Mediating between theory and practice: Activity theory concepts & tools for system design

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This paper discusses opportunities and tools for using activity theory (AT) to inform system design for CSCW based on my experience in collaborative system development. Two forms of mediating are reported: between the AT literature and the designers in terms of theory, and between the users and the designers in terms of system design. As a contribution to AT tools for design, three instruments are introduced, which formed part of our research methodology.

In what might be termed a paradigm shift, activity theory has become an accepted framework to analyse working practices and inform information technology design. The basic claims of the original theory (Leont'ev, 1978) that real-world activities rather than isolated actions or operations should be studied as the primary human condition, is now widely accepted. The theoretical framework has been further developed (Engeström & Middleton, 1996; Engeström, Miettinen, & Punamäki, 1999) and is applied to CSCW research (Bødker, 1991; Kuuti, 1996; Redmiles, 2002).

However, this trend is not undisputed and not easily understood by those who not already subscribe to AT. Explicit references to AT in systems design are still in the minority and faced with lack of understanding from the audience (Tuikka, 2002). Outside the CSCW community, "human factors" and the cognitive framework are still dominant. Both provide little conceptual basis for humans as active subjects in a social context, and their design guidelines aim to optimize ergonomic aspects but do not address organisational processes. In my experience the reasons why activity theory has not had more impact so far are twofold:

- Activity theory is a complex framework, which originated from Russian psychology and to most of us is only available in translations. It is based on a Marxist philosophical tradition and cultural-historical understanding of human society that not many scholars share in a world dominated by Anglo-American thinking.
- Although activity theory has contributed to a better understanding of collaborative practice it has often failed to provide a hands-on approach to be utilized for IT design.

This paper aims to contribute by an analysis of AT as a mediating framework between social science and design and by an overview of tools used to inform the design process in two examples.

Mediator for theoretical understanding

The first argument is that AT may help to understand work for design. Social scientists and system designers work in two epistemologically different worlds, and there is no direct relationship from observations and analysis of current practice and user comments to the conceptualisation and implementation of a new system. Work psychologists are traditionally equipped with empirical research methods and aware of the effects of technological change on motivation, skills and quality of working life. Typically they investigate where design went wrong after the event. Yet a proactive involvement of social science in the development of CSCW systems requires a language to discuss potential options and their potential effect, which both social scientists and system developers can meaningfully refer to. A true collaboration needs to take the form of a co-construction of terms and solutions (Wehner, Clases, & Bachmann, 2000). This requires an understanding of design on behalf of the social scientists, and of the user on behalf of the designers. AT provides a framework to for both purposes.

AT for understanding design

From my background as a work psychologist, I approached design as a goal-directed activity within employment structures and division of labour. Many aspects of designing fall into the remit of action regulation theory (Frese & Zapf, 1993; Hacker, 1998), a German modification of AT which combined Leont'ev's and Rubinstein's approaches with cognitive psychology. Action regulation theory assumes a hierarchical-sequential pattern of goal setting, action and evaluation. If the pattern is incomplete or interrupted, this will impact on both the quality of the result and the motivational value of the task. In recent years, work psychologists have began to realise that designing also is an iterative process and constant dialogue of the designer with the object. Yet system design is rarely a solitary activity. My investigations of the organisational context of design resulted in a model of designing as a goal-directed, reflexive activity within an activity system with professional and organisational rules, use of tools, division of labour and an internalised social context of a user/customer (Lauche, 2001).

AT for understanding users

AT can also help to conceptualise the system to be designed, which is then seen as a tool within the activity system of the user. AT then becomes a language to discuss system features and describe the impact upon the user. As a mediator between AT and design practice, I explained concepts such as internalisation – externalisation and collective objectification (Leont'ev, 1978) to the system designers who had no training in AT, philosophy or social science at the beginning of the project. Both projects aimed to design a planning tool with co-located multi-user interaction and intuitive interfaces. The BUILD-IT system

(Rauterberg et al., 1997) originated from an augmented reality board game It was inspired by the idea to overcome the gap between action and perception space inherent to any system that splits input and output devices. So the theoretical terms action and perception space formed part of the core design philosophy. BUILD-IT was further developed to manipulate virtual objects in a 3D plan by multiple physical bricks. The multiple bricks allowed for democratic participation of several users while still working on a collective objectification.

The second system called INNOPLAN (Kunz et al., 2001) was developed for electronic brainstorming and sketching in early stages of product innovation. Again several users can contribute to a collective objectification by externalising their own thoughts. The core design concept is based on the card technique from Metaplan facilitation. Several handheld devices allow for parallel input, which is integrated on a large interactive whiteboard.

The theoretical work became most fruitful during the writing of a paper (Fjeld et al., 2002), which gives an account of how the designers conceptualized their tool development in activity theory terms. The exercise of transferring the mental design processes into a collective objectification, the written text, stimulated and supported our common understanding of the project itself.

Tools for system design

Eliciting information about the user requirements and the context of the system to be designed is an important proactive contribution of social science and work psychology. The following section describes three research methods we developed and/or used during the two projects: VERA-KHR, analysis of artefacts and task analysis. All three instruments have been used reliably by different researches and contain procedural descriptions on how to apply them. However, they require some training, which should include an explanation of basic AT concepts.

The first one, **VERA-KHR** (Weber, 1997; Weber, Lauche, & Verbeck, 1999) is a technique for observations and structured interviews to determine the scope for collective action regulation: Which aspects of the purpose and management of a team can be determined by the members of a team and how far are they empowered to select and qualify their members. The empirical results from studies in production teams suggest that a higher level of collective action regulation leads to more shared responsibility and better results at group level.

The second instrument was directly derived from Leont'ev's concept of collective objectifications to analyse **artefacts** and their use in design teams (Verbeck & Lauche, 2001). We used it to classify knowledge stores, problem sketches, procedural documents, sources of reference and tools in terms of their formal features, individual function in the problem solving process, team function in generating shared understanding, and organisational function in terms of

knowledge management. It is mainly designed as an analytical tool to describe current organisational practice but was also used to indicate shortcoming in the feedback to companies.

The third type of instruments we successfully used to inform the practice of design with AT based understanding of working practice is **task analysis**. In distinction to the rather a-theoretical tradition of task analysis in Human Factors, action regulation theory has been instrumental in promoting instruments for human-centred task analysis and job design. Various instruments have been developed to assess if a job and its equipment is suitable for learning and development and to identify potential stressors (Dunckel, 1999). This is intended to provide a more sustainable basis for managing human resources rather than focussing on immediate maximisation of performance only. For the BUILD-IT system we devised a series of structured questions form several task analysis instruments on the design task and tools currently in use. In addition to that we asked for specific requirements for the BUILD-IT system. We visited potential users in the natural working environment, assessed artefacts and interviewed them about the context of their work. This resulted in a list of specifications for different tasks and expected commercial and individual benefits.

The challenge that remained as part of the collaborative nature of the project was how to communicate the results to the other team member and enable the system developers to share the same understanding of the context that the person who actually visited and interviewed the designer had gained. The most successful events were joined visits of social scientists and designers: The designers experienced the needs and constraints of the potential users first hand and were stimulated to ask further technical questions. The social scientists ensured consistency of the interview and raised questions of theoretical importance beyond the existing practice and preliminary system concept.

It still remains an open topic for discussion if the best approach to this kind of collaboration is to educate the designers on the theoretical background and tools or to maintain a mediator as a professional analyst of work practice for design.

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