Educating interaction designers – how are new tools for design changing learning situations?

ABSTRACT

Institutions for design education are creating new courses and study programs within the field of interaction design, in order to meet the challenges that arise with the changing role of the designer and the expansion of the object of design. The DesignEd project analyses how new tools for design work are changing learning situations and knowledge requirements in design education. In this paper I will present the research topics that motivate the planned and ongoing work on the DesignEd project. Ethnographic case study research has been carried out in a class of master level interaction design students at the Oslo School of Architecture and Design. The preliminary findings from this study suggest the need for further exploration regarding the importance of computer programming skills for interaction design activities, and how cooperation can be facilitated in groups with different levels of programming competencies.

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INTRODUCTION

In this paper I will present the research topics that are motivating the planned and ongoing work on the DesignEd project; a project analysing how new tools for design work are changing learning situations and knowledge requirements in design education. The DesignEd project is ongoing, with case study research continuing at the Oslo School of Architecture and Design (AHO) until the end of May 2005, in a master level interaction design class. The case study aims to contribute to the larger discussion of how designers develop professional knowledge.

Institutions for design education have begun to create new courses and study programs within the field of interaction design, in order to meet the challenges that arise with the changing role of the designer and the expansion of the object of design. The newness of these courses and programs makes them good candidates for exploratory case studies into the changing character of design competency. In the transition from traditional product design education to interaction design, changes in knowledge requirements are highlighted and subjected to discussions in the curriculum development process. As all teachers know, the process of implementing a planned curriculum in the classroom is never straightforward. Especially in the early stages of a new study program, there are numerous adjustment going on continuously, both small and substantial; some exercises might work better than others, unforeseen problems occur, or even successes just happen, the need to cover unplanned material arises, the time schedule might collapse, and some of the material might be too difficult, too easy or just irrelevant. The process of creating and running a new study program thus creates awareness of the essence of the new subject field. This happens at different stages and levels, in the initial stages, when teachers and education administrators with the original ideas for the new courses and programs have to justify how these innovations respond to a need or lack in the current institutional (and societal) structure. After funding and support for the new courses and programs have been secured, the actual curriculum is planned with the involved teachers and departments. This opens a new round of reflections. In the final stage of the implementation process, the teacher in the classroom has to make adjustments as the course and program unfolds. In the DesignEd project it is this last stage of the process that is studied.

The starting point of this paper is the question of how the professional knowledge design students develop is changing when new computerized tools increasingly support design work. The premise is that computerized tools change design education by changing how design work is carried out, and by opening up new possibilities for what can be designed, thereby promoting reforms in the design education curriculum that has to adapt in order to stay relevant. The view is that reflective participation in various activities is a prerequisite for learning and developing.

BACKGROUND – THE DesignEd PROJECT

DesignEd is a small subproject under the Multimo project of InterMedia at the University of Oslo. InterMedia is an interdisciplinary research centre exploring the intersections between design, communication and learning in digital environments. The Multimo project investigates digital aspects of multimodal discourse within the field of design and electronic art, informatics and learning. Multimo aims to develop interdisciplinary knowledge on methods for inquiry into multimodal multimediated discourse, and is funded through the Communication, ICT and Media program (KIM), of the Research Council of Norway. The DesignEd project is one of several first steps in a process of establishing a joint and inter-institutional research effort between InterMedia, the Department of Informatics at the University of Oslo, and the Oslo School of Architecture and Design. Other steps towards this end include cooperation on the Competence and Media Convergence (CMC) research initiative, and a project application to the Research Council of Norway.

One of the aims of the DesignEd project is to study and become familiarized with the educational environment at AHO as the research object, and initiate collaborative research on a small scale. Central to this preliminary effort is the identification of the situations and interactions in the learning situations that offer insight to how tools for design are being used, and how learning is affected. At this early stage, preliminary ethnographic fieldwork has been conducted and further research is under way.

The industrial design program at AHO is a 5-year program leading to a master degree. The program accepts 25 new students annually, and is a relatively small program. Towards the end of the program, the students can choose to specialise in product design or interaction design. This year there are 12 students specialising in interaction design. For the DesignEd project a class with interaction design students in their fourth year have been chosen for ethnographic observation and interviews. So far I have conducted 4 interviews (3 with teachers and 1 with a student), and 4 classroom/studio observations, in addition to reading background material about the courses provided by the school. Two studio courses have been studied; the course "Heart and Soul of Interaction Design" in the fall semester 2004, and the "Things that Think" course in the spring 2005 semester. Both courses merit 24 ECTS credits, and are to be supplemented with an optional 6 ECTS credit tool or theory course to make up a full semester of 30 ECTS credits. Both courses are taught by the same teachers, and consist of more or less the same group of students, with the exception of 3 international exchange students that joined the class for the "Things that Think" course. The studio courses are in principle stand-alone courses, and open to other AHO students from the architecture and product design programs.

The "Heart and Soul of Interaction Design" course covers the core elements and skills of interaction design, and is structurally divided into two- and four-week projects. The projects are individual, except for the Christmas decorating project which is a group effort involving the entire class. Each project has a deadline, and is followed by a critique session. At the end of the term an external evaluator is present for the final critique session, which is open to the general public. The "Things that Think" course follows more or less the same structure, with 3 minor tasks and several exercises that lead up to a major task that ends the semester. The major task will showcase how well the students have attained the course's learning objectives. The aim of the course is to provide the students with practice in the field of tangible/physical computing, with experiences in physical interaction [1]. Examples of minor tasks are an analysis of a vacuum cleaner robot, and the creation of a prototype of an object that processes data, is networked and gives a tangible output. The different obligatory tasks can be completed individually or in self-appointed groups, and are intended to prepare the students for the major task. All tasks are reviewed in a critique session, and the major task is critiqued in an open session with an external evaluator at the completion of the term.

AHO describes its teaching profile as being based on an academic tradition with studio-based project work and a conceptual design approach, with historical roots in an aesthetic and academy-oriented tradition rather than a polytechnic one [2]. This means that the emphasis is on studio teaching and close contact between students and academic staff.

TOOLS FOR THINKING – AND TOOL MAKING

Tools support and are part of cognitive processes such as learning, and in the context of this paper tools are also the object of design activity. This double significance of tools in the learning situation in the interaction design classroom can be confusing, and this discussion aims to examine and clarify the different meanings of the concept of tools for design, in order to establish the object of research.

Design can be understood as a social, historical and cultural activity, where influences from local organizational cultures and social norms on design, are fundamental to the design process, which is characterized by uncertainty and ambiguity. This view contrasts with views of design as a purely logical process, ruled by scientific laws and material constraints with a strong concentration on function, and where there will always be a singular best solution to any design challenge. It also contrasts with the view of design as a process ruled by the demands of the marketplace, or by aesthetics [3]. The consequences of a design understanding emphasizing the social and situational is that the context of design activities becomes important for understanding the process.

This view of design as a social, historical and cultural activity is paralleled by developments within cognitive theory and learning theory, where the importance of culture, history and social context is stressed, and the unit of analysis is defined broader than just intrapersonal processes. The current discourse on cognition and learning advanced the view that cognition and learning are situated sociocultural practices mediated by tools [4]. The implication of this understanding for learning is that the emphasis shifts from a focus on how knowledge can be transferred to and acquired by individuals, to how communities of practice can be organized in order to support participation. As Stephen Billett has stated: "In this context, opportunities to engage in work, the kinds of tasks individuals are permitted to participate in and the guidance provided become key bases to understand and evaluate how and what individuals learn through their work" [5]. Cognition in this sense is understood as distributed between the individual and the context. The context can include, but is not limited to, other individuals and supporting aids such as tools, artifacts, books, rules, recipes and instructions [4]. The identification of relevant aspects of the context, in order to select appropriate units of analysis for observation, can be supported by using the theory of tool-mediated action from Activity Theory.

From an Activity Theoretical perspective the minimal context for understanding individual action is an activity. Here an activity is seen as an artifact-mediated relationship between a subject and object, where the object can be material or immaterial. The activity is motivated by a goal that can be achieved by transforming the object. This reciprocal triangular relationship has been conceptualized by Kuutti in figure 1:

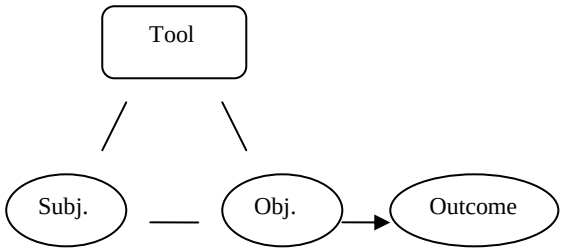

Figure 1: Kari **Kuutti's illustration of the triangular tool-mediated relationship between subject and object, based on Vygotsky [6].**

Kuutti has pointed out that: "The tool is at the same time both enabling and limiting: it empowers the subject in the transformation process with the historically collected experience and skill "crystallized" to it, but it also restricts the interaction to be from the perspective of that particular tool or instruments only; other potential features of an object remain "invisible to the subject" [6].

An artefact is part of the material world, historically modified and incorporated in goal-directed human activity [4]. It is the ability to use artefacts that separates humans from other species, and differentiates between cultures. Artefacts are resources that can be physical or verbal, and that are created and developed both between individuals and groups, and between generations [7]. Artefacts are the foundations for higher psychological functions, such as language, writing, calculating, drawing, conscious memory, focused attention and concept formation.

The minimal activity depicted above does not include social relationships, but Yrjö Engeström has expanded the activity triangle to also include social relationships, by adding the reciprocally related categories of rules, community and division of labour. Furthermore Engeström argues that it is through the study of the interaction of two or more activity systems, that one can understand expansive learning [8]. Learning is in this context is understood as a horizontal movement between activity systems, rather than a hierarchical process towards higher forms of learning. When studying design education, this means that attention needs to be directed towards social situations in the learning milieu, and movements between different activity systems.

Related to the DesignEd project this means that the use of tools, how learning happens and the development of knowledge requirements cannot be studied as isolated units, but must seen as interrelated. It also means that a broader context than the classroom is relevant. For instance, the student's involvement with design activities outside of school, and the movement between school and these other arenas is of interest. Several of the students are in fact engaged in such activities, either as interns in professional businesses or on a freelance basis. The teacher is supportive of these activities and will allow extensions on deadlines and make other adjustments in order to facilitate these extracurricular activities. It is however outside the scope of the DesignEd project to study the movements between school and work at this stage.

The tool-mediated relationship between subject and object in activity systems underlines how artefacts are carriers of social and cultural meaning. Designers can influence and present different behaviours through the design of artefacts, and this could go beyond presenting a surface design that points the user towards the objects traditional function or historical role [9]. This positions the designers as potential critics of society and culture, much like the Bauhaus movement [10]. This perspective on designers, in addition to the ever-increasing prevalence of design objects in our everyday material and digital surroundings, also makes it interesting to investigate how designers learn how to become designers, and how they develop knowledge and professional expertise.

COMPUTERIZATION OF WORK – CONSEQUENCES FOR KNOWLEDGE AND SKILLS DEVELOPMENT

The following section presents the discussion on the consequences of computerization on knowledge and skills development from the workplace learning discourse, in order to explore whether these findings have relevance for, and can inform the research on how new tools for design work are changing learning situations and knowledge requirements in design education.

The profession of industrial designers has always taken up and utilised different and new technologies to conduct their work. Today's computerized technologies differ though from earlier technologies, in their capacity to move design work from concrete and tangible tools and materials, to non-tangible representations and symbols. The move from pen, paper and models, to computer representations radically changes the activity of design. It also changes the kind of knowledge and skills design students need to master, which now include knowledge of different computer tools and programs, and even programming, in addition to other traditional designer's skills. For interaction design students, the need for non-traditional knowledge can be seen as even greater, as they frequently work with sensors for sound, light and movements, and responsive computer programs in public places. This enlarges the field of knowledge and skills relevant for interaction design education, which needs to incorporate these new areas of knowledge, plus knowledge of human behaviour and sociological knowledge, alongside more conventional skills such as sketching, modelling and knowledge of materials and their properties. Precisely what kinds of knowledge are needed and the consequences for design education are not yet clear.

The new aspects of the learning milieu of design students have been research in the recent Atelier-project. The Atelier-project investigated innovative ways of enriching the learning environment for design students, in order to develop new computerized tools and resources to support "inspirational learning". The project identifies certain factors that contribute to making the learning space inspirational, and emphasizes that learning emerges within a context. The learning context can be enhanced with images, music, artefacts, everyday objects and widgets that combine to promote creativity, and produce a transient, ephemeral and flexible atmosphere conducive for inspirational learning [11]. The Atelier-project gives insight to how design students work and utilize resources in their work environment, for instance by configuring work spaces and the artefacts within their work spaces [12]. The project does not focus specifically on how the students learn and develop knowledge, or how the extended uses of technologies influence their understanding.

In the transition from concrete tangible tools to manipulation of information and symbols, the effects of computerization on professional work with regards to knowledge and skills development in the professions, have been studied since computers made their way into the workplace. Recurring themes have been the possible "dumbing down" effect of using computerized tools, as workers lose a sense of overview and understanding when tasks are split into increasingly smaller subtasks. Fears of intelligent machines replacing humans, increased automation of work, and speculation of whether computerization leads to work becoming more abstract, have

also been issues. The problem of loss of coherent knowledge as technology supports the increasing division of labour, with a resulting loss of workers' power in the work situation, has been brought to attention since the 1970s [13]. This view was nuanced and expanded when the concepts of "automation of work" and "informating of work" were introduced to describe different emerging development scenarios. The first concept describes how workers can lose skills when machines take over and replace humans, and the second concept refers to the possibility of more interesting work, as machines take over routine tasks leaving room for and supporting humans in more complicated, analytical and judgment-based work [14].

Norwegian-based work life research has pointed to the importance of the specific context for computerization of work. Consequences for competence and professionalism are the greatest when computerization brings about a different kind of logic to the previous way of doing work [15]. The effect on tacit and professional knowledge has been studied among engineers in the oil industry who use 3D-CAD in their design work. Tacit knowledge is the knowledge that is silent and embodied, and that manifests itself in the work rhythm and practice, and thus cannot easily be reduced to formal and computerized sub-tasks. Findings from the 3D-CAD engineering study suggests that computerization can lead to erosion of tacit knowledge and a homogenization of skills, because computers necessitate the formalization and standardization of work tasks and thus only make the explicit elements of the work visible and articulated [16].

Is this discussion on homogenization of skills and tacit knowledge relevant when studying design education? There seems to be a sort of tacit and visual knowledge among designers that enables them to "read" artefacts like prototypes, and visual presentations of artefacts, in ways that give insight to the founding ideas of the design process. This is demonstrated by the fact that designers nearly always prefer observation of visual presentations, such as graphs, tables, mock-ups and illustrations, or physical artefacts, over scientific texts about design research and knowledge [17]. Designers are able to quickly "read" and understand visual presentations, and through them gain insight into the locally situated design process under analysis. Visual communication in different forms is also important for learning as it serves to launch critical and reflective discussions about the design process among designers and students. This visual rhetorical practice can successfully be presented through visual essays [18].

As a non-designer, more accustomed to reading conventional textual rhetoric, I find it difficult to immediately grasp the "story" presented in such visual essays, that when I carefully studied them seem full of possible interpretations and ambiguity. It is therefore probable that designers possess and share a sort of tacit professional knowledge, and that it is relevant to investigate whether this knowledge is altered when the professional tools change and usher in a different way of work and perhaps thinking.

THE INTERACTION DESIGN COURSE – EARLY IMPRESSIONS

This section will present some of the first impressions from the observations and interviews from the fourth year interaction design class. At this stage the data from the fieldwork are not substantial enough to draw any conclusions from, but serve as a starting point for the discussion of the research questions and topics brought forth in the previous sections.

At the time of my first classroom observation in November 2004, the students were engaged in the intensive studio course "The Heart and Soul of Interaction Design", working on the annual Christmas decorating project. This class project culminates in the decoration of the school's communal areas. The final exhibit invited the spectators to interact with the installations in various ways: digitally, tangibly, psychologically, emotionally, by sound, and by movement. Hence the exhibit demonstrated that the students by this time had mastered a wide variety of interaction design skills. A majority of the installations utilised computers and programming in some shape or form.

In a work meeting prior to the exhibit, the students' computer literacy was demonstrated by their effortless use of personal laptops, digital cameras and mobile phones. During the meeting, the various equipment were used to support the design process, by providing tools for programming interactive responses to sensors for sound, drawing, collecting relevant information, communicating, budgeting, planning, coordinating and note- taking.

The professor responsible for the curriculum described the main challenges for the course as the problem of integrating three elements; 1) the projects, 2) the methods and skills that enables the students to complete the projects, and 3) the theory (philosophy) informing the projects. These three strands can be presented dependent or independent of each other through the course, and taught either separately or in the actual classroom situations where the need for different kinds of knowledge spontaneously arises. Where the professor responsible for the curriculum was concerned with the integration of the three strands, the professor in charge of most of the teaching was concerned with the question of teaching the methods and skills necessary to complete the projects. To him the problem was "how to teach them programming - without making it a programming course". This was done by assigning projects, and offering help and support when the students needed it. The design activity was kept in the foreground, with the programming featuring as a supportive tool. Interestingly, the teacher also commented that this way of teaching programming had worked well, as the social group dynamic when students were cooperating in the studio on various tasks, seemed to have speeded up the learning process.

The programming language chosen to support the various design activities for the interaction design students is Processing. The creators of Processing describe this programming language as: "[…] a programming language and environment for people who want to program images, animation, and sound. […] It is created to teach fundamentals of computer programming within a visual context and to serve as a software sketchbook and professional production tool." [19]. Processing is an open-source project. The professor puts great emphasis on the importance of mastering basic programming skills for interaction design students. To him this represents a sort of material knowledge essential to the design process, but he also acknowledges that this is a slightly controversial view at the school. Critics argue that focusing too much on programming can be potentially harmful, as the activity of computer programming promotes a structured logical way of thinking, which may perhaps undermine creativity.

The previous presentation of theories of the effects computers on professional work has shown that this conundrum of whether computerization qualitatively changes the activity is not unique to design activities, but rather a persistent question in all professions that have been computerized. Drawing on the cohesive relationships between subject, object and mediating tool, placed in a social, cultural and historical context, as described in Activity Theory, it becomes clear that the answer is not to be found in the technology itself, but rather in the ways and settings the technology is being put into practice.

One problem encountered by the class of interaction designers in the spring course "Things that Think", has been the different levels of programming skills between the students who learned Processing during the fall term, and the new students that joined the class in January 2005 without these skills. The professor has made adjustments to the assignments to accommodate the new students, but as the major assignment for the semester is approaching, the knowledge gap between the old and the new students seems to have led to a polarization of the group. The students skilled in programming appear reluctant to include the new students in their projects, perhaps as the perceived cost of cooperating with "programming-skills-deficient" co-students seem too high. This raises two questions of interest:

1) How important are programming skills for interaction design activities?

2) How can different competencies become an asset as opposed to a perceived cost in collaborative activities?

These two questions will guide my fieldwork for the remainder of this preliminary study, where I continue to follow the students' work on their major assignment from the early concept formations and project descriptions, through to the presentation and formal critique sessions at the end of term.

CONCLUDING REMARK

Studies of how industrial designers learn and develop knowledge, and the effect of computerisation of design, is still a relatively unexplored area of research. A better understanding of this can inform educational reforms within the field.

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REFERENCES

1. Clatworthy, Simon, Timo Arnall and Daniel Senn. Physical Computing. Interaction Design Module – AHO – March 2005. Oslo School of Architecture and Design, Course description.
2. Architecture, Urbanism and Landscape, Industrial Design in Oslo. Oslo School of Architecture and Design. Available at: http://www.aho.no/English/web_nyversjon.pdf
3. Bucciarelli, Louis L. Designing Engineers. Cambridge Massachusetts: The MIT Press, 1994.
4. Cole, Michael. Cultural Psychology. A once and future discipline. Cambridge, Massachusetts: The Belknap Press of Harvard University Press, 1996.
5. Billett, Stephen. 2001. Participation and continuity at work: A critique of current workplace learning discourses. Context, Power and perspective: Confronting the Challenges to Improving Attainment in Learning at Work. Joint Network/SKOPE/TLRP International workshop 8-10th November 2001, Sunley Management Centre, University College of Northampton. Available at: http://www.infed.org/archives/e-texts/billett_workplace_learning.
6. Kuutti, Kari. Activity Theory as a Potential Framework for Human-Computer Interaction Research. In: Context and Consciousness. Activity Theory and Human-Computer Interaction, redigert av Bonnie.A. Nardi. Cambridge, Massachusetts: The MIT Press, 1996.
7. Säljö, Roger. Lärande i praktiken. Ett sociokulturellt perspektiv. Stockholm: Bokförlaget Prisma, 2000.
8. Engeström, Yrjö. Expansive learning at work: toward an activity theoretical reconceptualization. Journal of Education and Work (2001), Vol. 14, No.1.
9. Dunne, Anthony. Hertzian Tales. Electronic Products, Aesthetic Experience and Critical Design. London: The Royal College of Art, 1999.
10. Ehn, Pelle. Manifesto for a Digital Bauhaus. Digital Creativity (1998), Vol. 9, No. 4
11. Ehn, Pelle. 2004. Project Atelier – Final report. Available at: http://www.disappearing-computer.net/projects/ATELIER.html
12. Binder, Thomas, Giorgio De Michelis, Michael Gervautz, Giulio Jacucci, Kresimir Matkovic, Thomas Psik, Ina Wagner. Supporting configurability in a mixed-media environment for design students. Personal and Ubiquitous Computing (2004), Volume 8 Issue 5
13. Braverman, Harry. Labour and monopoly capital: the degradation of work in the twentieth century. New York: Monthly Review Press, 1974.
14. Zuboff, Shoshana. In the age of the smart machine: the future of work and power. New York: Basic Books, 1988.
15. Lie, Merete. Real World, Screen World and Abstract Word: Computers at Work. In: The Spectre of Participation, Technology and Work in a Welfare State, edited by Knut Holtan Sørensen. Oslo: Scandinavian University Press, 1998.
16. Lahn, Leif. Tacit Knowledge and the Computerization of Professional Work. In: The Spectre of Participation, Technology and Work in a Welfare State, edited by Knut Holtan Sørensen. Oslo: Scandinavian University Press, 1998.
17. Grocott, Lisa Disseminating Design Research: the contribution of visual communication in capturing and translating design knowing. Future Ground Conference 2004
18. Gruson, Edith & Staal, Gert (editors). Copy U Proof. A New Method for Design Education. Breda: St.Joost Akademy, 2002.
19. http://processing.org/