Design Practice in Human Computer Interaction Design Education

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Abstract—**As the need for Human Computer Interaction (HCI) designers increases so does the need for courses that best prepare students for their future work life. Multidisciplinary teamwork is what very frequently meets the graduates in their new work situations. Preparing students for such multidisciplinary work through education is not easy to achieve. In this paper, we investigate ways to engage computer science students, majoring in design, use, and interaction (with technology), in design practices through an advanced graduate course in interaction design. Here, we take a closer look at how prior embodied and explicit knowledge of HCI that all of the students have, combined with understanding of design practice through the course, shape them as human-computer interaction designers. We evaluate the results of the effort in terms of increase in creativity, novelty of ideas, body language when engaged in design activities, and in terms of perceptions of how well this course prepared the students for the work practice outside of the university.**

Keywords—HCI education; interaction design; studio; design education; multidisciplinary teamwork.

I. INTRODUCTION

There is an increased movement towards informing and embedding education practices from other disciplines into Human Computer Interaction (HCI). This is especially true when it comes to design practice and design pedagogy [1].

Many authors have stressed a need for considering new pedagogical approaches to HCI education that creatively synthesize HCI theory and methods with design thinking-in-action (see, for example, [2]–[5]). Faiola has argued for development of pedagogical models intended for teaching HCI that *"provide students with knowledge domains that can account for understanding design, social context, and business strategies in addition to computing"*, [6, p. 30].

Winograd and Klemmer, discussing the reasoning behind opening the now famous d.school at Stanford, an innovation hub with a core in human computer interaction design, state: "*The basic premise of the d.school is that students need two complementary kinds of training. The disciplinary training provided by conventional departments provides them with depth in the concepts and experience of a specific field. This gives them intellectual tools, but often misses the larger context of relevance and integration with other kinds of knowledge, which are required to innovate effectively in the 'real world'*", [7, p. 1]. Such multidisciplinary and effective learning arenas are not easy to create. They represent innovative thinking and innovative education, which has not yet been able to prove itself worthy over time. Thus, embedding innovative educations into traditional educational institutions is difficult. However, the evidence is there that the multidisciplinary approach, such as d.school, has its merits. In line with how Bannon argues why HCI needs to change in the 21st century [8], we argue that the HCI educations needs to change in order to accommodate for new technologies, new interaction forms, new practices, and new areas of research. One practice outside the traditional HCI field, which has a strong influence on changes taking place within HCI, is the design practice. Many scholars have explored the relation between HCI and design. Some of the notable results of these explorations are: a proposition to consider HCI as research through design, see [9]–[14], a proposition to consider Human Computer Interaction Design (HCID) as a radically interdisciplinary dialogue [15], convergent - divergent questioning [16], models, theories and frameworks toward a multidisciplinary science [17].

Two of the authors, of this paper, work within department of informatics, teaching traditional HCI and qualitative research methods. The third author works at a traditional design institution, the school of architecture and design. Over the past few years, the two schools have cooperated and run a graduate course in interaction design together. The course took place at the school of architecture and students from both institutions worked on design projects in multidisciplinary teams. The cooperation came to an end this year, as the design school faculty felt that the differences in traditions and practices between the two schools were too far away from each other. This situation was the immediate motivator for exploring different venues and different approaches to teaching design practice and design thinking within the department of informatics.

In this paper, we present the teaching approach that we have chosen and the results of applying the design pedagogy in the context of an advanced HCID course in the department of informatics. Our goal was not to educate designers, but to teach HCI students about design practice through direct experience and reflection. Similar approaches have been advocated by other scholars, e.g., [3], [10], [18]. Our intention with the course was to prepare HCID students for better collaboration in multidisciplinary teams, to bridge some of the differences in the traditions, to learn, inspired

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by the d.school, about design thinking, design practice, and to understand a reflexive practice. In order to evaluate the success of our approach we have chosen the following criteria: emergence of creativity, novelty of generated ideas, body language when engaged in design activities and perception of how well the course prepared students for the work practice outside the university.

The paper is structured as follows: in Section II, we briefly describe the HCI pedagogical models that the students were familiar with, and then a design model used by the school of architecture to teach interaction design. We proceed to explaining, in Section III, our case, where the new pedagogical model was applied to teach a course in HCID. In Section IV, we discuss our findings, and sum up the paper in the concluding Section V.

II. PEDAGOGICAL MODELS: HCI AND DESIGN

A. HCI model

Many HCI pedagogical approaches include a mix of user-centered requirement analysis, design, implementation and evaluation [19]. This mix is exactly what our students have received through three HCI courses, which they had taken prior to the graduate class described here. Their first course covers material from the book [20]. In the second course, students gain theoretical and practical knowledge on how to study situated use of technology and how such studies can inform design of technology. Reimer and Douglas [21] point out that such study program often falls short of teaching students good design of real-world artifacts, while engaging in real-world design processes. In order to address the real-world settings, the third course in HCI, using [22] as a course book, defines projects based on the needs of local companies and organizations. All three HCI courses are project-based courses. However, they use a classical teaching model consisting of two hour-long lectures, in a lecture hall, and two hour-long sessions in smaller groups. The later provides help with exercises from the book, questions around the material covered during the lectures, or issues related to the project work. The third course in HCI also offers an hour-long design feedback session with the instructor and a representative of a company for which the students are designing. The projects are carried out in project teams of 3-4 students. Although the third HCI course addresses the issue of real-life problems, there is still a gap between multidisciplinary teamwork in professional circles and what students can experience in terms of teamwork in the context of this HCI course.

Another important aspect of learning, present in some design disciplines and often lacking within HCI, is related to approaches that emphasize speculative and inductive ethos. Lewis argues in [23] that technology education nowadays needs to promote more than simply knowledge of materials, mastery of special technical skills and techniques, or correct use of tools or instruments. It should move beyond these to pursue "more subjective and elusive goals", [23, p. 35]. Among these goals he includes creative insight. According to Lewis, the teaching of design is ideally suited to uncover students' creative potentials, because design allows open-endedness [23, p. 45]. Design problems are ill-structured, solutions are not defined in advance, and pathways to the solution are open. Cropley [24] identifies these issues as precisely the conditions that promote creativity. Creativity can be nurtured through a pedagogical framework that builds on open-ended problem solving, using design processes for real-life contexts [25].

While *"HCI specialists still focus on the issues that gave birth to the field: Are technologies learnable, usable, useful, reliable, comprehensible, ethical? We are still concerned with assessing whether technologies serve, engage, and satisfy people and extend their capabilities, or frustrate, thwart, and confound them"*, as the authors state in [26, p. 44], so does most of HCI education as well. In order to answer questions about users and technology, the focus is, naturally on users and what they do with the technology. The students of HCI are thus also trained in seeking the input from users, whether it is for research or design purposes. However, as Bødker [27] points out, the so-called third wave of HCI includes broader consideration of cultural and historical embeddedness of technology, also in non-work contexts, where emotion and aesthetics play a much larger role. The third wave of HCI has, therefore, comes closer to traditional design disciplines, not only through aesthetics, but also focus on solving real-life problems through design of technological solutions.

B. Design model

Hoadley and Cox state: *Design is an important class of human activity because it links theory and practice, bridging scientific activities with creative ones in order to deal with ill-structured, open-ended problems*, [28, p. 20]. To solve problems for real-life contexts, designing combines formal knowledge, experience, practice and judgment, both through and in action. Schön proposes an *"epistemology of practice implicit in the artistic, intuitive processes which some practitioners bring to situations of uncertainty, instability, uniqueness, and value conflict,"* that he characterized as "reflective practice" [29]. Design pedagogy can be understood through a socio-cultural perspective on learning that is centered on developmental aspects occurring between cultural and socially mediated actions in contemporary and legacy contexts [30].

Design studio learning and teaching relies on the integration between people. Schadewitz and Zamenopoulos say: *"The studio model has fostered the type of enculturation into practice that modern schemes for distributed situated learning are just coming to understand,"* [31, p. 1]. Shaffer [32] presents the academic design studio as a coherent system where surface structures, pedagogy, and epistemology interact to create a unique learning community. Surface structures refer to components of the learning environment such as the space, furniture, assignments and so forth. Pedagogical activities include activities such as iterative design cycles, field research, and group discussions of work in progress. Epistemological understanding describes the beliefs and the nature of design knowledge and how it is constructed [3]. Brandt and

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colleagues draw upon Lave and Wenger's concept [33] of "communities of practice" that describes learning communities where novices are first introduced as legitimate peripheral participants and integrated more centrally into the community through their participation in increasingly more complex tasks. Learning-in-practice is contextual and situated in time and space and is shaped by the historical dimensions of institutions and participants' own life experiences which contribute to shape the manner in which the learning environment is enacted. In this way, it is similar to an "ecological approach" to understanding learning in a more holistic way that brings together a focus on practice, tools, learning environments, and social context; see [3, p. 336]. The teaching rarely involves research articles, books to teach from, or regular formal lectures.

We are now in a position to present our case and describe challenges and lessons learned from introduction of design studio practices into teaching an advanced HCI class.

III. THE CASE: DESIGN PRACTICES IN HCI TEACHING

In implementing a design practice in the context of the class we chose to work in the lab, where it was possible to implement practice-based learning. The students had access to materials such as scissors, paint, fabric, paper, tools like sawing machine, hammers, pliers and like, as well as electronic components, such as Lilypads, GPS sensors, LED lights, wires, welding station, etc. The number of students was restricted to ten. They were all advanced graduate students with three prior courses in HCI, as described in the previous section, including experience with user-centered and participatory design approaches. The teaching team consisted of the two in-house teachers and one teacher from the school of architecture and design. The later attended the class approximately every third week, providing feedback on the students' design projects. The authors of this article are the three teachers who have an insatiable curiosity about creativity and how it emerges. Specifically, we are curious about what happens when HCI practitioners cannot rely on the usual ways of thinking and working – that is, when they do not have the support of users in the design process. It is commonly considered that HCI designers should design interactive products *"to support the way people communicate and interact in their everyday and working lives"*, [20, p. 9]. In order to design such products, HCI designers rely on user participation and user studies. These studies inform the design, but also split the responsibility for "good" design between designers and users who informed it. It could be said that users are a great support to HCI designers in, at least, the following ways: helping in testing products and prototypes, informing design processes, participating in them, allowing designers to observe them interacting with technology and last but not least, by making HCI designers feel that designs processes are not dependent on the mystery of creativity and creative processes.

Throughout the course, the in-house teachers have uploaded literature of relevance to a dropbox. This literature covered a range of different subject matters such as: design thinking, design anthropology, differences between interaction design practices within design and HCI, service design, participatory service design, design research, and an article concerning design of wearable technology. Some of the papers were chosen in response to students' project ideas and others aimed at explaining the differences between practices of Interaction Design (ID) and HCID.

Instead of having the traditional lectures, the model described earlier which the students are used to, the shared time between the teachers and the students was spend on discussing various topics, design ideas, and on providing feedback on designs in progress. Some, perhaps unusual forms of stimulating students to be more open and creative were used. For example, in order to increase the energy level and engagement, we would form a circle, and in turn, everyone had to "design" a move that the whole circle then repeated for a while, and then proceeded to another person (see Fig. 1). Other times, we encouraged new ways of exploring the world [34]. For example, we brought artists with interesting ideas and products into the classroom; see Fig. 2. Altering the 'lecture set-up' in this manner was a part of the pedagogical aim of introducing new ways of conducting HCI teaching, with intention to increase the D(esign). In doing this, we aimed at making the students step outside their comfort zone, as well as encourage bodily engagement and hands-on design practices.

Figure 1. Students and a faculty member standing in a circle and "creating" new body movements.

In order to further support the bodily engagement and hands on practices, the students were asked to complete two projects during the semester. The aim of the first project was to design an exhibit addressing the activities and research interest of the group for design. The exhibit was shown at a faire, (which is held annually at the department of informatics), presenting the work of different research groups. The faire also featured representatives from many local IT companies. The second project was to design an installation for the library. The interactive installation had as a goal to bring forward those resources and services, available through the department's library, which usually remain hidden or under-used.

During the first eleven weeks of the course, we carefully documented the students' work on their first design projects.

 ISBN: 978-1-61208-325-4

Figure 2. Amanda Steggell, an artist who made the energy bank, a charging station for mobile phones, showed her product (in the red square, [35]).

In documenting the process we took photographs and collected Post-it notes, which we used to quickly note input (aim, what, how, do-ability) during a feedback session. Further, we took notes during conversations with students, or when they presented their work. Additionally, we handed out briefs with targeted questions concerning creativity, work effort in class, expectancies of outcomes from the course, and addressed the issues around multidisciplinary work. These targeted questions were answered either orally or in writing.

Both in-house teachers and students have taken photographs, amounting to over 300 images, and have shared them in the aforementioned dropbox. The dropbox was made specifically for this class to share photos, presentations of the design projects, and other class related material, such as the literature. The photographs, used in this paper, are from the shared pool in the dropbox. From a teacher's perspective the photographs have been a way of documenting [36] the process from the first drafting of ideas to the materialization of the designs. In addition, the photographs have served as information, beyond mere documentation, and have been used as entrances to gain understandings about increase in creativity, novelty of ideas, and body language when students engaged in design activities; see Fig. 2 and Fig. 4 – Fig. 7.

IV. DISCUSSION

From our experience of cooperating with the school of architecture and design and projects based on multidisciplinary teamwork, we have learned that the building of "communities of practice" did not work for us. The HCID students were not considered to be "real" part of the design team, but rather programmers waiting around for the time to come when technology is embedded into the product, and thus, they were never really integrated into the community of practice. This is, in part, natural, as they never experienced studio work before and needed time to understand surface structures, pedagogical activities and epistemological beliefs. The HCID students' work was never publically criticized before, nor was it ever exhibited for others to see. In addition, they have little practice in speaking about their work. The experience with shifting from humbleness underway to pride in ownership of the work they did and the ideas that led to the final product, was also new.

In our case, as suggested in [3], the students could not be introduced as novices and gradually integrated more centrally into the community of design practice through their participation in increasingly more complex tasks. We had to find a way to bring them closer to understanding and experiencing of that practice on our own. The start of this process; see Fig. 3, was not easy. It was clear that the students used "re-cycled" ideas, and simply changed the domain to which they applied them. For example, finding the faces in places (finding things that resemble faces, Fig. 3 upper right corner) was suggested as an extra activity during the exhibit. Never mind the fact that none of us, faculty or students, could find faces in the building, making the task really hard and little fun as an activity on the day of the exhibit, the idea itself was not novel and neither was a way of using it [34].

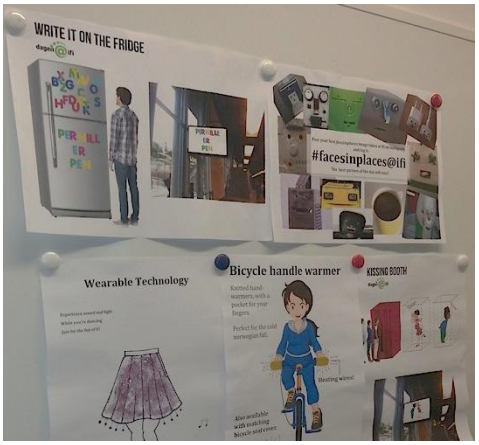

Figure 3. Among the initial ideas one can see recycled ones, such as the "faces in places", mixed in new ones, such as heated bicycle gloves for those who harsh nordic winters do not hinder from using the bike.

Figure 4. The body language of those present during the first feedback session shows little excitement or passion.

Students' (and faculty's, far right and far left on Fig. 4) body language also shows that there was little entusiasm for those ideas and concepts, most of which were based on pure entertainment.

 ISBN: 978-1-61208-325-4

Figure 5. The process of making things for the exhibit.

Critiques, especially in the beginning, were often taken personally. However, making things, such as the skirts or cushions for the "iConfession booth", slowly placed smiles on students faces; Fig. 5. It really helped to start unfolding some of internal processes leading to increased creativity and willingness to learn new skills or use the existing ones in order to further the processes that the group was engaged in. We have reported on the emergence of creativity in this context, and used assemblages of skills as a framework to analyze it [37].

Figure 6. The students working on the exhibit site, the exhibits representative of research on sustainable design, privacy and wearables.

After the first six weeks, there was a breakthrough. The first project was organized as exhibit consisting of three parts. The first part built on the idea of sustainability, producing the energy while biking, to power blinkers built into the glove, as well as to heat gloves, light up the wheels, etc. The presentations now included sketches, material choices, hand knitted gloves; see Fig.7.

Figure 7. Sketches of the prototype on the left, palette of material choices, as well as very handmade gloves, connected to a small dynamo.

The second part was related to design group's research projects regarding design for people with dementia. The skirt for dement ladies was the result, as as a counter-balance a "bliky" party skirt that lights up when the proximity sensor is activated; see Fig. 8 and [38], [39].

Figure 8. On the left, the skirt with a proximity sensor. Remaining images are of the skirt for dementia: comfort balls, the GPS and a QR code.

The third part was an iConfession booth, a tool for exploring the anonymity and willingness of people to disclose a secret; see Fig. 6 and [40], [41].

Finally, all three parts were put together; Fig. 6 and Fig. 9 show making of the exhibit and the final result, respectivelly.

The ideas implemented, although inspired by one thing or another, were novel. The audience received the exhibit very well, and students have expereinced the sense of pride and satisfaction with the result.

In order to get feedback directly from students around their perception of readiness to partake in multidisciplinary teams, we have designed a short questionnaire. Asked about the difference between the usual HCI classes and this one, they said: *The course focused more on design thinking, and to get a finished product to exhibit. It was less literature, testing, and report writing than other HCI courses.* All students expressed that they have better understanding of the design practice. In a short survey after the course we asked them if they thought that articles were helpful; half of the students answered that they thought so, while the other half thought that for this course the articles were not so important. When asked if they thought that design oriented practices (making things), have given them new skills, as HCID designers, six students agreed strongly, one did not reply and three were neutral. As for the perception of how well they are prepared after the course for work with

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designers, six students answered that they strongly feel that they are better positioned for such cooperation, and four did not have strong opinion about the issue, but were not negative.

Our understanding is that the experience they gained may help them discover who they are as HCID designers [42, 43], both by understanding the difference between the HCI practice and the design practice, and by direct experience of the design practice.

V. CONCLUSION AND FUTURE WORK

The lessons learned and discussed in this paper show that HCID students could adopt and understand design practices, in spite of a rather long experience and a strong sense of being rooted in the HCI tradition. The teachers, the students, and the audience at the exhibit have all been satisfied with the exhibit in terms of adequateness of concepts in relation to design task, prototypes developed and organization of those into an exhibit. The students' body language has changed from indifferent and closed to engaged and open. They all perceive this piece of learning to prepare them for the work as professional interaction designers better than the HCI courses alone could do. Thus, we conclude that this approach warrants further exploration. As future work, we would like to follow these students into their work life and see if this experience had an impact when working in teams with designers in real-life projects.

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Figure 9. The exhibit addresses sustainable design, anonymity and meaningful wearables. Students recruited participants for the part of the exhibit wearing Guy Fowler masks, a symbol of anonymity, as part of the exhibit activity.