the product design specialization course.

2.3 Criteria used for assessing students' work

In the following, we describe the criteria for marking the students' work. The article and the project are marked separately.

2.3.1 Article:

A An ability to reflect on the matter in an independent manner, and/or contributes to theory on her/his own.

B A good review article with an overview and understanding of the relevant issues, but without own reflections or contributions to theory.

C A review article covering the most essential issues with an average ability to communicate the theory through the article.

D The student lacks essential elements of the theory, and/or has problems in communicating the subject through the article.

E The student is far off target, i.e., does display limited understanding of the subject, and/or has severe problems with communicating the theory to others through the article.

2.3.2 Project:

A A successful integration of relevant theory into the design solutions proposed in the project, an ability to communicate that integration, and a convincing design solution.

B Parts of the relevant theory has been successfully integrated into the design solution, and the design solution is still convincing.

C Attempts have been made, more or less successfully, to adapt theory to the design project, and the design solution is acceptable.

D No visible attempts to integrate theory into the practical project, but the design

solution, seen isolated from theory, is acceptable.

E The student is far off target, both in respect to integration of theory and in the design solution.

2.4 Challenges

The main challenges we have seen in the course are:

- Some students want to be practical, not theoretical, i.e., they want to spend time designing rather than reading theory. These have severe problems with the course, and are difficult to motivate.
- Students' ability to think for themselves is being systematically destroyed throughout school – they are thought to deliver the answer they think their tutors want. It is thus a challenge to get some students to reflect on their own hand.
- Some students run into trouble when they realize that their theory cannot be applied or verified in a sensible manner in the project. However, this is also a useful finding to us.
- It is difficult for the students to plan the effort for the given course timeframe. The extent of the work becomes apparent to the student fairly late in the course, and she/he is then too far consumed in the subject to set sensible limits and milestones.

3 EXAMPLES

Below, we provide a few examples of the results from the specialization course. The examples illustrate the span in subjects and interests among the students. Note that the figures used in the theory-part of the figures are in some cases taken from existing literature, but we have not provided the references as they are just for illustration purposes.

3.1 Ingrid Rønneberg Næss (figure 2)

Ingrid's starting point was that many products for elderly and disabled are stigmatizing. Even if they meet their functional requirements, they often do not look very attractive, neither to the users nor others. In her article, Ingrid identifies criteria for designing products that are both functional for disabled and elderly, and that look attractive both to the users and others. This results in the design of ice spurs, traditionally used mainly by elderly, but which now may be attractive to younger people as well, due to their new design. Her contribution is found in [3].

3.2 Guro Nereng (figure 3)

Guro's article is concerned with how designers may communicate environmental values to the community through design, as a contribution to the path to more sustainable consumption. She also discusses barriers in today's society that may act as counter-measures to this effort. In her project, she develops, for a small city near Trondheim that has joined the Cittaslow movement, various outdoor furniture. Her contribution is found in [1].

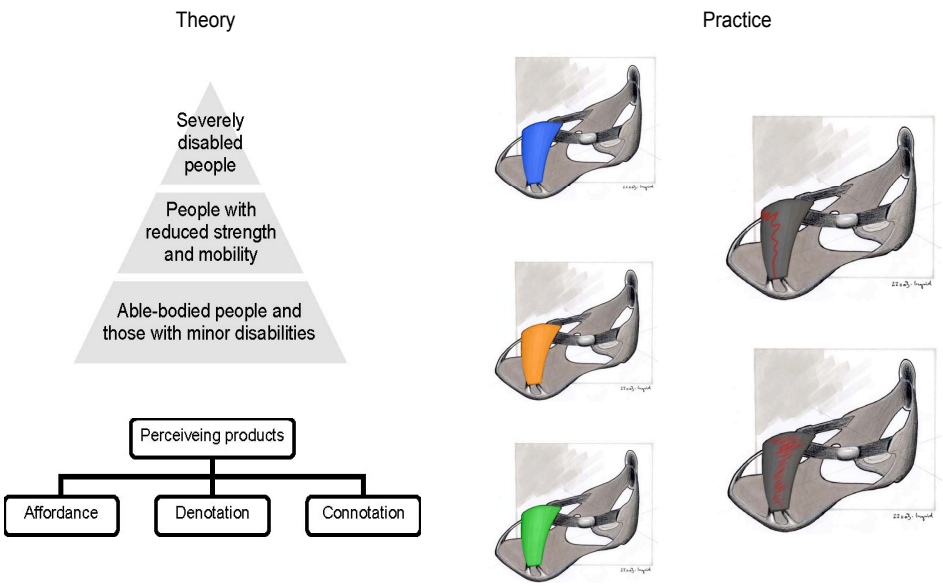

Figure 2. From theory of inclusive design to ice spurs.

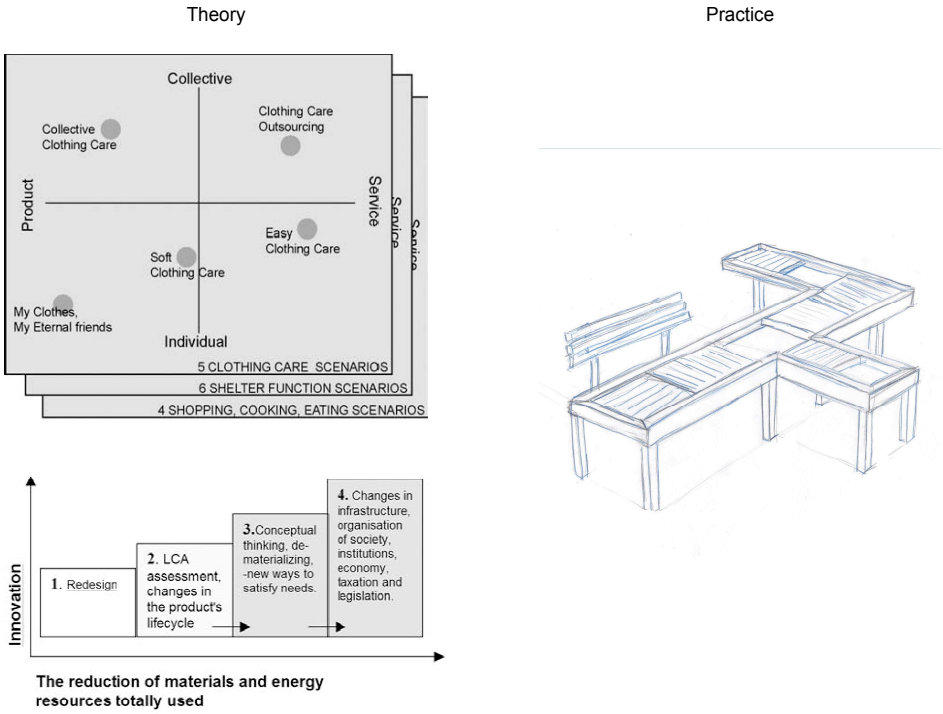

Figure 3. From theory on communicating environmental values to outdoor furniture for the Cittaslow movement.

3.3 Hans V. Bjelland (figure 4)

Hans' article surveys theory behind human's sensory abilities and the possibility of electronics to fully utilize our sensory capabilities through the use of sensors and actuators. Electronic products have long had limited interfaces without haptic feedback. In his project, Hans proposes a haptic interface for complex interaction in cars, thus allowing the driver to keep his eyes on the road while operating equipment in the car, such as the car radio. His contribution is found in [2].

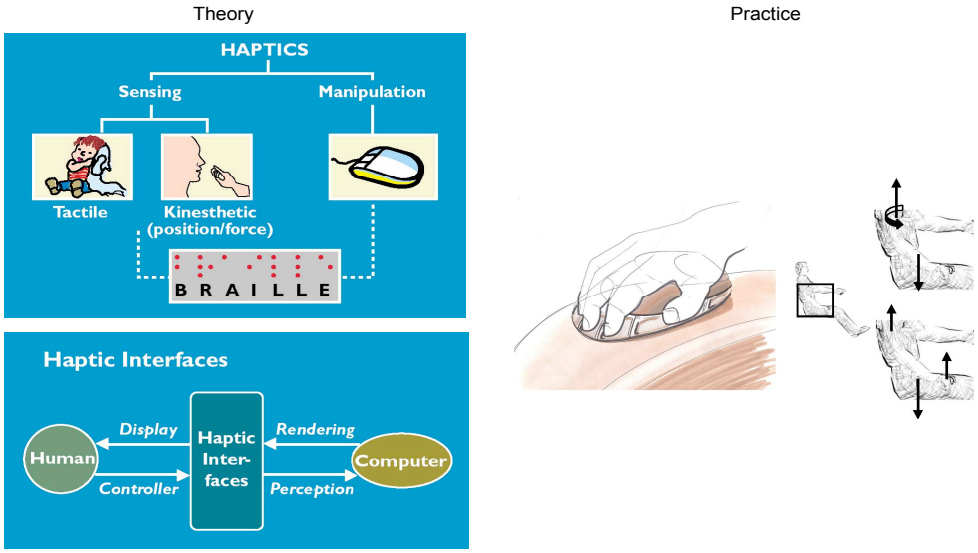

Figure 4. From theory on haptics to user interfaces in cars.

3.4 Hanne Wetland (figure 5)

Hanne identifies the language as an ambiguous barrier for communication and understanding in the design process. At the same time, the language is an important source to understanding potential users' product experience.

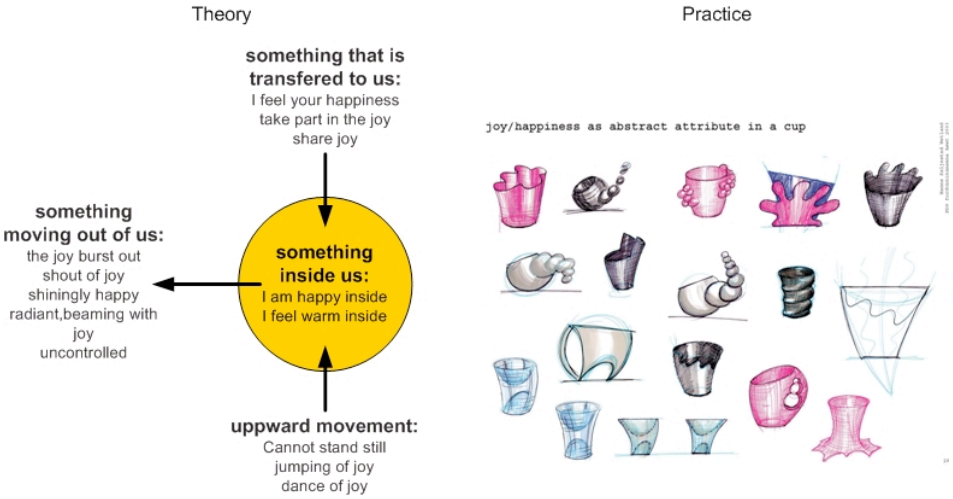

Figure 5. From language to form.

In her article, she proposes approaches to transforming abstract language terms to physical shapes and abstract product attributes. In her project work, she illustrates this with a large number physical attributes resulting from different abstract language terms. Her contribution is found in [1].

4 CONCLUSIONS

Whether we are successful or not in our attempt to teach students to search for, and apply design theory in their professional career, we cannot yet say. The time is perhaps mature for carrying out a survey amongst former students who took this course, and the yet earlier students who did not. Perhaps we can see whether there are differences between the two groups in their approach to applying design theory in their projects. We are, however, uncertain as to how to measure differences, if measurable at all. Thus, our conclusions so far are qualitative and fairly subjective.

We know that most students (not all) appreciate the opportunity to specialize within a field of particular interest, and appreciate the ability to create their own cutting edge as designers. But the clearest results so far are found in their master theses through increased 1) interest in searching for relevant theory, and 2) ability to, and confidence in applying relevant theory. This has, in our opinion, resulted in a quality improvement of the master theses.

As mentioned above, we cannot say if this approach prevails after graduation, but we know that many former students are keen to read the results annually published to the course web-site. The interest is not only because it provides an up-to-date review of theory in many areas, but because theory application is illustrated through projects. This provides a valuable addition for practitioners to existing journals and conferences that tend to be aimed at academia.

Other, very valuable side effects of this course are:

- The results from the course attract attention from other educations within industrial design engineering in Norway, and are being used by other institutions as well.
- The articles are printed as a form of course “proceedings”. These are also used by younger students, and improve their education.
- Design theory is tested and evaluated in practice.
- The academic fundament has improved both among the students and the staff.
- Design literature is reviewed by students, with the best material extracted.
- Both we and the students have an improved basis for publishing articles.
- There has been a significant increase in the number of students wanting to do a Ph.D. within industrial design engineering.

Industrial design engineering is a discipline which does not have a tradition for research. We hope that the output from this course may help to establish such a tradition, and that other schools/universities contribute in the same manner. Perhaps the best and most interesting results should be presented and discussed in a yearly Nordic/European conference?

REFERENCES

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[2] Industrial Design Engineering Specialization, 2002:

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