DESIGN COMPETENCE IN ICT EDUCATION

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ABSTRACT
The new discrimination law in Norway requires new products and environments to be developed in such a way that they can be used by as many people as possible. In response to this legislation the applied information technology curriculum at Oslo and Akershus University College of Applied Sciences has been adjusted to incorporate universal design (UD). This curriculum is the basis for this case study which addresses the possible effects the role of design might have if included as a study module in a technically-oriented bachelor program. The empirical data discussed in this case study have been gathered from three types of sources: final year bachelor project reports, focus group interviews and a questionnaire. The study indicates that there is a growing awareness among students and educators at the College that knowledge engendered from working with design processes can influence the outcome of information technology projects to become more innovative, contextual, conceptual and holistic. The study suggests that making design an inherent part of the curriculum enables students to create and evaluate a variety of information and communication technology (ICT) concepts targeting the general public. Although the students consider themselves as a link between engineers and interface designers, their written work shows relatively little focus on the enabling dimension of usability in universal design, which indicates that they lack universal design competence. Among the main implications of the study is the need to modify the required learning outcomes of an information technology curriculum so as to include theoretical knowledge and practical competence related to universal design.

Keywords: Universal design, ICT education, design methods

1 INTRODUCTION

The awareness of the importance of universal design (UD) is growing. It is also becoming a potentially significant marketing asset due to the ageing of the general population [1]. Since July 1, 2011, new information and communication technology (ICT) products that serve the basic functions of a business activity targeting the general public in Norway are required by law to be universally designed. Moreover, existing ICT systems must be upgraded to satisfy the principles of UD by 2020. Globally, 173 countries have ratified the Convention on the Rights of Persons with Disabilities (as of February 2012) [2] which states that “every aspect of an organization’s activities must be evaluated to ensure accessibility and inclusion”.

ICT bachelors programs are emerging in order to fill an acute gap between supply and demand as far as professionals with universal design competences are concerned. In 2004, the Faculty of Engineering at Oslo and Akershus University College of Applied Sciences (HiOA) established a bachelor program in applied ICT with a particular emphasis on universal design. A majority of graduates who complete this program view themselves as a link between designers and engineers. Hence, they have an awareness of design as being an important part of their future work. Their written work usually indicates that they have had a focus on design while conducting their project work. There is, however, a significant difference between focusing on universal design during coursework and having acquired the required design competence to function as professional with universal design expertise. Yet, there is a risk that students having had a design focus during their coursework may be led to believe that they have developed enough design competence through their work. This again may lead to a mismatch between the students’ understanding of their own competences and the expectations of users and employers.

In order to address the issues at hand, we have set about to investigate what type of design skills applied information technology bachelor student actually acquire during their study program, how those skills are acquired and in what way they can be useful in their future work, in particular work related to universal design. We first provide an overview of the case study and provide a short overview of what is understood by Universal Design. We then present the data from bachelor exam reports, student interviews and questionnaires, which we analyze and discuss before we conclude with suggestions as to how design can influence the quality of the outcome of an ICT educational program with an emphasis on UD.
We argue that the inclination to lean on fellow experts as an alternative to creating multidisciplinary teams to build up the curriculum structure has influenced the tendency found in the student reports. We discuss the value of design competence through processes of problem formulations, usability and experience design to meet the demands of the discrimination law within field of products.

1.1 Case study: bachelor in applied ICT

In our description of the case study, we choose to focus on the design aspects of the applied ICT bachelor at HiOA. Technical issues related to this study program are therefore beyond the scope of this discussion.
The complex nature of the research question and the large amount of variables at hand point towards the case study as a suitable method for this study. A case study also enables the use of a variety of data sources, which can be linked to each other in a triangular fashion [3]. The methods used in this case study consist of concept mapping, semi-structured group interviews with students and a questionnaire.
Final year bachelor project reports from 2009, 2010 and 2011 were explored through concept mapping [4, 5] by the authors in order to identify recurring elements across the years. In addition we performed additional data collection to explore the tendencies identified in the bachelor project reports. We carried out a series of semi-structured group interviews of third year bachelor students performed on January 27 and 28, 2012 and sent a questionnaire to all the students currently enrolled in the bachelor program on March 14, 2012.
The findings from the group interviews were used as basis for the design of the questionnaire. For example, one student said that she believed that her future role in a business activity will be to be “a link between ICT engineers and designers”- an opinion that was shared by rest of the group. This claim inspired us to introduce the following question in the questionnaire: “what role do you think that you will have in your future work; engineer, link between engineer and interaction designer, interaction designer, or other?”
The questionnaire consisted of a combination of open-ended questions to address competence descriptions and closed-ended questions that allowed us to aggregate results. All the close-ended questions consisted of value statements that the students could answer on a 5-point Likert scale (to very large degree, to a large degree, to a moderate degree, to little degree, not at all). Some questions were accompanied with additional explanations. For example, in one of the questions, we provided an overview of what we meant with the term design skills as follows “the questions are based on a comprehension of design skills as; the ability to develop innovative products and user interfaces, the ability to enhance the usability and functionality in relation to form, color, appearance, composition, etc. and the ability to influence users experience through the use of colors, pictures and design elements such as specially developed navigation buttons, navigation patterns (for example tap and sweep), banners etc.”
The numbers of students that answered the questionnaire gave the typical response rate at 24.9% (58 out of 233) and a sample usable to give some insights for the case study [6] .

1.11 Curriculum

The bachelor program cover subjects such as prototyping, human-computer interaction, visualization and universal design in addition to more technical subjects such as web programming, system development and basic programming. Mathematics does not play an important role in this program, a factor mentioned by several of the interviewed students as being an important factor for why they applied for this particular study program.

1.2 Universal design

In this study, we choose to use the definition of universal design found in the Norwegian Anti-Discrimination and Accessibility Act (Norwegian Ministry of Children, Equality and Social Inclusion, 2008) because it incorporates ICT as a part of UD, that is: "*UD is to design or facilitate the main purpose of a service or product to a physical setting, including information and communication technology (ICT), in a way that allows as many as possible to use the basic functions or service [7]. The linked definition of ICT by the ministry is: technology and technology systems that can be used to express, create, transfer, exchange, store, multiply and publish information or in any other way make information usable"*.

2 DISCUSSION

2.1 Student reports

A "concept map"-based analysis of the student reports revealed a number of general tendencies. Most of the student projects are written as a description of how the student group has gone about to tackle a pre-defined real-world problem, which is often clearly limited in scope. They do not generally put much emphasis on trying to reformulate the problem at hand or place it in a wider context. Hence there is little evidence that conceptual thinking is used as a basis for an understanding of broader issues than the task at hand. Furthermore, although most of the reports mention having the end-user in mind throughout the project, the propositions made as far as interface designs are concerned have generally little relation to appearance, experience, semantics and usability and brand mechanisms.

2.2 Questionnaire and interview

2.21 Generalist education

The competence that one can acquire through the ICT bachelor program is described as *wide* by 42% of the students. The students reported that the competence was: "general, a bit of everything" or "Jack of all trades, master of none". One student said: "I am still having problems understanding the competence that I will get. I know what subjects I have, and will have, but not what kind of job this makes it possible for me to get". The remaining respondents evaluated the quality of their future competence with answers such as "good, very good, ok" etc. instead of descriptive answers.

2.22 Link between designer and engineer

The majority (49%) of the ICT students view themselves as a link between engineers and designers while 25% of the students view themselves as interaction designers (figure 1).

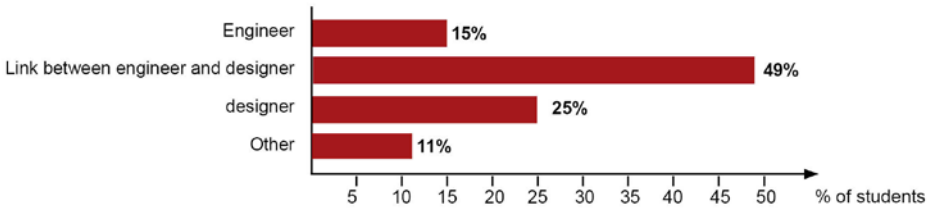

Figure 1. Question 15, from the questionnaire; how do would you describe your role in your future work?

This self-assessment question suggests that students perceive themselves as being generalists, while having an ambition of becoming a link between the traditionally separate professions of engineer and interaction designer.

A natural question that emerges from the student description of becoming a link between professions is firstly whether society and industry need graduates with such a profile. Secondly, if a link between the mentioned professions is needed, what learning outcomes should be defined in the curriculum to meet this need?

2.3 Design and ICT

The students' descriptions of becoming interface designers or links between engineers and interface designers through general competences with little experience or skills in design fit with our assumption that design can play a constructive role as a supplementary subject in ICT education. For a development team to create functional user interfaces within the principles of UD, a more holistic approach which includes concept development is an imperative [8-12]. Iterative processes alone can help increase the usability of an existing system in a confined setting, but have marginal effect on the larger context of the system that includes experience, market, etc. [8].

The bachelor project reports show that many of the students have identified the necessity to work with design issues even though they do not have the training or competence to do so. This is not an optimal situation for the student striving to develop interfaces within the principles of UD with high quality. Moreover, when 25% the students look upon themselves as designers it might cause a disparity between the students' ambitions and their future employers' expectations.

The disparity might not be easily identifiable since the students might not look upon working with design as a creative activity. One student that has described his or her coming work as *designer* also answers that a job "preferably within ICT, preferably in combination with creative activity, for example web design" is an ambition. This situation might represent of a paradox in the data that should be investigated further.

Assuming that becoming a link between existing professions, and perhaps therefore a generalist, is regarded as an advantage by society and industry, there might be a need to revise the curriculum with additional subjects (compulsory or optional), in order to strengthen the students' competence for this specific purpose. Optional modules can form possible directions of specializations such as project management, teamwork and design with emphasis on UD.

A larger degree of specialization in design as part of the bachelor study might lead to an enhancement of the students belief of being able to perform [13, 14] when creating universally designed products. The belief in one's own capability is directly connected to the degree of a person's motivation [15] and therefore also to the feeling of mastery [16] which is important for the general student welfare and sense of achievement.

2.4 Effects of design on ICT education

The interviews and questionnaire responses concur concerning the interest for design as a possible enabler to strengthen the degree of innovativeness (Figure 2) and usability (Figure 3) in the student projects and to enhance the quality of dialogue with designers (Figure 4).

The degree of design skills as an influence to the functionality in a UD perspective rates lower than the effect of design skills for the innovativeness in the student outcomes. This is in contrast with the traditional comprehension of design as being a topic in composition, semantics and therefore also readability. This might be explained by the aforementioned different understandings of design, even though the term was defined in the questionnaire.

The ICT students that focus on UD use processes - often iterative - for developing and evaluating the functionality of for example an interface. The reliance on these processes might reduce the belief that semantics such as colors, shapes on buttons, etc. influence user behavior and usability as the already acquired skills are considered sufficient.

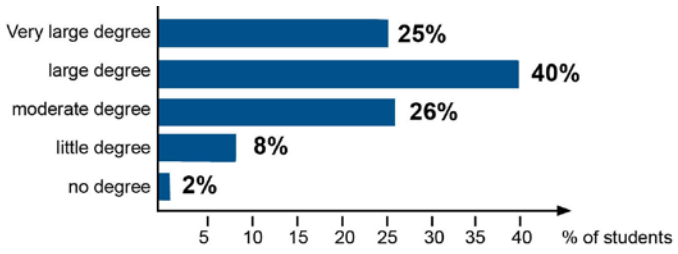

Figure 2. Question 16, from the questionnaire: To what degree do you think that one student module in design would make your work more innovative?

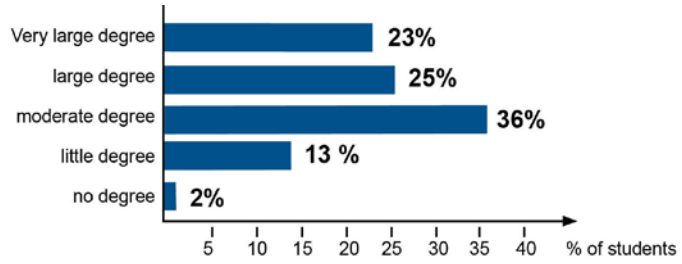

Figure 3. Question 17, from the questionnaire: To what degree do you think that one student module in design would optimize the function of your work? (Function is understood as: easy to use and understand)

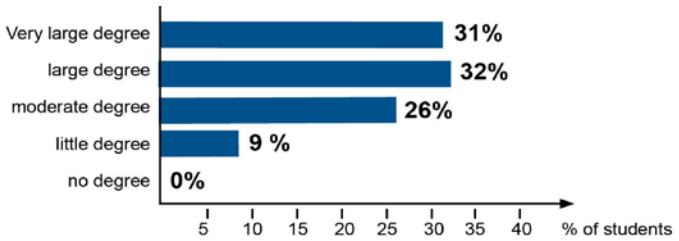

Figure 4. Question 18, from the questionnaire: To what degree do you think that one student module in design would ease your dialogue with designers?

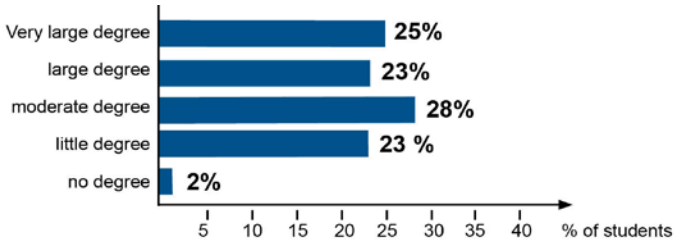

Figure 5. Question 19, from the questionnaire: To what degree do you think that one student module in design would increase your chances of getting a relevant job?

2.5 Creative concept development

Design education typically put the emphasis on training students to understand, take part in and initiate the development of creative tools and to master processes related to the generating of original ideas and concepts. Because design students train to become creative through an awareness of, and through hands-on practice with the use of creative tools, the outcomes of their education are generally diverse, experience-based and context-oriented. Design students are encouraged to espouse a holistic approach to creative processes, also when working in confined or limited spaces. It is natural to assume that similar mechanisms are valid within the realm of ICT education [8-12] - an assumption indirectly supported by the ICT students who report that design skills can enhance the degree of innovativeness of their projects (figure 2.).

A large part (47%) of the ICT student respondents report that the education challenges them to be creative to a moderate degree, while 32% of the students report that they are introduced to creative tools to a moderate degree.

One of the findings from the student reports is that the ICT students typically limit the scope of their work to an often narrow and precisely delimited area of work. For example, they usually focus on parts of a process or functionality, with little interest in considering possible alternative or more extensive contexts or user experiences. In other words, there is a definite potential for development as far as student awareness of the various dimensions of user behavior is concerned. [17].

Contextual and conceptual thinking along with holistic approaches are often considered to be key professional skills for candidates to project manager positions, which are of much relevance to ICT students who expect to become links between engineers and designers.

3 FINAL REMARKS

Based on the case study we have listed some possible recommendations that might be of interest on a general level for the development of ICT bachelor programs with emphasis on UD: The knowledge engendered from working with design processes can play a central role in making applied ICT education more innovative, contextual, conceptual and holistic. Furthermore, one or more design modules in an applied ICT bachelor program with an emphasis on UD can contribute to equipping students with the required skills to function as project managers or as professionals serving as links between engineers and interface designers.

As mentioned in the findings presented above, the students expect a design module in their education to represent a potential boost to the relevance of their study to the world of work (figure 2.). In particular they expect such a module to allow them to develop their skills in terms of innovativeness as well as their communication skills between professions.

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