Dealing with the human-centered approach within HCI projects

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Abstract

Our interactions with objects or/and systems through digital screens are constantly increasing. Industry and information technology have more and more ambition toward offering new functions and interactions through these computerized systems. At the same time as the complexity of these systems is escalating, the complexity in designing them also grows. While user-centered approaches and usability in the area of human-computer interfaces (HCI) have been thoroughly researched for more than a decade now, we still encounter regularly unsatisfying interfaces. It is generally recognized that the design of HCI within multidisciplinary teams brings better answers to users. However as design practitioners, we see the inadequacy when it comes to working with other disciplines, at the conceptual level, and in creating shared understanding and new knowledge regarding user-centeredness. The paper explains what factors contribute to user-centered design and how we can see the inadequacy within multidisciplinary teams. Aiming to create the conditions for knowledge sharing and emergence of innovative and sustainable solutions, we propose a model called environment for reflective collaboration that encourages interdisciplinary attitude and allows for achieving joint reflective practice. Both seem necessary for dealing with the complexity of HCI. In this model, design is used as a method to understand people. Applying this design process in the early stages of a project provides the needed structure for collaboration. We explain the model as used in a real project, and we explain how a project-grounded approach helped the team bridge theory and practice.

Keywords

User-centered design; HCI; Interdisciplinary; Project-grounded approach.

As users of a variety of digital devices, we are witnessing an ongoing development of human-computer interfaces (HCI). While digital technologies are transforming lives, each one of us can recall occasional dissatisfaction. User-centered approaches and usability have been thoroughly researched in the area of HCI. Also it is known that it is crucial to develop HCI within a multidisciplinary team (Dourish, 2004; Löwgren & Stolterman, 2004; Preece, Rogers, & Sharp, 2002). However as design practitioners, we encounter conflicting situations: within multidisciplinary teams, members have difficulty in agreeing on the needs and motivations of the user, on usability issues, and on creating shared understanding.

It is generally accepted that unsuccessful design is a direct result of an inadequate approach at the conceptual level, and in many cases, the inadequate approach is caused by problems of communication and understanding among team members (Carrara, Fioravanti, & Nanni, 2009; Kleinsmann, Valkenburg, & Buijs, 2007). In our practice, we have witnessed that HCI specialists (who, in many cases, are computer scientists) and designers have a different understanding about users' interests and needs as well as usability. We have also noticed that HCI specialists and other participants of these multidisciplinary teams are mainly concerned with their own expertise, making it very difficult to consider the end user.

In this context, how can we create the conditions for a variety of contributing experts to go beyond their individual knowledge, thereby enriching their reflections in order to efficiently collaborate within a human-centered design? The idea is that their enriched knowledge will then contribute to a more successful design, and to the development of the project in a timely and more economically efficient manner.

What contributes to user-centered design?

Early interfaces were technology-centered, made by engineers in order to be used by experts like themselves (Carroll, 2000; Linard, 2001). In the beginning, as the computer's time was more expensive than people's time, efforts were focused on making more efficient computers rather than making them more usable for users (Dourish, 2004). With early software interfaces, in the 1950s and 1960s, the communication with computers was by code, based on the mathematical model of computers (Boyarski & Buchanan, 1994). During the 1970s, communications were cognitively based, which means they were based on task requirements (Linard, 1998). It was only later, around 1983, when the Internet appeared that we started seeing interfaces based on users' needs, related to the context of use, and activity of the user as Mark Weiser mentioned in1988 (Weiser & Brown, 1996): "The important waves of technological change are those that fundamentally alter the place of technology in our lives. What matters is not technology itself, but its relationship to us". Yet human-computer interfaces are still mostly developed with a technology-centered approach (Carroll, 2000; Dourish, 2004; Linard, 2001).

With the development of information technology, an interest in the active user and in activity theory also grew. The designers of human computer interfaces (HCI) found themselves confronted with new demands of users, which were created by the evolution in Information Technology (IT), and by the lack of performance of the classic engineering-type interfaces (Linard, 1998; Norman, 1988; Winograd & Flores, 1986).

The fast development of information technology, along with users asking for an easier and more efficient interface, contributed to the creation of a new design domain called 'interactivity design', which is defined as "The shaping of use-oriented qualities of a digital artifact for one or more clients" (Löwgren & Stolterman, 2004). This new domain combined interests form many disciplines including business, technology and engineering, psychology, interaction, design, media and culture. It became clearer that interactivity design was about humans and the way humans understand information technology.

With the technological advancement of HCI, the disciplines of ergonomics and cognitive psychology became highly involved in studying users' needs and performance with the use of interface and interactive devices, which contributed to the move away from technology-centered design and to the shift to a focus on the human being. The following definition by Boyarski & Buchanon (2000) shows the focus on users: interactivity design is: "the synthesis of many traditional and new elements of design thinking, leading to products that provide intelligent and emotionally satisfying experiences serving a wide variety of human needs."

Inadequacies

With the growing number of non-specialist users of computers and interactive devices, around 1995, companies started to see the need to better understand users. They brought together project teams composed of a variety of people with different expertise. However, as Preece et al. (2002) mention, the communication and collaboration between the team is not easy. "The more people there are with different backgrounds in a design team, the more difficult it can be to communicate and progress forward the designs being generated." The reason seems to be that people from different backgrounds have different perspectives and different ways of talking about things; what is valued by one person maybe of no interest to another; the lack of a common language creates confusion and becomes the source of disinterest and dissatisfaction regarding the exchange of ideas. Communication and collaboration become almost impossible. This communication difficulty is similar to what we have experienced on many occasions throughout our practice.

To better serve users, a number of researchers have suggested new ways and techniques for a user-centered design. However, in our practice we have remarked that it is difficult to use those techniques thoroughly within a multidisciplinary team. The encountered difficulties are, in most cases, that team members fail to see the advantages of using such new ways and that they are not committed to user-centered approaches. In this situation, it seems essential that we need to create a situation where sharing knowledge among team members becomes natural and easy.

Aims

In HCI projects, to increase the efficiency of the user's experience, project members should consider the user in all phases of the design process, from the early stages of a project (Carroll, 2000). In addition, it is well accepted that the design of any interactive system is a multidisciplinary activity (Löwgren & Stolterman, 2004). We find essential to consider the following four factors: the uniqueness of each project, the continuous change of user needs, the rapid development of information technology, and that we are dealing with complex and messy situations. We believe that to design with usability and sustainability in mind, the multidisciplinary project team needs to, not only consider these four critical factors, but also understand the relationship between them.

An efficient communication seems to let us deal with these factors. However, searching for effective ways of communication between disciplines has been a concern for researchers, trying to find a new language that could go beyond the subjects of individual specialists: a language that could be understood by all would allow for the exchange of knowledge and design outside the boundaries of individual disciplines.

As a team, we need fluid communication between disciplines and exchange of knowledge, which means to move toward interdisciplinarity. According to Morin (1994), the interdisciplinary approach supports dialogue and the exchange of knowledge, analysis, and methods between two or more disciplines. It also implies interaction and a mutual enrichment between specialists. By agreeing on the needs and motivations of the user, by sharing knowledge and by constructing new knowledge, the team can become committed to each other and to interdisciplinarity.

Design activity in HCI

With a particular focus on the design of interactive devices, researchers in this field generally accept that 'design' is not something that can be narrowly defined. In that respect, of main concern to the HCI community is user-centeredness and the various approaches and techniques offered. Carroll (2000) recommends the scenario-based design method, which he defines as follows: "scenarios are concrete stories about use". Referring to Schön, he says, "scenarios evoke reflection-in-action".

From a cognitive point of view, Visser (2006) mentions that design, in the context of HCI, has specific characteristics that distinguish it from other cognitive activities. She explains that design takes different forms depending on its main purpose. For her, from the perspective of computer science and cognitive design research, design can be characterized as a problem solving activity with the following aspects: that design problems are ill-defined problems (or in Simon's terms, ill-structured); design problems are complex and cannot be decomposed into independent sub-problems; design problems have several acceptable solutions, which are more or less satisfying; analysis of the problem and elaboration of the solution are not two consecutive stages, rather they progress in parallel; for their activities, designers cannot rely on a pre-existing plan: they need to use opportunities related to different design situations; and, designers reuse knowledge from previous design projects.

Although the above list does not mention the multidisciplinary aspect of design activity and all issues related to collaboration leading to design solutions, the author also explains that design always requires the integration of information, knowledge and competencies from several domains.

The activity of design, as Boyarski (1998) brought up, is also practiced by other disciplines that include engineering, computer science, and information technology. In that respect, today partnering with these disciplines is common practice. However, communication between various disciplines is still problematic. The question remains how design activity can lead to a better exchange of information and construction of new knowledge for the project?

In project situations, although the team shares the overall objective, each team member has a particular goal towards which her/his effort and focus is directed. Team members' interests may even be in conflict in some situations. Nevertheless, when the issue is designing HCI, it is fundamental that all disciplines exercise and integrate a user-centered approach in every aspects of the project. This idea has been gaining acceptance by many researchers. User-centeredness cannot simply be a tag phrase used in a general sense in discussions; rather it must be applied to achieve specific concrete goals. Consequently, adherence and engagement of all team members

to the approach is needed. This means bringing team members together to work constructively and efficiently, with common understanding of goals. For Boyarski (1998), there is need for an 'interdisciplinary attitude', by which he means "integrating approaches from other disciplines, allowing 'multiple sighting' on a problem". This suggests that all team members should participate in the design and should think about collaboration and sharing knowledge as an important element for the development of new ideas, processes, and working relationships. It means that each team member could engage thoroughly in the project, to propose solutions which cross boundaries in such a way that others not only understand, but also to which they can adjust their own solutions accordingly.

Research methodology

The research has been developed in the context of a professional design project in order to understand what really happens during the process of collaboration. The focus of the research was on the design approach and on the interaction between experts and non-experts participating in the design of a website interface.

As designer-researcher, we wanted to know what discussions and activities were fruitful or fruitless; what approaches were acceptable by all and carried out successfully or unacceptable and abandoned; in meetings, what motivated the collaborators to participate fully and in a constructive way or what made them become passive; and, what tools were helpful for demonstrating and understanding the complexity of the project (including design process and collaboration). The design research method, 'Project-grounded research' (Findeli, 1998, 2004) was privileged for this study. This kind of research, first called 'Research through design' by Frayling (1993), is about developing knowledge and theory related to design activity by going through a real design project. It conciliates theory and practice. In other words, conducting research and constructing knowledge become part of the design project.

This approach allows the development of our project towards the two poles 'research through design' and 'design through research' as Jonas mentions (2006, 2007). In recent years, this type of research has become a method also privileged among some researchers in HCI (for example, for Zimmerman and Forlizzi 2008, Löwgren 2004, and Fallman 2008). Fallman (2008) also brings up the two concepts: 'research-oriented design' to describe the user-centered design approach generally applied in HCI practice, and the concept of 'design-oriented research' "where research is the area and design the means". In other words, by involving design activities in the research process, new knowledge is produced. Löwgren and Nagai (2008) talks about practice-based research and asks if we can construct knowledge about a phenomenon by designing for it. For Zimmerman and Forlizzi (2008), the research through design approach offers several benefits that compliment HCI research such as addressing wicked problems and allowing an "ongoing dialogue on what a preferred state should be".

This research approach can deal with 'wicked' problems (Rittel & Webber, 1973), contrary to techniques of science and engineering, which deal with 'tame' problems. Alexander, Simon, and other thinkers also pointed out this distinction between design and science as we can see in the following well known quotes: "Scientists try to identify the components of existing structures, designers try to shape the components of new structures." (Alexander, 1964) and "The natural sciences are concerned with how things are… design on the other hand is concerned with how things ought to be." (Simon, 1996).

It is common practice today to bring together a multidisciplinary team, in a virtual or face-to-face setting, for solving various parts of the problems related to a design project. However, team members often have difficulties with sharing knowledge. They each have their own knowledge, operating procedures, their own ways in which they communicate about the design, and how they make representations of their ideas (Klinsmann et al., 2007).

Design activity, therefore, should take into account all contributing disciplines but also all human factors related to cognition, social and cultural influences. As Boyarski mentioned, (1998) "without primary consideration for the people using the artifacts we design, and the context for their use, –in short, the entire experience of use– we relegate design to a marginal and self-serving activity." In HCI, this concern for the user is what distinguishes design disciplines from computer science and also from other 'problem owners' (for example, managers and clients).

Design model

Based on *interdisciplinary attitude* and *joint reflective practice* we introduced a design model (figure 1) geared to facilitate collaboration and knowledge sharing among team members of a complex project, while positioning the user at the center of the design process. The model, *environment for reflective collaboration*, allows for the construction of collective knowledge, which will be achieved by collaborative learning opportunities that combine theoretical and practical aspects.

a. the *interdisciplinary attitude* will allow openness to other perspectives and a willingness to share information. It means shared commitment, acceptance of approaches from other disciplines, and looking at the problem from various perspectives (Boyarski 1998). For us, the interdisciplinary attitude is the mind-set that encourages an informal teaching and learning dynamic. Once the information is contextualized (for the project at hand), it will be easier for all team members to understand diverse perspectives and to see the relevance of diverging viewpoints. To achieve good understanding as a team, the individual team members need to interact with others, and through a continuous process of learning each other's roles, responsibilities, priorities and practices, they will become aware of diverse aspects of the task (Gero & Kannengiesser, 2003). This process will encourage the team to adopt an attitude of critical thinking. As the team members become more familiar with the situation and with each other, interaction and collaboration become natural. We expect that through the commitment to an interdisciplinary attitude, the team will become more engaged in all aspects of the project.

b. through *joint reflective practice*, we bring together diverse knowledge and skills, allowing the team to notice interconnected problems, construct new knowledge, and to formulate the situation differently. HCI design situations are complex and problems are interconnected. The complexity is increasing continuously as we have to design for very diverse end-users of technology. So the design tasks require the confluence of a variety of expertise. As more people become involved in the design process, we also see more value conflicts. Schön (1983) emphasizes the "complexity, uncertainty, instability, uniqueness, and the value conflicts" of situations of professional practice and explains that these situations are not problems to be solved. They are problematic situations, which are uncertain and unclear, but they need to be understood. As reflective practice is associated with learning from experience, it will allow the team to change its perspective, gain new knowledge, and challenge the concepts and theories by which they make sense of knowledge. As a consequence of joint reflective practice, a project-specific team will bridge different understandings and through intense team interaction will produce new knowledge to deal with uncertainty.

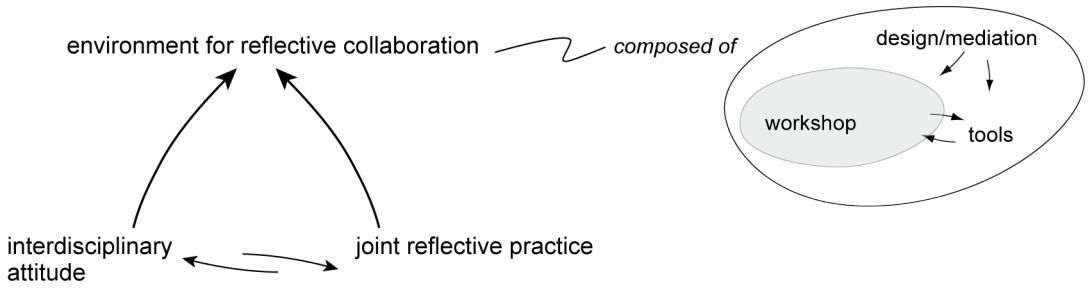

Figure 1: ERC, based on interdisciplinary attitude and joint reflective practice

Both the interdisciplinary and the reflective attitudes are essential for linking the knowledge of an individual team member to others in order to stimulate emergence of team expertise. We support this process with our proposed model *environment for reflective collaboration* (ERC). The model has the following objectives:

- to encourage contact between actors
- to incite knowledge sharing and develop a holistic vision
- to encourage critical thinking and direct feedback
- to reach consensus
- to make resources readily accessible to all at the opportune moment, and
- to advance the project in an efficient manner, on time, and while respecting the process

This model allows for collaborative learning opportunities that combine theoretical and practical aspects. It is composed of the following three elements:

- An intensive workshop to encourage joint reflective practice and collaboration, composed of a series of activities organized at the onset of the project
- Tools to support knowledge sharing and team performance (i.e. visual representation of processes, systems like wikis for contribution and access to information, etc.)
- Design as a method to facilitate collaboration and understanding between people

The workshop, the tools and the designer in the role of facilitator –to apply design as a method–, are strongly related.

The research was carried out through a real design project of a complex website for Princeton University. The design project became our field of research. This means that the theory was situated in the project and its implication on practice was directly observable. As we become more engaged with the project and the research, new questions emerged and modified the research throughout the project.

The client approached us to redesign a website. The existing one was designed a short time before this intervention, however it had technical flaws which seemed to be the single reason for the client's request to redesign. A careful analysis of the website made it clear that it was designed following the administrative structure of the institution and very elaborated visual elements were used to make the website attractive to users. Although most content was valid for reuse, the site had several shortcomings from a user point of view, including deficiencies for those who had to feed the site and keep it updated. These people, (who are another type of users), were not computer specialists. They were office staff members who had the responsibility of updating the site daily. They were also in direct contact with end users of the site and received regular feedback. A functional site was urgently needed to serve both groups, but very limited time was available for redesign and development of the website. However, the time constraint in this case was of help; the client accepted to make everyone involved in the project available for the redesign and the development of the site. The availability of these people for a set period of time was the needed condition for applying the mentioned design model through which, we aimed to translate disciplinary collaboration into new knowledge construction, useful for the purpose of the project.

A project team composed of eleven persons including office staff members, content experts, higher management, web programmers, and a designer was created. However, in most activities the workshop functioned with 6 or 7 team members. Based on the previous analysis of the project (i.e. through the design brief, meeting with project owners, research), its estimated complexity, and the knowledge about the team, the workshop was planned for 6 days.

The collaborative design process started with the intensive workshop. All project members were invited to engage in the predesigned activities in order to achieve the mentioned objectives.

We prepared a set of activities (e.g. creating personas, writing use scenarios) to support the collaboration during the workshop and planned to facilitate its progress. Visual representations of design and development process were shared with the team. Also the team developed a web-based system for gathering information about the project, which could be accessed when needed. As the main goal of the intensive design workshop was to redefine the information architecture of the site with a user-centered approach, it was clear that a common understanding of users' interests and needs was essential. The team participated in all activities and design activity became a method for better collaboration.

Discussion about the process helped the team to share information and develop a common understanding; it also helped them to realize the complexity of the project. The team worked together in redefining the objectives and priorities of the site and the methods to achieve them. They used their personas and use scenarios to structure the information architecture of the site, and to plan future steps. The team’s focus remained on the users as it can be seen in the following anecdote regarding personas: After brainstorming, 5 sets of characteristics were defined. The team created silhouette-shaped cardboards for each persona, marked their characteristics on the cardboards, added a face and gave a name to each of them. During most activities and discussions, the cardboard silhouettes were placed on the table as if they were also assisting the meetings. In a few occasions while the team was working on the information architecture of the

site, a team member (one of the office staff members) suddenly made comments on behalf of those personas and suggested a different solution.

We carried out the following roles: first as designer, we analyzed the project and designed, not the project, but the ERC (the workshop, the activities, the tools). Then as a mediator, we ran the workshop (created the activities and brought the team together to collaborate, made a synthesis of each step of collaboration, modified activities to fit the on-going project development, and supported the team to reach consensus). Finally, we worked on the actual project. Our research activity continued during the workshop: as designer-researcher we needed to learn from the situation in hand, to evaluate the actions and adjust new ones.

The principal expected results of the workshop were: better definition of the project where parameters and priorities were clarified, access to new knowledge, user-centeredness, and higher level of collaboration among the team. These elements led to a faster process for design and development and a more sustainable end-result focused on users.

Through the project-grounded research it became clear that the designer-researcher need to have an overall familiarity with the variety of disciplines involved in the project and be able to see the complexity of the situation rapidly. The research also showed how design could actively modify the project members' visions in order to promote the exchange of knowledge, while ensuring that the design activity remains concentrated on the user.

We noticed two main difficulties: 1. some specialized vocabularies, which were not understood by all team members, made participating in the discussion difficult. 2. some information and shared knowledge came at a wrong time, or with too much details when the team was not yet ready for it. Although later in the process the information was essential, at the time it created confusion and changed the focus of the collaboration. It became clear that because of the uniqueness of each project, adequate activities and tools needed to be designed for each situation. Examples of these tools are: visual representations of processes, systems for contribution and access to information (such as wikis), and tools for project coordinating (such as Basecamp), which give access to the on-going and growing knowledge of the project and which help its management.

Through this model, we sought to build the particular sense and the know-how for the project, to enrich and harmonize the understanding of the users' needs and motivations, and to create conditions for interdisciplinary exchange. We noticed that the dynamic and the productivity of the ERC depend not only on how the workshop plays out, but also upon the effectiveness of the designer/mediator to facilitate the events and to prepare and adjust the tools.

By achieving an interdisciplinary attitude along with a joint reflective practice, it became possible to encourage the design team, in the early stage of the project, to approach the design problem with a research stance, while keeping their focus on the end-users.

Conclusion

Applied to the mentioned project, the ERC model showed how the intensive collaboration of the team at the very early stage of the project, coupled with the mediation of the designer, directed the project toward a human centered design, reduced significantly the development time, and added value to the project by becoming a sustainable design.

We wish to turn back to the purpose of design research as explained earlier. The outcome of design research should satisfy the design research community, design practice community, and design education community. Clearly for each of these communities, the produced knowledge may have different value and relevance (Findeli, 2008). In other words, at this point, we are interested in the produced theoretical knowledge for the research, and the applicable knowledge for the practice.

The aim of the inquiry was to explore the design activity in the area of HCI and to develop a new methodological model intended to assist multidisciplinary teams designing thoroughly user-centered interfaces. This knowledge would be useful for a practitioners' community. It became clear that achieving this goal might only be possible by engaging all project team members in a joint reflective practice in the early phase of design. The joint reflective practice would lead to enhancing the shared understanding of the project, in clarifying the problematic, and in making the knowledge that is retained among stakeholders accessible to all. Finally, it stands to reason that

only by bringing different and controversial viewpoints together does the framing and resolution of such complex design problems become possible. This is to say, by creating an environment that empowers the team to adopt an interdisciplinary attitude, new ideas for solving problems emerge.

However the activities geared to support the interdisciplinary attitude, as well as the joint reflective practice, which are the foundations of our suggested model, need to be designed and facilitated. For us, the designer should ensure this facilitation for a number of reasons that are related to her/his expertise as a designer. These include, among others: she/he is trained to develop a holistic view of the situation despite it's wickedness and fuzziness, has skills to diagnose problem areas, can communicate visually, can rapidly develop mockups and prototypes that would be used as tools for helping teams exchange ideas, and (referring to Cross, 1993, 2001), has a 'designerly' way of thinking, knowing and acting (referring to the specific tacit know-how of a designer). The designer needs to be trained for this new role that we call designer-mediator. Therefore it becomes important to consider the outcomes of research in design education. Additional knowledge and a set of new skills will be required: for example, to enable the designer to organize and run the environment, to facilitate the interactions among the team, to facilitate the achievement of the needed attitude, to keep the team focused on the goals, to create a synergy, to mediate the informal situation of learning and teaching, and so on.

Our next step is to present the model to three practitioners for peer review and validation. We will create a short questionnaire to verify if they deal with similar frameworks. Then we will discuss the process in detail to see if the model fits in their practice and if so, what makes the model sustainable in their practice. As raised by Manzini (2008) the transition toward sustainability is by "a radical change in ways of being and doing."

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