Activity Theory: A framework for analyzing CSCW Systems

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ABSTRACT
This paper investigates what is activity theory and why it differs from other cognitive theories from Computer Supported Collaborative Work (CSCW) perspective. We also present an elaboration of the theoretical perspectives with respect to analysis of people's use and design of CSCW systems.

Author Keywords
Activity Theory, Human Computer Interaction, Computer Supported Collaborative Work, Activity System Triangle

INTRODUCTION

What is Activity Theory?

Activity theory was developed by Vygotsky, Leontyev and Luria (three researcher at Moscow Institute of Psychology) in the former Soviet Union. This is a philosophical framework for studying different forms of human praxis as developmental processes, with both the individual and the social level interlinked.

According to Nardi [1], Activity theory is a powerful and clarifying descriptive tool rather than a strongly predictive theory. The purpose of activity theory is to explain the unity of consciousness and activity. Activity theory amalgamates strong notions of intentionally, history, mediation, cooperation and development in constructing consciousness. Activity theorists argue that *you are what you do*. Because consciousness is not a set of discrete disembodied cognitive acts, and certainly it is not the brain. It is located in everyday practice.

There is a social matrix which is a combination of people and artifacts. [2] Every person is an organic part of this matrix. And what people do is firmly and inextricably embedded in this matrix. Artifacts may be physical tools or sign systems such as human language. Understanding the interpenetration of the individual, other people and artifacts in everyday activity is the challenge activity theory has set for itself.

Comparison with other cognitive theories

While developing an interactive system, we need a theory which will shape an object of study and highlight relevant issues. This theory is going to help us to bring some objects into sharper contrast, while others fade into darkness. So we are more concerned with how to use a theory to understand a specific domain, reach insights about collaborative work in general, or design for a particular problem.

If CSCW perspective is considered, we need a theory which focuses on socially-distributed, tool-mediated human performances. There are two matching theory for our needs: activity theory and distributed cognition. Both attend to the historical development of social and tool systems and also diverge from other cognitive theories by incorporating the social and cultural context of cognition. But they differ in practice.

Activity theory proposes that people are

- agents with their own motives and resources in a larger system
- capable of development, that is, growth and change and,
- able to not only use but transform tools and practices.

Distributed cognition, for example, asserts that people and things are of similar type. It studies networks or systems of people and things exchanging information. This is interesting and useful; however it leaves out a lot. Motive, development, and the use of imagination to transform tools and practices, for example, are missing from the equation.

ACTIVITY THEORY

Activity systems contain interacting components (subject, tools, object, division of labor, community, and rules) and are organized to accomplish the activities of the activity subsystems. Activity subsystems (production, distribution, exchange and consumption) describe the higher order functions, interactions, and relationships between the components of the triangle.

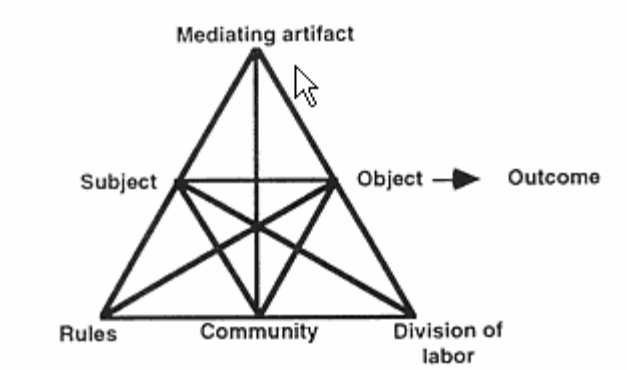

Figure 1. Cole and Engeström's analysis of activity and the mediating relationships among the individual, tools, or artifacts and organizations participating in the activity

Production Subsystem

The top triangle of the system, production is the primary focus of the activity. Production of the object is oriented by the outcome or intention of the activity system.

The production process in any activity system involves a subject, the object of activity of the activity, the tools that are used in the activity and the actions and operations that affect outcome. [1]

Subject

Subject of any activity is the individual or group of actors engaged in the activity. Activity systems are perceived from their point of view.

Object

All activity is object oriented. Objects of activity systems are artifacts that are produced by the system. Whether physical, mental or symbolic, they are the product that is acted on by the subject. The transformation of the object into the outcome represents the purpose or intention of the activity.

Tools, signs, and mediators: The production subsystem is completed by the tools, sign systems, theories and procedures that mediate the activity. These are the means that actors (subject) use for acting on the object. They can be anything used in transformation process (physical like hammers or computers or abstract like sign systems, modals or heuristics).

Distribution subsystem

It ties the object of activity to the community by defining the division of labor.

Division of labor

It refers to the horizontal division of the tasks between cooperating members of the community but also to the vertical division of power and status. [3]

Exchange subsystem

It engages the subject and two contextual components, the rules that constraint the activity and the community with which the subject interacts. It regulates that the activity of the system in terms of personal needs.

Rules

The rules refer to the explicit regulations, laws, policies and conventions that constraint activity as well as the implicit social norms, standards and relationships among members of the community. Rules inherently guide the actions or activities acceptable by the community, so the signs, symbols, tools, modals and methods that the community uses will mediate the process.

Activities are socially and contextually bound. So, ay activity system can be described only in the context of the community in which operates.

Community

It negotiates and mediates the rules and customs that describe how the community functions, what it believes and the ways that it supports different activities. With in the community, individuals support different activities.

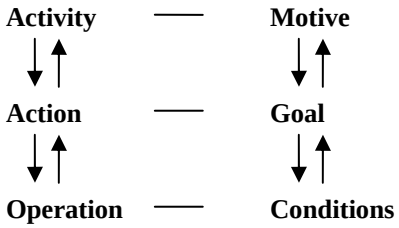

Figure 2. Hierarchical nature of activities, actions and operations

Activity Structure

Activity with in and between subsystems consists of goal directed hierarchy of actions that are used to accomplish the object- the activities, actions, and operations that transform the object.

ACTIVITY THEORY IN STUDYING PEOPLE USE OF INTERACTIVE SYSTEMS

What is an Interactive System?

Software or hardware system that enhances and support people in their everyday working lives or the systems that creates spaces for human communication and interaction. It can be computer software, a laptop, PDA, TV, etc through which people interact with each other.

Activity theory helps us to understand these mediated interactions. In human activity theory, the basic unit of analysis is human activity (work). Human activities are driven by certain needs where people wish to achieve certain purposes. This activity is usually mediated by one or more instruments or tools (the concept of mediation is central to the whole theory) [4]

When people are interacting, they are performing an activity and every activity has some object, every object will result in an outcome; this transformation of an activity by a subject (which is people here) is possible due to mediation of some tools. Also these people while trying to achieve a desired goal will interact with their environment which again consists of other people and artifacts around. The interaction among these people and artifacts is again mediated and bounded by some rules. These rules are fixed by the community (other people and artifacts) in which they operate. At the same time in this whole interactive scenario every person and artifact has some fixed task to perform, which means that the work is distributed among them. Hence we see an activity can not be segregated from its environment. It is a complex structure with each node [5] interconnected and dependent on each other and together they work in coordination bounded by some rules, mediated by artifacts and driven by subject to reach their goal or object.

ACTIVITY THEORY IN DESIGN OF CSCW SYSTEMS

As we mentioned above, interactive systems act as mediators in an activity structure. When designing these systems one must have a broader view of how whole system will be consumed in the activity.

Let us take an example for understanding the design of a CSCW system from an activity theory perspective. A CSCW system in it consists of various interactive systems working in coordination to achieve desired goals. If a person in a company is presenting an idea to his colleagues and the audience need not to be at the same place such a presentation will consume a lot of interactive systems ranging from a simple presentation to a state-of-art real time video conferencing system. Analyzing this, our person is a subject who is doing an activity of presentation and his goal is to convey his ideas. This whole process seems to be simple at first sight, but to achieve his goal he is using computer, software, projector, display screen, video conferencing cameras and lots of other things. These artifacts acting as mediators at the same time if we look into the background, this person is also consuming some resources from his environment he is working in (his community). To build upon his ideas he had used a lot of data and help from his colleagues, in doing so he is bounded by rules (social, corporate). Also he managed a lot of information using other interactive systems like Internet, phones, computers, etc., which again is a different activity structure. All this time he is preparing, work is distributed among various persons like someone has prepared the presentation for him, someone has setup the video conferencing system, etc.

If you observe, from this presentation he wants to impress his superiors and wants his proposal to be accepted (his goal). He is bounded by time, so the presentation software must be capable and advanced enough to present his data in a legitimate way (pictures, sounds, videos, graphs). At the same time the whole system should support him, like the video conference system should not produce delays, the projector should display properly, screen should have proper resolution, and the computer he is using should not hang.

Now if you observe each individual artifact or system, their development is another activity and they are developed keeping in mind the people, places and context in which they will be used. So each activity is related to the others.

Observing the Engeström's triangle, we can use bottom to top approach that is we are building from the bottom, putting each segment on the top of other till we reach the top. That's why mediating artifacts (interactive systems) are so important. They are the final elements through which we achieve our goals. Hence, these systems cannot be secluded from rest of the system. Of course, activities are socially and contextually bounded, so any activity system, its rules, its subject and its mediating artifacts can be described only in the context of the community in which they operate.

DISCUSSION

It would be too optimistic to think of activity theory as an approach that can provide ready-made answers to the problems related to group and organizational computer use. However, it appears that basic principles of activity theory can be elaborated on and operationalized to make the theory a useful tool for studying supra individual levels of information technologies use.

Computer-supported activity of a group or organization can be analyzed along the general lines of activity theory: finding the motive, goals, and conditions of the activity; identifying structural components of the subject's interaction with reality (individual activities, actions, and operations) as well as tools mediating the activity; and tracing developmental changes of the activity.

CONCLUSION

This paper has attempted to outline theory for the development and empirical investigation of activity theory in interactive systems. Activity theory seems to provide a rich framework for studies of context in its comprehensiveness and engagement with issues of mediation, division of work, and coordination among various elements of activity.

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