INTERNATIONAL CONFERENCE ON **ENGINEERING AND PRODUCT DESIGN EDUCATION**
4 & 5 SEPTEMBER 2008, UNIVERSITAT POLITECNICA DE CATALUNYA, BARCELONA, SPAIN

HERE AND THERE – WHAT DESIGN-ORIENTED AND RESEARCH-ORIENTED CURRICULA CAN LEARN FROM EACH OTHER

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ABSTRACT
The curricula of a design-oriented bachelor study and a research-oriented master study have been compared from my personal perspective as a student. Both curricula are strong in their respective areas and may function as examples for other curricula. At the same time they can still improve and learn from each other. I conclude that design-oriented curricula are strong at motivating students and at making them feel responsible for their own work and learning processes. Research-oriented curricula are strong at scoping work and reusing the work of others, which enables students to gain more in depth domain knowledge.

Keywords: design, research, bachelor, master, program, curriculum, comparison

1 INTRODUCTION

Design-oriented curricula are generally more applied and creative, while research-oriented curricula tend to focus on theory and abstract thinking skills. Although these curricula aim to educate different kinds of people, they also share goals. For example, they both want to motivate students.

In 2001, I was among the first 75 students to start with the new bachelor of science program in Industrial Design Engineering (IDE) at Eindhoven University of Technology (TU/e), The Netherlands. In 2005, I was among the first six students who graduated. I then applied for the master program in Content and Knowledge Engineering (CKE), a track within Information Science, at Utrecht University (UU), The Netherlands. First I took the mandatory, yet personalized pre-master program to address my deficiencies. In 2006, I started with the master program, which I will have finished by the time of publication of this paper. During my studies I have been involved in several extracurricular educational activities, such as the promotional team (TU/e), teaching assistance (UU), meetings with the accreditation committees (TU/e, UU), the start of an Honors Program (TU/e) and a discussion with the deans on the future of education (TU/e).

In this paper I will share my perspective on the bachelor and master curricula. I reflect on the main strengths of the curricula and the possibilities for improvement. This way, I hope to contribute to the following more general research question: What can design-oriented and research-oriented curricula learn from each other?

In section 2 and 3 the two curricula will be introduced. In section 4 the research question will be addressed. Section 5 concludes with my findings, which are discussed in section 6.

2 INDUSTRIAL DESIGN ENGINEERING

The IDE bachelor of science program at TU/e started in 2001 [1]. IDE aims to educate academic designers of intelligent products, systems and services, who are able to integrate human, socio-cultural, business and technical aspects [2,3,4,5]. The bachelor program (three years) educates an integrator, i.e., someone who brings team members with different backgrounds together. The department staff consists of a unique mix of designers, engineers and scientists, who work within the four research groups of the department: Designed Intelligence (technology focus), User-Centered Engineering (human focus), Designing Quality in Interaction (interaction design focus) and Business Process Design (business focus) [6]. In 2005, the IDE master program started.

2.1 Curriculum

IDE has a unique educational model where the student is treated as a junior employee. 60% of the time (!) students work on projects for actual clients, one at a time, in teams of four to six students, during periods of 14 weeks. The students are responsible for satisfying the needs of the client. Most skills and knowledge are developed on the job, but students may call on the help of their project coach or any of the members of the department. Additionally, students spend 40% of their time on two other assignments per period. These are workshops and smaller projects, done alone or in pairs.

Students can select projects and assignments themselves, giving direction to their own competency-development. There are six core competencies, such as Ideas & Concepts, Integrating Technology and User-Focus. There are also four supportive competencies, such as Multidisciplinary Teamwork and Self-Directed Learning. Students maintain a learning portfolio, in which they reflect on their own competency development and support this with learning evidence. Evidence consists of examples of intermediate and resulting work and feedback by assignors, clients, project coaches and experts. Students discuss their competency development progress with their competency coach. Twice a year, the portfolio is assessed by an assessment committee, which decides if the student is capable of continuing to the next half year of the program, whether additional requirements apply, or if the student should be advised to leave the program.

This curriculum is an example of a design-oriented curriculum integrating ‘users’, ‘technology’ and ‘business’. The most highly valued outcome of a project is a design prototype that fulfills the needs of its user, e.g., in terms of solving a user’s problem, or supporting pleasurable interaction, that functions flawlessly and is feasible from a business perspective.

2.2 Strengths

Especially during the interaction with other students, coaches, clients and experts, I learned about my strengths and weaknesses as a person and as an Industrial Design Engineer in general. From *my perspective*, the five main strengths of an IDE bachelor graduate are:

- *Innovation:* to be able to solve ill-defined (‘wicked’) problems, in creative, revolutionary and innovative ways;
- *Synthesis:* to be able to synthesize ideas and create prototypes that support the communication and development of those ideas;
- *Teamwork:* to integrate the expertise of people with different backgrounds and different levels of experience, in one design solution;

- *Self-awareness:* to know about one's own strengths and weaknesses and to use this awareness to give direction to one's own development;
- *Dedication:* to feel responsible for the satisfaction of clients and other stakeholders and thus to be motivated to continuously improve the quality and quantity of the work.

3 CONTENT AND KNOWLEDGE ENGINEERING

Utrecht University offers two master of science programs within the field of Information Science. One of them is CKE, which started in 2003 [7]. It is closely related to the CKE research group at the same institute [8]. CKE emphasizes the integration of the technical side of content and knowledge management with cognitive and social aspects. The program accommodates both research-oriented students and industry-oriented students who are interested in positions as project manager, content manager, knowledge engineer, or business consultant. The department staff is specialized in Content Management and Content Processing (technology focus), Cognition and Communication (user focus) and Organization and Information (business focus).

3.1 Curriculum

The CKE master program (two years) consists of four mandatory courses covering information, technology, user and business aspects, six optional courses and a thesis project. Students work on two courses at a time, during periods of ten weeks. Most courses consist of a varied range of learning activities such as lectures, practicums, weekly assignments and sometimes a small project. The practicums are often organized on a smaller scale than the lectures, better facilitating interactions between students and teachers. Students are assessed on the basis of their work, which is often a combination of taking a written test, submitting the weekly assignments and if applicable, submitting a report or paper about the project.

This curriculum is an example of a research-oriented curriculum integrating 'users', 'technology' and 'business'. The most highly valued outcome of a course is a scientific article that is of publishable quality. Of course, high marks on the assignments and written tests are important as well.

3.2 Strengths

Especially because of the switch from the educational environment of my bachelor program to the educational environment of my master program, I learned about my strengths and weaknesses as a person and as a Content and Knowledge Engineer in general. From *my perspective,* the five main strengths of a CKE master graduate are:

- *Reuse:* to be able to build upon the scientific work of others and to contribute to the evolution of human knowledge;
- *Depth:* to be able to solve complex problems within the domain of content and knowledge engineering, based on in depth knowledge of the domain;
- *Complexity:* to be able to solve complex problems based on various mathematical and logical modeling skills, such as statistics and programming;
- *Processing:* to process and memorize large amounts of information, acquired during lectures or from literature;
- *Abstraction:* to be able to reason about theoretical cases, without the need for the knowledge to be related to a real-world experience (i.e., to understand things in theory, without ever experiencing it in practice).

4 WHAT CAN THESE CURRICULA LEARN FROM EACH OTHER?

The switch between the programs gave me quite a few insights in their educational strengths and differences. Based upon these, I will give some recommendations for further improvement of the curricula, so that they can continue to set the path for other curricula in the future. I will discuss three possible ways to improve the CKE curriculum and three possible ways to improve the IDE curriculum. In my opinion all six topics cover knowledge, skills, or attitudes that should be mastered by both IDE and CKE graduates.

4.1 Motivation

At CKE I was less motivated than at IDE. There are two reasons for this: (1) as a student I felt more anonymous, because for most of the work, there were no other stakeholders to satisfy, except for myself and the teachers, who were too occupied to be involved in my personal development. The classes were larger and the use of literature as a knowledge source resulted in less collaboration with teachers. (2) Study work did not feel like 'real' work: most work was evaluated by people from within the university and applied to hypothetical cases, rather than real cases. CKE does a better job than several other curricula, but further improvement could be realized by doing more projects for external clients. Thereby the study will become more like the real-world, rather than a laboratory. Additionally, traditional unidirectional teaching activities could be replaced with more interactive ones, such as workshops and mentoring, to bring students and teachers closer together.

4.2 Self-Awareness

At CKE I was less aware of my learning goals and the steps I should be taking to achieve those. Instead of consciously eliminating my weaknesses or building out my strengths, I was following the path laid out by my teachers. This may be improved by judging students on their learning process, in addition to the outcomes of their work. A simple way to partially achieve this, is by asking students to write reflections on their project work.

4.3 Problem Solving Skills

At CKE problem-solving often meant doing the chunks of work assigned to me by my teacher. I did not need to worry about organizational issues and therefore I could go into more depth than at IDE. However, the disadvantage was that I was less conscious of the process (also see previous paragraph) and that I got less training in solving ill-defined (i.e., 'wicked') problems. This may be improved by giving students more freedom in how they approach their work and in what the outcomes may be, especially during projects. This does not imply being less critical in evaluating their work however, so teachers will need clear assessment criteria.

4.4 In Depth Knowledge

At IDE I felt there were fewer opportunities to develop fundamental, in depth knowledge of the domain. The main cause was that most learning activities were very open, i.e., the goals and scope of the work were not clearly defined. This required frequent 'trial and error' before being able to work things out in detail and thus to go into more depth. This may be improved by scoping projects to focus on smaller problems, to determine the range of allowed outcomes prior to the execution of the projects (e.g., 'the design must be a computer interface', or 'the design may not be a computer interface’), to define projects based on learning objectives (e.g., technology-oriented projects vs. user-oriented projects) and to stress the use of literature in assignments. The advantages gained may justify the loss of some wicked problem solving skills.

4.5 Knowledge Reuse

At IDE I have seen quite a few projects where things were ‘invented’, which weren’t new at all. Also, I found it hard to transform a general idea into a detailed solution, or even a working prototype, because our concepts for intelligent systems and services would get very complex when going in detail on how they should work. This problem is related to the previous paragraph and caused by a lack of reuse of other people’s work. This could be improved by putting more emphasis on benchmarking and literature studies. Especially in the assignments, assignors could do more preparation of the reading and practice materials, so that students can spend their time on the actual studying of the materials, rather than on acquiring and filtering them. Finally, more ‘follow-up’ projects should help to develop more complex and realistic designs.

4.6 Handling Complexity

At IDE I sometimes felt a need for dealing with complex problems, mathematical ones in particular (e.g., combinatorial optimization and statistics). However, often somewhere in the middle of a project, there was no time to acquire the skills to solve them. Many skills at IDE can be acquired ‘on demand’ and by ‘learning on the job’. But that does not hold for these complex problems. Except for getting help from experts, the solution was to choose a related assignment later on. Unfortunately the share of assignments in the total curriculum is too small to master complexity in all areas. This problem is inherent to the IDE discipline, which is more general than for example physics or math and as such ID engineers will always be dependent on the help of specialists. However there should be a minimum level of knowledge to be able to collaborate with those specialists. This could be improved in the following ways: (1) by facilitating depth and reuse, see the previous two paragraphs, (2) by making students more aware of the usefulness of ‘abstract’ assignments, such as math, early on in the curriculum (i.e., I have to choose all assignments myself, but how do I know which math assignment to choose if I do not know what it will be useful for) and (3) by making the staff themselves more aware, e.g., by hiring more engineers, in addition to the designers and scientists.

5 CONCLUSION

The following more general conclusions can be drawn from comparing the two curricula: Design-oriented curricula are strong at motivating students and at making them feel responsible for their own work and learning processes. Research-oriented curricula can partly adopt this strength, by doing more applied research in which students have to satisfy the needs of a real client and by judging students on their learning processes in addition to their results.

Research-oriented curricula are strong at scoping work and reusing the work of others, which enables students to gain more in depth domain knowledge. Design-oriented curricula can partly adopt this strength by better defining the goals of design projects in advance and by putting more emphasis on benchmarking and literature studies.

6 DISCUSSION

- Two specific programs have been compared and used as examples of design-oriented and research-oriented curricula. The IDE program is however not just a design-oriented program, but also a competency-based curriculum. Future research should lead to more clarification which of the findings are derived from the design-oriented characteristics of the curriculum and which are derived from the competency-based characteristics.
- The CKE program educates for both work in industry and research in academia. As such it is ‘research-oriented’ and not ‘research-only’, such as the relatively new master programs in The Netherlands, which are called ‘research masters’. These programs only aim to prepare students for a research career.
- Finally, these findings are *my personal* opinion and stress the things that I think are important in academic curricula. However, they are the result of many discussions with fellow students and coaches, over the years. By means of this paper I want to continue this discussion with the scientific community, which may lead to even better design-oriented and research-oriented curricula in the future.

Acknowledgement

I am grateful to all people who have contributed to the IDE and the CKE curricula. In both places I have learned things that have been and will be, very important for my future career and my life in general. With respect to this paper, I wish to thank for their comments: S. Kyffin, M.P. van Putten, F.L. Meijler, A.P. Meijler-Schendstok, A.P. Meijler, M. Sierhuis, S.R. Wolfe and C. O’Guinn.

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