

The concept of activity as a basic unit of analysis for CSCW research

Kari Kuutti

Department of Information Processing Science, University of Oulu,
Finland

Abstract

CSCW research has had problems in selecting the basic structural and functional unit for the analysis of work. For convenient location of the computer support, some meaningful intermediate whole should be defined between the individual and the organization. The concepts of 'team' and 'group' are intuitively understandable, but somewhat weak for serious analysis.

This paper suggests that the concept of 'activity' from Activity Theory could fill the gap, and compares the properties of the activity concept with the needs of CSCW research. A classification of work support types based on the concept of activity, is produced in order to demonstrate its potential usefulness.

1. Introduction

One of the most fundamental questions of research is the selection of the basic unit of analysis. One should be able to delineate the object of research and to draw a boundary between the object and the background, and one should be able to find an entity in which all the threads of research can be conveniently connected. In many cases this is really a trivial task and not worth mentioning, especially if we stay within a well-defined tradition, but in a new, emerging research area the definition of the "real" object of research may be a major challenge, a driving force behind the long development of the whole field (the history of science contains many examples of this kind). A new research field emerges because there exist phenomena which do not fit nicely within the existing frameworks and are difficult to comprehend within existing research traditions. Because the old frameworks are not adequate, new ones have to be established. Usually there are several different approaches to

grasping the "essence" of the field, however, and thus the early times may be quite confusing.

As a new research field, CSCW (Computer-Supported Cooperative Work) may be suffering just this kind of syndrome, for to legitimate its efforts an unique object should be delineated theoretically - and all the better if a corresponding entity could also be easily recognized in practice. This has not been an easy or trivial task, we do not yet have an adequate and universally accepted definition for the concept of "cooperative work", for example, although there certainly has been no lack of attempts to produce one.

This paper suggests that a lesser-known concept — that of activity — from a lesser-known research tradition — Activity Theory — might be useful for defining the basic research unit in the CSCW area. The paper is organized as follows: Section 2 contains a short overview of attempts to define the unit in recent CSCW research and some properties required of this unit, section 3 presents the concept of activity with some background regarding Activity Theory, and section 4 contains a comparison between the needs of research and the properties of the concept of activity. The usability of the concept of activity is demonstrated by producing a classification of work support types based on the structural properties of an activity.

2. Attempts to define the object of research in CSCW

Groupwork and teamwork

What is the 'cooperative work' which is to be supported by computers? The most common answer has been 'work of a group', e. g. "CSCW has emerged as an identifiable research field focused on the role of the computer in group work" (Greif 1988, p. 5), "One definition for it might be 'software for a group'. Another is 'computer-supported cooperative work.'" (Tazelaar 1988) or "CSCW looks at how groups work and seeks to discover how technology (especially computers) can help them work." (Ellis et al. 1991). Although this may intuitively sound acceptable, it is based on a naive view of groups: "In most cases the term 'group' is used in this connection without any clarification as if it had some clear, widely accepted meaning. Unfortunately, (...) this is not the case." (Lyytinen 1990, p. 6, footnote). Johansen (1988) uses instead of group the term 'business team', which is less ambiguous, and he even justifies it by referring to on-going development in business

work¹. He does not elaborate the concept towards a more analytical conceptual tool, however.

Other attempts

Besides these 'intuitive' efforts there have been some other attempts, mostly based on distinguishable external features of the work to be supported (e.g. Sørgaard 1987) or 'design metaphors' (like tool, shared material, communication medium etc.). The difficulties in defining the term "CSCW" or the corresponding research field have been notified by many recent authors, however, e. g. Bannon et al (1988), Bannon & Schmidt (1991), Lyytinen (1990) and Suchman (1989). The term has been found to be vague, redundant or undifferentiable from traditional systems, even erroneous. On the other hand, some onerous attempts to overcome these defences, e. g. Sørgaard (1987), have been evaluated as too restrictive e.g. by Bannon et al. (1987) and Lyytinen (1990).

Sørgaard's work is worth a closer examination, because the author — inspired by a perspective of greater democracy in working life — really takes pains to delineate a special kind of work in terms of the nature of the task. Sørgaard suggests that CSCW has the following attributes: it has a shared goal, it is non-competitive, it is not hierarchically organized and it is relatively autonomous. Despite his effort, the result remains somewhat elusive: "Pure cooperative work is hard to find. Cooperative work can be an aspect in many organizations ... " (Sørgaard 1987, p.721).

Bannon & Schmidt (1991) make a radical departure from the use of the external features of cooperative work or design metaphors as starting points for a definition. They presents their view briefly as follows: "Cooperative work is constituted by *work processes that are related as to content*, that is, processes pertaining to the production of a particular product or service". (pp. 5-6).

Lyytinen (1990) uses structuration theory as developed by Giddens to analyze work and the role of CSCW applications. This apparently gives a firm foothold and the paper is rich in interesting avenues for further exploration. According to Lyytinen, structuration theory sees the work process as a social structure, con-

¹ I agree with Johansen that there is a change going on in work organization and new, formerly exceptional work organization forms are now becoming more and more common. I have also suggested, in Kuutti 1989, that the rise of CSCW may be connected with this development. The elaboration of this theme is beyond the scope of the present paper, however.

structured continuously by 'human agents' and possessing a detailed internal structure. He puts special emphasis on the formation of social structures in interactions and thus on the role of CSCW applications both as a medium and an outcome in the formation of the work process. Lyytinen's definition of 'cooperative work' comes close to that of Bannon and Schmidt presented above.

Suchman (1989, 1991) suggests that use of the term CSCW implies more a shift in the perspective adopted by designers than actual change in technology, and emphasises a couple of fundamental aspects of work: that practice is always fundamentally social and that it is always mediated by artifacts.

Tentative synthesis

Would it be possible to find a 'lowest common denominator' for different definitions expressed above and still maintain an acceptable delineation of the research field? If we define CSCW as *work by multiple active subjects sharing a common object and supported by information technology*, we can obviously cover a great part of recent research and still be able to draw acceptably clear boundaries around the object of it.

The key element is naturally the definition of 'active subjects' or 'human agency' in Giddens' terminology: "Agency refers to the human being's capability for doing things and to the volitional character of his action, i.e. that any individual could act differently at any phase in a given sequence of conduct" (Lyytinen 1990, p. 10). This existence of active subjects gives us a means for delineating CSCW from "traditional information systems", where predetermination of work sequences by the system is the normal case. On the other hand, a common *object of work* is clearly different from a shared goal (criticized as being too restrictive) or shared material (criticized as being too loose). Negotiators may have opposite goals, but they have a common object, a problem space. Database users may share material, but the objects of their work need not have anything common. Also, a community which shares a common object of work can always be delineated in practice, whatever the contributions of the different participants may be.

Besides the basic definition, there are additional needs expressed by different researchers which should be fulfilled by the basic unit of CSCW research. Bannon & Schmidt (1991), Lyytinen (1990) and Suchman (1989, 1991) all agree that: 1) Work is mediated by artifacts and the basic unit should have this aspect too. 2) The unit should allow considerations of socially constructed meanings and cultural

aspects of a work situation. 3) Work and the means for it are continuously reconstructed, and thus the unit should be suitable for studying transformation and development.

A couple of other basic needs could also be emphasized: 4) To assist accurate analysis, the unit should have a detailed internal structure (Lyytinen 1990). 5) It should also be possible to consider topics of control and conflicts within the unit (Kling 1991).

What kind of concept could fulfil all these different needs? There is a school of social thinking, Activity Theory, whose basic concept of *activity* seems to suit this purpose quite well. It will be explored in more detail in the next section.

3. Activity Theory and the concept of activity

Background

Activity Theory may be the only school of social thinking which has originated in the Soviet Union and has been able to gain a foothold in the western world, too. The theory has three main historical sources. One is the 18th and 19th century classical German philosophy from Kant to Hegel, in which the concept of activity was first introduced, another consists of the writings of Marx and Engels, who also elaborated the concept of activity further, and the third source is the Soviet cultural-historical school of psychology, founded by Vygotski, Leontjev and Lurija. Although the concept of activity as a scientific tool was first formulated within Soviet psychology, it has gained users all over the world, and it has been found useful and adaptable for the analysis of other disciplines such as education, the social sciences, cultural research, anthropology, work science etc. The activity theory "school" has just become organized, the First International Congress on Activity Theory having been held in Berlin in 1986, and the Second Congress in Lahti, Finland in 1990. From 1988 on there has also existed a journal - the Multidisciplinary Newsletter for Activity Theory.

Broadly defined, Activity Theory is a philosophical framework for studying different forms of human praxis as developmental processes, with both individual and social levels interlinked. Although the framework is still more an agenda for a research programme than a 'complete' theory, the conceptual tools developed thus far have promising qualities. Three of the key ideas of Activity Theory can be high-

lighted here: activities as basic units of analysis, the historical development of activities and internal mediation within activities.

Activities as basic units of analysis.

The behavioural and social sciences have always suffered from a dichotomy between the individual and the social. If one uses a social system as a unit of analysis, there are problems in maintaining human agency. If one studies individual actions, there are problems in maintaining contextuality. Social systems in general are too big and messy to be used as contexts, but actions without context are often meaningless. On the other hand, arbitrarily selected contexts (like those in many lab studies) do not help much in theory building.

The solution offered by Activity Theory is that there is a need for an intermediate concept — a minimal meaningful context for individual actions — which must form the basic unit of analysis. This unit — better defined and more stable than just an arbitrarily selected context, but also more manageable than a social system — is called an activity. Because the context is included in the unit of analysis, the object of our research is always essentially collective, even if our main interest lies in individual actions. The concept of activity is elaborated further in the next section.

History and development.

Activity Theory claims that activities cannot be really understood without seriously analyzing the historical development which has led to their present state. The activities themselves and their elements are under continuous development, and this development is not linear or straightforward but uneven and discontinuous. Because of the unevenness of the development process, different contradictions will emerge between the elements of an activity and between different activities in systems of activities, and the resolving of these contradictions is a major developmental task. The different forces and contradictions can be uncovered only through a historical analysis, and without a knowledge of these there can be only blind attempts to guide the development.

Mediation.

A key concept is that the relations within an activity are not direct ones, but they are mediated by different artifacts, e. g. instruments, signs, procedures, machines,

methods, laws, work organization forms, accepted practices etc. These artifacts have been created and transformed by people during the development of the activity itself and carry with them a particular culture — historical remnants of that development. Therefore artifacts actually are not "given" and they should be never treated as such. "The idea is that humans can control their own behaviour — not "from the inside", on the basis of biological urges, but "from the outside", using and creating artifacts. This perspective is not only optimistic concerning human self-determination, it is an invitation to make a serious study of artifacts as integral and inseparable components of human functioning." (Engeström 1990a, p. 12.).

The concept of activity

The following contains a short description of some of the properties of the concept of activity. Because of the scope of the theory and the space limitations of this paper, the description is a somewhat superficial one and some topics are just mentioned².

As noted earlier, the basic idea is that there exists a "fundamental type" of context, which is called an activity. It is meaningless to study essentially human qualities using a smaller object of research, because without that basic context one cannot grasp the essence of the phenomenon.

The activities in which humans participate are the basic units of development and human life, and thus form a foundation of the study of all contextuality. Activities — an individual can participate in several at the same time — have the following properties:

- an activity has *a material object*³ and activities can be distinguished according to their objects. The transformation of the object towards some desired state or in some direction motivates the existence of an activity.
- an activity is a *collective phenomenon*.

² For those with a deeper interest, (Kuutti, in press) contains a more comprehensive introduction to Activity Theory (AT) and also relevant bibliographical references. (Bødker, in press) in the same volume considers AT from a more practical (Information Systems) viewpoint. (Engeström 1990b) studies the use of AT in different empirical research settings.

³ The term 'material' must be understood as in Marxist philosophy, for it has a different meaning in Marxism from that used in everyday language. It does not mean only touchable "things", but everything objective which exists independent of individual consciousness. Thus the Marxist definition also covers processes, relations, shared concepts, meanings etc. and is far broader than the everyday use of the term.

- an activity has an active *subject*, who understands the motive of the activity. This subject can be individual or collective. Not all participants involved in an activity necessarily understand the motive of the activity in which they are participating or even recognize the existence of it. In this case they are not active subjects of the activity.
- an activity exists in a *material environment* and *transforms it*.
- an activity is a *historically developing* phenomenon.
- *contradictions* are the force behind the development of an activity.
- an activity is realized through conscious and purposeful *actions* by participants.
- the relationships within an activity are *culturally mediated*.

Y. Engeström (1987) has made an attempt to establish a simple structural model of the concept of activity and culturally mediated relationships within it.

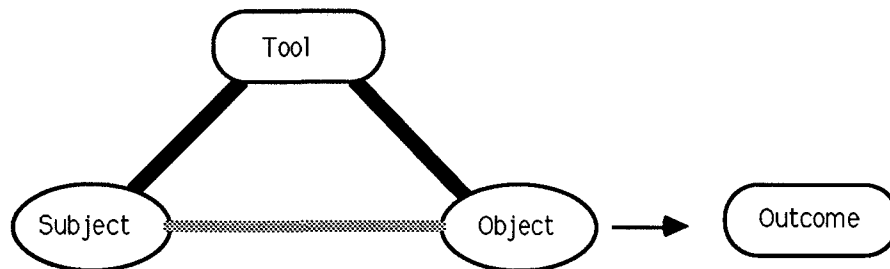


Figure 1: Structure of an individual, mediated action

Cultural mediation is dealt with in Engeström's model by replacing binary relationships with mediated relationships. This is carried out by introducing a third, intermediate term which carries with it the cultural heritage of the situation. Thus the central relationship — that between the *subject* and the *object* of an activity — is mediated by a *tool* into which the historical development of the relationship between subject and object thus far is condensed. This simple structure is not adequate to fulfil the needs of a consideration of the systemic relations between an individual and his environment, however, and thus Engeström adds a third main component, namely *community* (those who share the same object of activity). Thus two new relationships are formed: subject-community and community-object. Both of them need also a mediating member and thus we have the following structure (Figure 2):

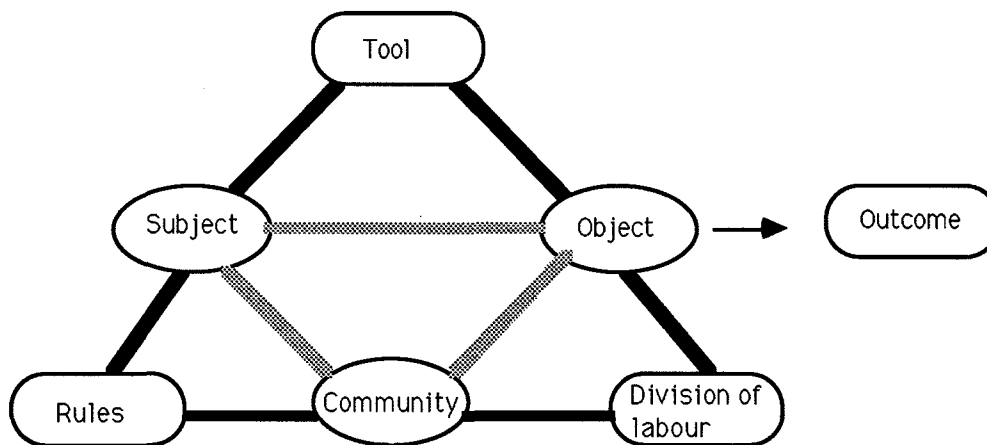


Figure 2: Basic structure of an activity

This systemic model — which according to Engeström is the simplest possible in terms of a unit of analysis— contains three mutual relationships between subject, object and community. The relationship between subject and object is mediated by tools, that between subject and community is mediated by *rules* and that between object and community is mediated by the *division of labour*. Each of the mediating terms is historically formed and open to further development. In fact, the corresponding mediating members are continuously being reconstructed during the existence of an activity. This development is not a smooth, and linear one, however, but uneven and discontinuous, driven by various contradictions.

People generally participate several parallel activities in their work, home and social life. An IS development project for a departmental application, for example, can obviously be described as an activity. It has a collective subject — the development group — which uses a development methodology as a tool in order to transform an object — the working practice to be improved. There is a community which shares the object: at least the manager of the department and those workers whose work will be affected, and there is a set of explicit and implicit rules controlling the relationship between the subject and the community: administrative procedures, accepted work practices, union regulations etc. There is also a certain division of labour in transforming the object: what the development group is expected to do, what is the role of departmental manager, the role of the workers etc.

At the same time there is another activity, in which the subject is the leader of the development project, his or her tools are project management tools and the object is the successful completion of the development project itself. The community consists of the members of the project group. Again, there is a certain — but different — set of rules and division of labour.

We can imagine a third connected activity, where the subject is the departmental manager, who is using the whole project as a tool to alter the power structure of the organization for his or her own benefit. The community is the set of his or her peer managers and upper administration, and again a body of rules and a division of labour can be found.

Thus real life situations always feature an interconnected web of activities which can be distinguished by their objects. Participation in these interconnected activities, having very different motives, can cause tensions and distortions (e. g. the position of the departmental manager in the example).

Besides this overall 'external' structure, activities also have a hierarchical inner structure. Activities consist of *actions* or chains of actions, which in turn consist of *operations*. This hierarchical structure has been found useful for analyzing the relationship between a person and a computer system at the human-computer interaction level (Bødker 1989), but it is not elaborated any further here.

One very important feature is that activities have a double nature. There is both an external and an internal "side" to every activity. The subject and the object of an activity are in a reciprocal relationship with each other. On the one hand, the subject is transforming the object — and on the other hand, the properties of the object penetrate into the subject and transform him or her. A person's internal activity assimilates the experience of society in the form in which it manifests itself in the corresponding external activity. Thus Activity Theory rejects the notion of static mental models and assumes that cognition is a situated process. The internal side of an activity is again not elaborated any further here.

This rough outline of the structure of an activity will be examined against the needs of CSCW research in the next section .

4. The potential of the concept of activity in CSCW research

The concept of activity as a basic unit of analysis

It is easy to see that the concept of work activity fits exactly with the tentative definition of the basic unit of work to be supported. The concept allows analysis to span from the individual to the organization-wide level and even broader, but it is far more flexible than the concept of formal organization. On the one hand, it is possible to study formal organizational units as activities – to the extent that a community of active subjects sharing the same object can be found. In most traditional, hierarchical organizations the formal borders of the organization do not necessarily fit nicely together with the activities, because often only the managers of the organizational units are 'active subjects', who use their units as tools in striving after their goals. Thus the activities found at the traditional organization level are mostly only managerial ones, and other people are treated as wheels in the organizational machinery, invisible in activity analysis. On the other hand, the concept of activity makes it easy to cross any departmental, organizational or geographical border – only inclusion among the active subjects sharing a object is relevant.

How well does the concept of work activity suit the other needs of CSCW research in analyzing given work settings? Let us compare it with the needs listed in section 2.

1) Mediation of work by artifacts is a fundamental feature of work activities. The concept of a mediating artifact – tool or instrument – is rich and also covers signs, symbols, models, theories etc.

2) Regarding the existence of socially constructed meanings and cultural aspects, there is an elaborate mechanism for how cultural features are brought into every activity by the corresponding artifacts. Apart from the tool/instrument/sign artifact immediately used in transforming the work object, there are two other groups of socially constructed artifacts, namely rules and division of labour.

3) Work reconstruction, transformation and development. From its very beginning, Activity Theory — and thus also the concept of activity — has been developed in order to study developmental processes. The reconstruction of the various artifacts is a basic feature in activities, and there is an elaborate mechanism for modelling the dynamics of this development.

4) The concept of work activity has a rich internal structure, of which only a part is described here. This should help in structurizing the work settings to be studied.

5) The ability to deal with issues of control and conflict. The concept of activity contains two different channels of control: hierarchical power structures embedded in the division of labour, and control through norms and values embedded in rules. There is also a mechanism to deal with conflicts: the developmental dynamics of activities are based on the emergence and solving of contradictions, and conflicts are regarded as surface symptoms of contradictions.

Although the present analysis has been superficial, the concept of activity is evidently a promising framework. If it is used as a basic unit of work analysis it may help us to include certain actual research needs and to find a more coherent perspective. The overall structure of an activity is used in the next section to classify different computer support types for work.

A typology of work support

Research into computer support types for CSCW has been limited, with the most common approach being simply the use of popular metaphors such as "tool", "medium" or "shared material". A "panopticon" – an instrument for increased social control (Bannon et al 1988) and a "shared knowledge or memory" (Bannon & Schmidt 1991) have also been mentioned. It is clearly difficult to locate the support and to produce good analytical descriptions of the relationship between work and information technology – although CSCW research is not alone in suffering from this inability. I have suggested elsewhere (Kuutti, in press) that one reason for this – using the Activity Theory terminology – is that information technology penetrates into every part of the structure of a work activity and changes them all. Thus the "support" is in fact inseparable from the corresponding parts.

The structure of the activity concept is used in the following to generate a classification of basic work support types in information technology (Figure 4). The classification is not specially aimed at CSCW applications, but is a broader analytical tool also suitable for studying personal computing applications and traditional information systems. In practice, applications usually cover several types. The classification of the columns is based on the main structural parts of an activity. The internal activity of the subject is (somewhat crudely) condensed here under the title 'thinking'. The rows are based on the different roles a person can have in an activ-

ity: a passive participant – not an active subject but 'a wheel in the organizational machine', an active subject working within a 'given' activity and, finally, an active developer of an activity.

		<i>Area of support</i>					
		Instrument	Rules	Division of labour	Subject, 'thinking'	Object	Community
Role of a person in an activity	Passive	Routine automation	Control	Fixed	Triggering of a pre-determined action	Data	Separating, hiding visibility
	Active	Tool	Shared meanings	Coordination	Searching information	Shared material	Visible network
	Expansive	Automation or tool construction	Rule construction, negotiation	Organizing work	Learning, comprehending	Object construction	Community construction

Figure 4. A classification of basic types of work support.

As stated above, the design and implementation of any system causes changes in all the columns — and depending on application the changes may span several of the rows, too. These changes can be either intentional or accidental. It is obvious, that the first row describes the 'support' – more a replacement – given by traditional information systems, and it is best suited to Tayloristic work settings. We can claim that to some extent there already exists a partial mastery of the changes at that level – we can design and implement systems for Tayloristic work with some success (from the managerial viewpoint, at least), and with the advent of socio-technical design the designing community is learning some tricks for avoiding the worst accidents.

The second row describes the area of recent CSCW discussions - the support of active subjects working with a common object. There the degree of mastery is considerable less, and we merely know something about how to design tools for individual use. The systems designed to support some particular aspect of a work activity cause accidental changes in other aspects, too, as has already been recognized by researchers such as Grudin (1988) and Howard (1987).

The third row describes a new approach which has been emerging within the CSCW research - researchers who have become aware that the ultimate computer support for work is reconstruction of the work by creating computer artifacts for the work by workers themselves. The achievement of this will generate even bigger challenges than simply the support of active subjects. CSCW researchers with this attitude are e. g. Bannon & Schmidt (1991), Lyytinen (1990) and Suchman (1989, 1991).

The basic support types are considered in a little more detail below.

Routine automation: has been the old cornerstone of all computer applications — replacing the work of a person by automating some accurately defined routines.

Control of somebody using information technology. Counting of the customer throughput of a cashier etc.

Fixed division of labour. A computer system place the people automatically in a defined relation with others. The different work positions are strictly defined by a system -e. g. between a clerk (data input) and a supervisor (data use) etc.

Triggering. A computer system produces a triggering impulse for preplanned actions – various alarms etc.

Data. The object of the work can reside in the computer, but for passive participants it is merely 'data'.

Separation. A computer system may separate the members of a work community from each other and make them invisible.

Tool. A computer system is used to produce and transform an object. Examples: Text processing, diagram drawing etc. When used by a group, this needs a corresponding object (shared material).

Shared meanings. A computer system makes a set of existing rules and shared meanings more easily accessible.

Active coordination. A computer system helps a community of active subjects to coordinate their efforts.

Search of relevant information. A computer system enables the finding of additional information. Examples: database queries, running a ready-made spreadsheet model.

Shared material. A computer system helps several people to transform an object together by giving them access to the shared material.

Visible network. A computer system forms a network which promotes the existence and visibility of a community. Example: e-mail within an established work group.

Tool or routine construction. A computer system enables the automation of a new — not predefined — routine or the creation of a new tool for handling objects. Examples: Devising of a letter form, building a spreadsheet model, programming.

Rule construction. A computer system helps in negotiating a new set of rules for a community.

Work organization. A computer system helps in generating a new work organization.

Learning, comprehension, innovation. A computer system enables the construction of a new mental model of an object. Example: what-if analysis with spreadsheet models, visualization.

Object construction. A computer system enables a phenomenon to become a common object of work.

Community construction. A computer system helps in creating new communities or establishing new contacts. Examples: Creation of a new e-mail posting list for a new project team, using UNIX News or some other bulletin board in asking help.

Due to space limitations, no attempt has been made to locate existing CSCW applications in this classification. The classification may also be less successful in ordering existing applications than in opening up new views and generating new design metaphors. Despite the superficiality of the analysis some areas of potential support can be located which have scarcely been discussed at all yet, e. g. the support of learning and object construction.

Conclusion

It is suggested here that Activity Theory offers a promising framework for CSCW research, because the concept of the activity as the basic unit of work analysis seems to meet a number of acute demands expressed by CSCW researchers. It has also been possible to generate some new design metaphors by starting out from the structure of an activity. How useful these constructs really are can be ascertained only in practical applications, however.

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