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Understanding intuitive use of screen-based user interfaces in a skilled worker environment

Sturla Bakke
Westerdals – Oslo School of Art, Communication and Technology, Oslo, Norway

***Abstract*— In this paper, I discuss some aspects of the possible relationship between participatory design and its implications for the actual end state of the graphical user interface and its capacity for intuitive use. This paper discuss the relation between users' skills and an employed tool, and how we might support the notion of intuitive action through the user interface in a human-computer interaction context. This paper briefly investigate the possible connection between mutual learning in user/designer relationship, which is a central concept in participatory design and the extent to which the final version of a computer system supports intuitive flow in the interaction between user and tool. This paper suggests that a participatory design approach may have a positive impact on the perceived intuitive use of user interfaces, and that co-location may be a prerequisite for the sufficient exchange of information needed for mutual learning to occur.**

***Keywords*— intuitive use of user interfaces, participatory design, mutual learning, co-location.**

I. Introduction

This paper is primarily discussing some theoretical aspects of the relationship between participatory design (PD) and its implications for an actual end state of the graphical user interface and its capacity for intuitive use. The relation between users' skills and an employed tool, and how we might support the notion of immediacy in activity through the user interface are discussed. The paper briefly investigates the possible connection between reciprocal knowledge exchange in a user/designer relationship, which is a central concept in participatory design [1]. The interaction with the software employed, which is a planning software for the stowage of chemical tankers and done through a screen-based graphical user interface.

We discuss perceived intuitiveness in user interfaces in an activity theoretical approach, and whether a particular constellation of participatory design, namely co-location of users and designers, could have an impact on how the users end up perceiving the user interface. In this context, the research undertaken suggest that the continuous reciprocal knowledge exchange has led to a system that empowers the skilled workers and support their «flow» of a more or less unconscious work pattern.

In much of the literature that describe intuitive interfaces, the term is, linked to people's cognitive understanding in a setting of human-technology relations. Also, much of the literature that discusses the term do so from an approach comprising physicality, embodiment or tangible user interfaces while some researchers claim that intuition is a matter of experience [2-5].

Sturla Bakke
Westerdals – Oslo School of Art, Communication and Technology
Norway

Based on literature, and excerpts from empirical findings of a case study following the software development process of a stowage planning system for chemical tankers, the ORCA[1] project, this paper proposes that intuitiveness is emerging through activity, and that the knowledge distribution regarding this particular activity takes place during user participation in a setting where users and developers co-located on the users' premises.

The research aim is motivated by discussions of *intuition* in a graphical user-interface-context with an activity theoretical lens. In the case study I also wanted to explore the development work by practitioners from a participatory design angle, and discuss the connection between the experienced immediacy of a user interface and the level of user participation during the development process.

II. Literature and previous research in participatory design

Here I briefly present the terms of intuitiveness, affordances and mediation in the chosen literature on which the understanding of *immediacy* is based, in addition to some of the central literature on participatory design.

A. *Intuitiveness*

Norman links intuitiveness to the subconscious, as he, in his 'Subconscious and Conscious Systems of Cognition', relates what we regard as typical features of an intuitive approach to problem solving, e.g. speed, automation and multiple sources of knowledge, to the subconscious, while task solution, where actions are characterized by or based on reflection, emerges as sticky, rule-based and with few or limited knowledge sources [6]. Raskin, on the other hand, links our perception of intuitiveness to familiarity, and claims that it is the experience that leads to something being recognized as an opportunity to act, which is the basis for an intuitive approach to activity [5].

The scarcity of scientific literature on intuitiveness within the HCI field, might stem from the fact that it is either described as diverse or vague [7; 8] or something that, among regular humans outside the HCI community, is perceived as knowledge without a rationale, and almost like some kind of supernatural gut feeling, not entirely dissimilar to the the definitions found in ie. Merriam-Webster[2], where the meaning of the term intuition is described as:

- «a natural ability or power that makes it possible to know something without any proof or evidence
- a feeling that guides a person to act a certain way without fully understanding why

[1] Odfjell Resource Control Application
[2] http://www.merriam-webster.com/dictionary/intuition. Accessed: October 17, 2014.

- something that is known or understood without proof or evidence.»

The term *intuitive* is often used as a term of honour when talking about user-interfaces of either regular software, information systems, or even web-based systems that have some socio-technological connection or relevance, whether they are information systems or regular websites. There are, however, several contexts where the term *intuition* is being used, which renders it rather ambiguous, or even contradictory to how researchers in the field might define the term. We might consider definitions or descriptions where everyday usage could be, 'quick and easy insight' or 'immediate apprehension or cognition', or something that is perceived as almost supernatural, not very unlike the definitions found in the aforementioned Merriam-Webster,[3] but these are still rather vague descriptions. In daily speak, there is the notion of *intuition* as understanding without a rationale or previous knowledge. This is not a problem among ordinary people in their daily life; it is, though, rather useless for the part of the HCI community that works with the *making* of human-machine interaction.

beneficiary to our argument of task or activity based understanding of what constitutes intuitive use of user interface elements, if employed in this context. Therefore, I argue that their skill development matrix, in itself, can be made to use in describing the various degrees of intuitive use of user interfaces.

In more recent research on intuitive interaction related to user interface design, Blackler et al. [2] have stated that a familiarity with technology also includes a recognition of *similar* technology and claim that knowledge and experience gained by using other technology, will be the basis for intuitive interaction. Recognition or recollection, they argue, takes precedence over expertise. Their three principles of familiarity, in order for designers to develop user interfaces that are intuitive to use, are: use familiar symbols/words in expected positions for functions that are the same or similar features that the users already know. Secondly, metaphors for something that is already known should be linked to new functionality in the process of creating familiarity with something that is unknown. Also, knowledge and metaphorical content and meaning should be coherent in all

TABLE I. THE FIVE STAGES OF SKILL ACQUISITION FRAMEWORK BY DREYFUS AND DREYFUS [3].

Skill level	Components	Perspective	Decision	Commitment
1. Novice	Context-free	None	Analytical	Detached
2. Advanced beginner	Context-free and situational	None	Analytical	Detached
3. Competent	Context-free and situational	Chosen	Analytical	Detached under-standing and deciding. Involved in outcome
4. Proficient	Context-free and situational	Experienced	Analytical	Involved under-standing. Detached deciding
5. Expert	Context-free and situational	Experienced	Intuitive	Involved

According to Dreyfus and Dreyfus, the *novice* user is characterized by strictly following rules and regulations, with only a very limited situational perception and also lacking the ability to relate to situational adjustments. The *competent* user is capable of handling complexity and tension, and is also able to consider actions as part of or as suitable or appropriate within a larger conceptual context, while following a set of procedural standards or routines. The *expert* practitioner, on the other hand, does no longer rely on rules and guidelines, and maintains an intuitive approach to situated circumstances based on acquired skills and tacit knowledge, only employing an analytic approach in extraordinary or problematic situations. Intuitive skills are just accumulated knowledge.

It is, however, important to note that this framework was developed as a foundation to discuss the limits of artificial intelligence, and not as a general learning model per se. However, since this framework was based on "the dynamic processes of human skill acquisition" [3], it could prove

parts of an interface [2]. This is also mentioned in Israel et al., [7], who in addition to prior knowledge and subconscious action, emphasize mental efficiency by leaning on Mohs' discussion of mental focus on problem-solving. Here we can see how attention shifts from the 'interface' by non-intuitive use to be 'task oriented' by intuitive use (Mohs in [7].

Naumann et al. also focus on intuitive use rather than the UIs themselves should be intuitive [9]. In addition to discussing whether, or possibly how, intuitive use relates to the visual part of the user interface design, which is outside the scope of this paper, also intuitive use that is contextually related to tangible user interfaces is discussed.

B. *Affordances and mediation*

Gibson's original concept of affordances is mainly about framing the direct perception and action between animals and their environment. This perceived notion of action possibilities comprises three basic characteristics; an affordance relates to the capabilities of an actor but is *independent* of the actor's capacity for perceiving it,s i.e.

[3] http://www.merriam-webster.com/dictionary/intuition. Accessed: October 17, 2014.

experience and culture, and, finally, it does not evolve as means and objectives of the actor change. [10].

The concept of affordances was brought into the HCI discourse by Don Norman [11], who differs from Gibson in the definition of affordances; while Gibson describes affordances as independent of a user's capacity to utilize them, Norman speaks about the perceived and physical/real character of an affordance which relate to an actor's previous knowledge and experience [11]. Later, Norman clarified his ideas by being specific in his arguments on perceived affordances, distinguishing the real from the perceived ones, stating that, even if design is about both strands of affordances, it is the perceived affordances that determine the usability of a technical system [12].

The amount and level of usage that screen-based media have reached in current societal practice, where an increasing part of human activity, being either private, societal or as a part of ordinary work processes are conducted through screen-based media, shows that screen-based user-interface artifacts are being internalized and, will subsequently be regarded as 'real' tools for action. This is further developed by Gaver's notion of affordances encompassing screen elements in user interfaces, and can be placed within an activity theoretical approach as he sees affordances as «properties of the environment relevant for action systems». By exploring the Gibsonian bi-directional 'able-ness' [13], and original ideas of affordances for the design and assessment of user interfaces, Gaver defines affordances as:

«Affordances are properties of the world that are compatible with and relevant for people's interaction. When affordances are perceptible, they offer a link between perception and action; hidden and false affordances lead to mistakes» [14].

Gaver states «People perceive the environment directly in terms of its potentials for action, without significant intermediate stages involving memory or inferences. For instance, we perceive stairways in terms of their 'climbability'»[14]. This we can do because of the availability of attributes. In a user-interface context, this is transferable to UI-elements, like buttons, sliders, unequivocally designed hyperlinks and the like, where the potentiality for action is unambiguous.

In this paper, I describe mediated affordances in the user-interface that, in addition to facilitating actions, also clearly explain *how* the user-interface artifacts are to be used or operated. This resembles the notion of a per-element, user guide as an inherent part of the user-interface, and not solely as possibilities for action that lie in every object. Here, I concur with the "re-groundings" of Gibson's theories of affordances by Kaptelinin and Nardi [15; 16] which discusses three specific types of affordances, namely *effecter affordances*, *handling affordances* and *learning affordances*.

Kaptelinin and Nardi's concept of *handling affordances* and *effecter affordances*, [16] shows that functional user-interface artifacts ought to be regarded as more than just "symbolic communication", i.e. as *mediated affordances*. Mediated affordances are artifacts that afford, but not limited to, motivated [inter]action. According to Kaptelinin and Nardi's notion of *handling* affordances, they also encompass a how-to functionality, through mediated abstractions in a user-interface, following their concept of *learning affordances* [15], which creates a notion of immediate understanding in performing tasks through 'abstracted tools' in the user-interface.

The 'how-to' part is also appropriated by the activity theoretical approach stated by Nardi, Kaptelinin, Kuutti, and Bærentsen and Trettvik among others [15; 17; 18]

While Bærentsen and Trettvig [18] focus on a general activity theoretical approach to affordances, the approach of Nardi, Kaptelinin and Kuutti [15; 17; 19] is centered around the various diversities and incompatibilities regarding the use of the affordance concept within the HCI discourse. They do this by pinpointing the main limitation in Gibson's framework in a HCI-context, stating that «it lacks an appropriate conceptual apparatus for understanding technologies as a special type of objects, that is, tools mediating human interaction with the environment».

Discussing mediated affordances and mediated artifacts, it is also natural to mention Bolter and Grusin's discussion on remediation, which is situated in the discourse of converging hypermedia, where one medium might be represented by, or within, another [20]. This is in line with Bødker's description of the character of 'mediation by artifacts', where she argues that both the «instrumental and the communicative side» of human activities can be mediated by artifacts [21].

C. *Participatory Design*

Early Scandinavian Participatory Design research emphasized workplace democracy and the collective resource approach, where the employees should have a say and be allowed to participate in design decisions regarding computer use, decisions that influenced their own working situation [22]. The early participatory design projects emphasized active cooperation between users and developers, and user participation represents as such the inclusion of end-users into the design work in the development process of software systems facilitating mutual learning as a key aspect of a development processes.

Two ground-breaking Scandinavian participatory design projects were the Swedish UTOPIA-project, from 1981 to 1984, aimed at developing text and imaging software for the graphic industries, and the Norwegian Florence-project, from 1984 to 1987 was initially concerned with an increased influence on the workplace through rationalisation and automation, aimed at building software systems directed towards the daily work of nurses.

Short introduction to the Utopia-project:

"Utopia was a Scandinavian research project on trade union based design of, and training in, computer technology and work organization, especially text and image processing in the graphic industries. […] Graphic workers and computer and social scientists worked together in the UTOPIA project. Besides working directly in the project group, the Scandinavian graphic workers' union followed and supported the project through a reference group consisting of representatives from Sweden, Denmark, Finland and Norway, appointed by the Nordic Graphic Workers' Union (NGU)" [23].

Short introduction to the Florence-project:

«The aim of the Florence project was to build computer systems for nurses' daily work, based on their professional language and skills. Technological solutions should be tested in real work situations […] The project therefore took place in a hospital ward. To avoid the bias from one workplace two hospital wards were involved in the project.» [22; 24]

I will later draw some connections between these projects and to the case study from which I have excerpted examples in this paper, the ORCA-project.

III. Method

I have conducted a longitudinal study following the development and implementation phases of the ORCA project, ranging from late 2011, until summer 2013. The empirical material consists of observations of the cooperative process, i.e. the communication between the development team, project owners and participant super-users, in addition to interviews with members of the developer team, management, and super-users.

In this period, I have followed the system development process from the very beginning, following SCRUM teams, project management, and participant (super users) and regular users during this development period.

From this research the empirical material relevant to this paper consists of observation of the dynamics of SCRUM meetings, and semi-structured interviews (number of interviews in parenthesis) with project owner (3), management representative (2), head of developer team (2), main developer (1), liaison member of developer team (1) expert user(1), and super user (3). The interviews lasted about 45 -90 minutes.

IV. Empirical material

The ORCA software is a system for skilled workers. The primary managerial requirement, when all mandatory aspects of the software such as handling all rules, regulations, and other information related to the field were covered, was that the software should tend towards being self-explanatory. This means that an operator who knows how to stow a chemical tanker in real life should also be able to use the stowage system without extensive software training. It is in the organization's interest that this vocational competence can be used to understand the tool; that you have comprehensive control over the tool, and vice versa; that extensive software knowledge empowers the workers' vocational knowledge.

The stowage processes of chemical tankers are vocationally very specific. It is not something that people outside the business know much about. Therefore, the developers knew very little about the variety of tasks the system they were hired to develop had to resolve. This led to the choice of co-locating, and to a situation where the developers, during the development process, got to know the users exceptionally well, since they, during the development period were located in the same place. This gave them the freedom to talk continuously with the users and identify expertise as they needed. For the developers, this meant having immediate access to the users' vast body of expertise, including the immeasurable amount of experiential tacit knowledge. It also meant that they had to take into account strong opinions from experienced users on how to best do their work, and how *not* to do it, and what they need from a process supporting software.

The findings of the ORCA project shows a rather clear PD profile through a co-located, agile development process, where users and developers moved in together and undertook a continuous "conversation" about the conceptual framing of the software, and of functionality and user interaction. This is in line with Ehn's tool perspective, which is:

"the ideal of skilled workers and designers in cooperation designing computer artifacts as tools for skilled work […] The idea is that new tools should be designed as an extension of the traditional practical understanding of tools and materials used within a given craft or profession. As a conse-quence of this, design must be carried out by common efforts of skilled, experienced users and design professionals." [23]

The ORCA project also concurs with Greenbaum and Kyng's, argument of usefulness and product quality as the primary goal in PD projects, rather than workplace democracy [25].

[Project owner:] *"The intention with the use of the software is, if you know how to stow a chemical tanker, you should, intuitively, understand how the system works. If you do not know how to stow a chemical tanker, then you don't have the experiential knowledge of using the system. Experienced personnel should not need long training. The system should be intuitive. It's a bit like an experienced operator thinking «If I'm doing THIS, then THAT should happen», and then THAT will happen."*

In an interview with the main developer, regarding possible impact of sitting so close to the future users, he expressed a rather positive attitude, underscoring the convenience in being able to just walk into the room next door, to the users. With an expressed proximity like this, a developer can receive immediate answers on the questions he might have, without having to wait for any significant amount of time. In an interview with one of the developers, he said:

[Developer] *"If we had been sitting in a secluded room in the basement, the question is, how many times one had managed to muster enough energy to leave the desk and to go up four floors and down again, with some unfinished business. We would have ended up using the phone anyway, and then there's no point in sitting together, is there?"*

This kind of proximity made the software developing team being regarded as virtually colleagues, further facilitating user participation.

V. Discussion

It is tempting to look at the case study of this paper, the ORCA project, in connection with the two pivotal participatory design projects in early Scandinavian participatory design-research described in section 2C: the Norwegian Florence project, which ended with a system that was actually utilized, and the Swedish Utopia project which was prematurely ended. These research projects were firmly rooted in the Scandinavian workplace democracy tradition.

ORCA, on the other hand, is a system developed in a commercial context, but with a clear participatory design approach, with the belief that the users' knowledge and agency will improve the relation between computer system and work patterns, as this is described by Bjerknes and Bratteteig [22]. The concurrent belief regarding *this* project stems from a top-down, managerial notion that a good user-experience also could provide an increased ROI. From many researchers' point of view, the purpose of participatory design is to create tools that provide a greater autonomy in the workplace and give the users a sense of empowerment [1].

How could we understand a possible connection between mutual learning in user / designer relationship and the extent to which the final version of a computer system supports intuitive interaction between user and system?

According to Raskin, intuition is based on recognition, which in turn derives from the accumulated experience. For developers who are to design systems where the tacit knowledge of accumulated experience, in one way or another is be incorporated into systems where users who are otherwise familiar with their field of work should be able to preserve their sense of intuitive action in a normal working context, where the system is being used. According to Ehn, «The systems designer has to spend a lot of time trying to gain some insight into the specific labour process» [26]. This claim is unconsciously followed in the ORCA project, through the decision to co-locate.

A brief look into the term intuition.

'Intuitive use' is considered an attribute of human-machine interaction. When the use of technology in daily life is increasing significantly, we hear more and more that something is 'intuitive'. What does it really mean when something is described as intuitive?

Etymologically the term intuition stems from around mid-1400. In Harper Collins' English Dictionary it is stated that «from Late Latin, intuitiō a contemplation, from Latin intuērī to gaze upon, from tuērī to look at».[4]

Looking at the definition of intuition in Merriam-Webster mentioned in Section IIA, it is, perhaps no surprise that intuition is still a rather problematic term, not necessarily among the lay people that the HCI community calls the users, but within the scientific HCI community itself. This paper aims to address some problematic aspects of the term in what we may refer to as socio-technical development.

Activity centered intuitiveness

The very basic foundation for interaction is, besides having an idea of what to do, the activity itself. Leaning mainly on the *mediated action perspective* on affordances presented by Kaptelinin and Nardi, in their "re-grounding" of Gibson's concept, which states that "the most characteristic feature of human beings, differentiating them from other animals, is that their activities and minds are mediated by culturally developed tools, including technology." [15]. By supporting the presumption of varying degrees of an affordance [27], and adding this to the aspects of intuition defined by Dreyfus and Dreyfus [3] and later by Blackler et al. [28] and Hurtienne et al. [4], emerges a notion on intuitiveness as an activity-based value.

We might say that artefacts are mostly about affordances, and the affordances pointed to in this paper are all mediated. Focusing on the mediating technology part, I support the notion of affordances as giving meaning to the use of abstracted functional screen elements in the user-interface, and providing instructions for the possibilities for action, as well as being guides for specific actions also described by e.g. Gibson, Norman or Bødker among others [13; 29; 30].

As an artefact, a user interface can not really be intuitive in itself. As intuition, according to e.g. Raskin [5], is grounded in familiarity, and as such is leaning on the recollection of a user interface's intuitive potential might be revealed through *human activity*. By employing the user interface as a tool towards an abstracted, mediated, object, this leads us to discuss intuitiveness in the terms of *intuitive use*, rather than 'intuition' or something 'being intuitive'. Being utilized by a human, *the artifact*, depending on the ease of which it is being used by the human in question, and supporting a specific or related activity, might be regarded as intuitive *to use*. By looking back at, and concurring with, Blackler et al. and their claim of recognition or recollection taking precedence over expertise [2], we see that this corresponds to a context where the skill level is low, and where the dependence of artifacts and what they afford are equivalently high. Then, recognition and recollection will play a more significant role precisely because affordances in user interfaces contribute in making users familiar with screen elements. This particular familiarity will be perceived by the user as solving tasks in an intuitive way. While I agree that recognition and recollection take precedence over expertise in a low-skill setting, however, in a context of e.g. vocational use of specific software, which users use every day in their work, we will be able to see a slightly different picture. Here, expertise will be analogue to familiarity with process and task-flow. The discussion of transferring or expanding the familiarity-concept from being connected to artifacts to also encompassing the familiarity of a process, through skill acquisition, is however not within the scope of this paper.

Discussing intuitiveness in user interfaces, we do this in the sense of human activity through the utilization of functional artifacts in the user interface, and the task-based understanding of what they afford doing. The use of these elements becomes evident, or intuitive, through the required actions the human has to take, in order to accomplish a goal. I argue that intuitiveness is emerging through activity; and that this specifically activity-theoretical approach, to how humans relate to technology, namely the use of it, might be permitted a name of its own, other than the cognitively based intuition. I suggest *immediacy*, as the activity- and process-oriented approach to highly skilled and experienced human activity. This differs slightly from the notion of *transparent immediacy* we find in Bolter and Grusin, who discuss why and how interfaces become transparent, leading to a use-experience that is not mediated, but directly comprehensible, pointing towards natural user interfaces, and perhaps, even circumventing the need for affordances altogether. They situate the notion of transparent immediacy

4 intuition. Dictionary.com. Collins English Dictionary - Complete & Unabridged 10th Edition. HarperCollins Publishers. http://dictionary.reference.com/browse/intuition (accessed: October 17, 2014).

in the hyper-mediated context of remediation [31]. In one sense, however, understanding the character of remediation, by Bolter defined as «the representation of one medium in another» [32] might serve as an aid/tool for our comprehension and use, or utilization, of affordances that are mediated in a user interface.

Intuitive use of, not only software, but any human technology interaction, is the result of a goal-oriented activity and related to previous experience. Since Dreyfus & Dreyfus' framework was based on "the dynamic processes of human skill acquisition" [3], it could be beneficiary to our argument of task or activity based understanding of what constitutes intuitive use of user interface elements. Therefore, I argue that skill development matrix developed by Dreyfus and Dreyfus, in itself, can be made to use in describing the various degrees of intuitive use of user interfaces. Here, it would have been interesting to discuss the skill acquisition itself as a goal in an activity theoretical perspective, but it would, however, be outside the scope of this paper.

Intuitiveness through mediated activity => immediacy?

All human-computer interaction is based on exactly that: *interaction*. Basically, we might categorize this activity as humans hopefully accomplishing things with the help of technology, normally with some kind of computing power, in the form of regular computers, lap-tops and, increasingly, tablets and smart-phones. This means that the activity or action increasingly is done or abstracted through technology.

Dreyfus and Dreyfus [3] claim that an *intuitive understanding* must come from previous education and accumulated experience. Concurring with Dreyfus and Dreyfus and leaning on Raskin [5] and Mohs ([34] in [7]) I argue that an *immediate understanding* is primarily gained through familiarity with process, although affordances in the mediated artifact, even in a skilled worker environment, are not without significance.

The connection between '*intuitive'* and '*affordance*' that is central to the understanding of *user-interface immediacy* is presented by Bærentsen in his definition of an intuitive interface. His definition says that an intuitive interface could be defined as: *"immediately understandable to all users, without the need neither for special knowledge by the user nor for the initiation of special educational measures. Anybody can walk up to the system; see what kind of services it affords, and what should be done in order to operate it. While operating the device, navigation and manipulation of the system interface should proceed without the need for conscious awareness of the sensory- motor operational aspects of the interface."* [33].

It is in his acknowledgement of the definition's lack of achievability that Bærentsen states the necessity of supplying the definition with:"the availability of functions supporting learning of unknown functions and their operation, but in a way that is not perceived as "teaching" or "education". Learning must be a spontaneous product of the activity of use." [33].

Affordances are not physical objects but represent, through their visual character, instructions on how the objects of which they belong, are to be used? Again, a central aspect of user interface elements is use. If an affordance represents an instruction for use, it must also be an element in facilitating intuitive use of user interfaces. This must be situated in a goal directed, human activity centered, vocational context. This is in line with Bødker, who states, «The user interface cannot be seen independently of the goal or object, or of the other conditions of the use activity» [21]. This supports the argument of task or activity based understanding of what constitutes intuitive use of user interface elements.

Also, we might regard all interfaces, analogue and physical as well as digital, like a mediating tool through which people might perform work or communicative activity. A screen based user interface can, then, be regarded as a framework for mediation; a mediated whole, in which to situate functional elements and the adhering affordances that might linked to them in order to give the user the possibility, or sense, of immediate action pointing towards an activity theoretical approach to intuitiveness in user interfaces.

From a developer's point of view, the vocational knowledge, that the users have acquired in their work, and all the things that skilled workers do without thinking is transferred by participating users. This knowledge of skilled workers' intuitive activity might be transferred in a primarily participatory design-approach. Therefore, I argue that employing a participatory design approach to software development has a definite impact on the final interfaces - that could facilitate intuitive actions.

VI. Concluding remarks and limitations

In this paper, I have presented a primarily theoretical discussion on some aspects regarding the development and intuitive use of user interfaces, and the connection between a core principle of participatory design, namely mutual learning. I have described a specific instance of participatory design from the case of the ORCA-project, where the developers and the future users chose to *co-locate* on a permanent basis, and how this may have been a prerequisite for the exchange of information needed for mutual learning to occur in a project where intuitive use was explicitly articulated as the end state.

Also, in this paper, I have used 'mediated affordances' and 'mediated abstractions' as terms of user-interface artifacts, and that an activity-centered approach to intuitiveness in user interfaces and use of mediated affordances constitutes what we might coin as an *immediate* user-interface. Following Ehn's tool approach, we might conclude that without the participation of users and the *continuous conversation* with their requirements gained from being co-located, this understanding might not have been available to the developers.

A. *5.1 Limitations*

I acknowledge the fact that the field of understanding intuitive use in general and intuitive use of user interfaces specifically, is vast, as the field of participatory design itself is diverse. What I have presented here, then, is merely a glimpse into one possible junction where participatory design meets human-computer interaction.

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About Author :

Primary research interest: user interfaces in general, and specifically what makes human-computer interfaces *intuitive* to use.