COLLABORATIVE INTERACTION THROUGH THE LENS OF ACTIVITY THEORY

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Summary & Learning goals

SUMMARY:

The students are introduced to activity theory as a lens to understand collaborative interaction mediated by technology. Students describe the key concepts and principles accounted in *activity theory* and discuss its use in different cases in related fields that study information systems and technology design. Topics for the final discussions is on analysing the breakdown situations or contradictories in current collaborative activity systems and bring ideas to modify the system to enhance the collaborative interaction.

LEARNING GOALS:
With this lecture students will be able to;

• identify the underlying concepts and principles of *activity theory*
• explain different components or aspects of a system that mediate the collaborative interaction
• outline how to utilize *activity theory* as a framework for analysis of an existing collaborative activity system.
• discuss the breakdown situations or contradicting actions within or between collaborative activity system(s) to translate theoretical knowledge into interaction design practices.

Recommended readings

- Bertelsen, O. and Bødker, S. (2003) Activity theory. In J. Carroll (ed.), HCI Models, Theories, and Frameworks: Toward a Multidisciplinary Science. Amsterdam: Morgan Kaufmann. Pp. 291–324.

- Kaptelinin, Victor, and Bonnie A. Nardi. *Acting with technology: Activity theory and interaction design*. MIT press, 2006.

Content / Outline

- A brief history of activity theory

- Key concepts and principles in activity theory

- Application of activity theory in technology design for collaborative interaction

- Case Studies in HCI, CSCW, CSCL

- Summary

THEORETICAL APPROACHES TO COLLABORATIVE INTERACTION IN TECHNOLOGY DESIGN

Collaboration is a complex phenomenon and allowing people to have smooth collaborative interaction via technology have been a challenge for researchers.

Theories provide a lens to analyse collaborative interaction as a complex phenomenon and bring questions to be asked. For example, within various multidisciplinary research fields that focus on information systems and technology design.
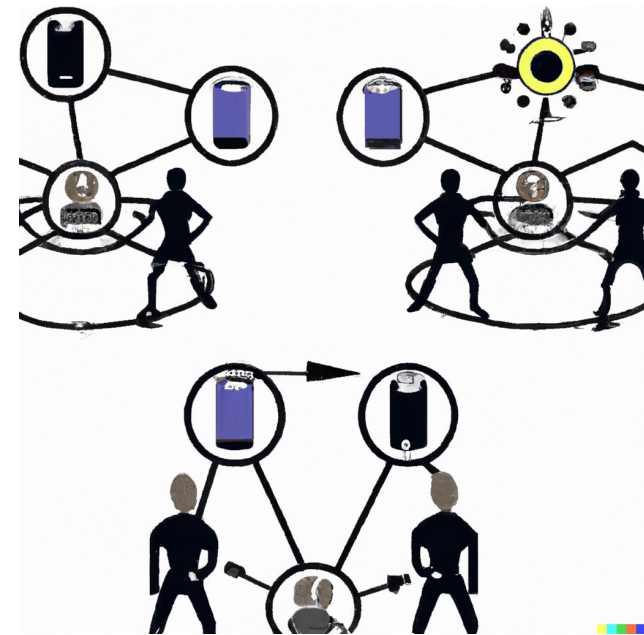

image created by Dall-E with the description: "two collaborative activity systems in which people's interactions are mediated by technology", in January 2023

ACTIVITY THEORY: A FRAMEWORK FOR ANALYSIS

Activity theory is a framework that provides a theoretical lens, and it is used in descriptive, analytical and interpretive levels in human-computer interaction (HCI), computer-supported cooperative work (CSCW), and computer-supported collaborative learning (CSCL).
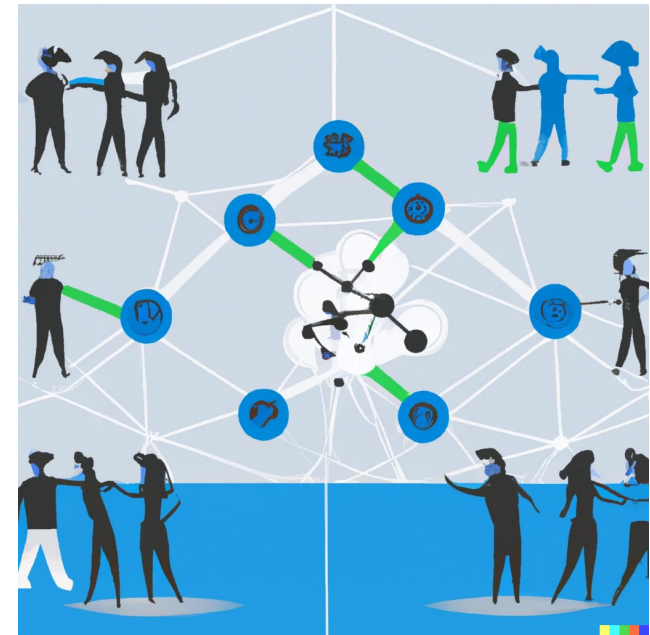

image created by Dall-E with the description: "collaborative activity system in which multiple people's interactions are mediated by technology", in January 2023

ACTIVITY THEORY: OVERVIEW

A BRIEF HISTORY OF ACTIVITY THEORY:

➜ A psychological and socio-cultural framework

➜ Inspired by Marxist philosophies as well as Lev Vygotsky,

➜ Developed by Sergei Rubinstein, Alexei Leont'ev, and Yrjö Engeström to understand how
   - work activities were mediated and influenced by the tools
   - the resources (e.g. skills, tools, knowledge) that were used in the activities,
   - the social and cultural context in which the activities took place influence the human activity.

ACTIVITY THEORY: OVERVIEW

TRAJECTORY OF KEY CONCEPTS OF ACTIVITY THEORY

➔ Principle of unity and inseparability of human cognition and activity (Rubinstein, 1947)

➔ Theory of mediation based on the idea of a triadic relationship between object (goal or purpose), a mental interpretant (subject), and a sign (language as a tool) (Gagnepain, 1960)

➔ Mediational aspect of tools for human activity (Vygotsky, 1978)

➔ Object-oriented analysis of human activities: activity-action-operation (Leont'ev, 1978)

➔ Three level notion of developmental forms of subject-object-subject relations: coordination, cooperation and communication in social learning (Fitchner, 1984)

➔ Exchange of information between an individual and their environment within an activity system; subject-object-community interaction (Engeström, 1987)

➔ Mediational means for subject-object-community interaction; tools/instruments/resources, rules/roles/skills, division of labour (Engeström, 1997)

ACTIVITY THEORY: OVERVIEW

ACTIVITY THEORY / CULTURAL HISTORICAL ACTIVITY THEORY

Activity theory also referred as Cultural-Historical Activity Theory (CHAT) exploring and understanding interactions in multiple contexts and cultures (e.g. social, historical, economic, political, etc.), and the dynamics and development of human activities such as learning and education, or work.

Cole, Michael, and Yrjö Engeström. "A cultural-historical approach to distributed cognition." Distributed cognitions: Psychological and educational considerations (1993): 1-46.
Sannino, A., & Engeström, Y. (2018). Cultural-historical activity theory: Founding insights and new challenges. Cultural-historical psychology.

ACTIVITY THEORY: OVERVIEW

KEY PRINCIPLES OF ACTIVITY THEORY

Activity theory centered on three core concepts and principles;

➔ *Subject (actor):* Refers to a person engaged in an activity; humans act collectively, learn by doing, and communicate in and via their actions, and develop with their operations.

➔ *Mediating artifacts, signs, and tools:* Humans make, employ, and adapt tools of all kinds to learn and communicate

➔ *Object (objectives, aims, goals):* Refers to a motive or motivation towards a future-oriented objective.

ACTIVITY THEORY: OVERVIEW

Engeström's expanded Activity Theory model

Tools — By what means are the subjects performing this activity?

Production

Who are involved in a common goal and carrying out this activity? **Subject**

Consumption

Why is this activity taking place? **Object**

Outcome — What is the desired outcome from carrying out this activity?

Exchange

Distribution

Rules — Are there any individual or group norms, rules and roles governing the performance of this activity?

Community — What is the environment in which this activity is carried out?

Division of Labour — Who is responsible for what, when carrying out this activity and how they are organized?

ACTIVITY THEORY: OVERVIEW

KEY PRINCIPLES FOR COLLABORATIVE INTERACTION IN ACTIVITY THEORY

➔ *Social-cultural context specifity:* Development of human cognition and behaviour is shaped by the interaction between an individual and their social and cultural environment (Vygotsky, 1978; Leont'ev, 1978), as well as being shaped by historical and cultural factors.

➔ *Object-orientedness:* Human consciousness and activity as the internal and the external, are closely interconnected and mutually determine one another (Rubinstein, 1947)

➔ *Unit of analysis:* Human activity is the fundamental unit of analysis, rather than the individual or group (Vygotsky, 1978; Leont'ev, 1978)

➔ *Mediation:* Human activity is a purposeful and goal-directed process that is mediated by socially produced artifacts, such as tools, language, and representations (Engeström, 2001, 2015).

➔ *Division of labor:* The social organization of activity play a key role in shaping human behavior and cognition, and depend on the actors' roles and resources, as well as their organizations (Engeström, 1997, 1999)
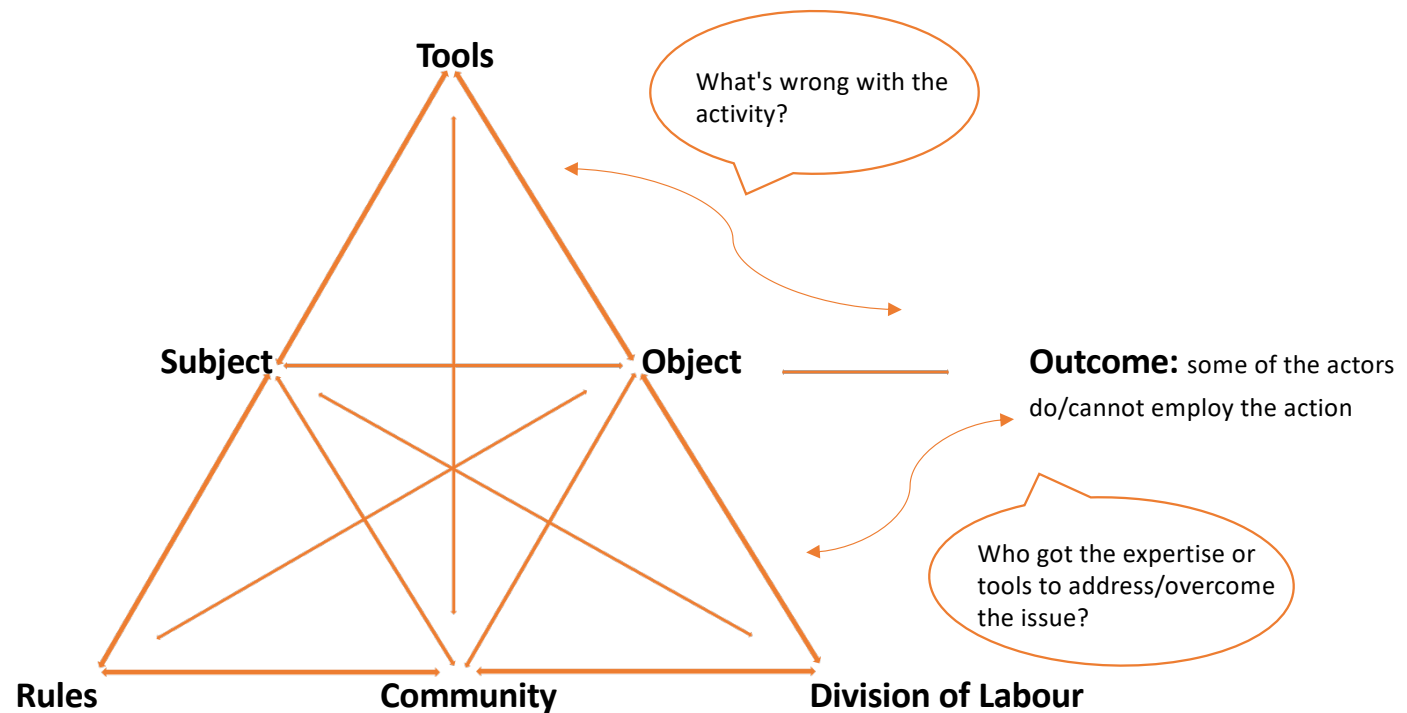
ACTIVITY THEORY: APPLYING THEORY INTO PRACTICE

HOW DO WE APPLY ACTIVITY THEORY IN COLLABORATIVE INTERACTION AND TECHNOLOGY DESIGN?

ACTIVITY THEORY: APPLYING THEORY INTO PRACTICE

The iterative design cycle that use activity theory as a lens begins with identifying the **tensions**, **conflicts**, **contradictions**, **controversies,** and/or **breakdown situations** that exit among components in the activity system(s) to create a collective force for development, change and innovation.

Gay, G. & Hembrooke, H. (2004) Activity-Centered Design: An Ecological Approach to Designing Smart Tools and Usable Systems. Massachusetts Institute of Technology, MIT Press.

ACTIVITY THEORY: APPLYING THEORY INTO PRACTICE

Adapted from; Sannino, A., & Engeström, Y. (2018). Cultural-historical activity theory: Founding insights and new challenges. Cultural-historical psychology. P. 49
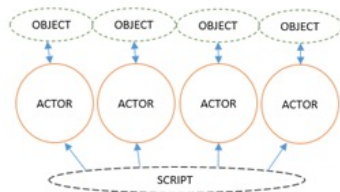
COLLABORATIVE INTERACTION

LEVELS OF COLLABORATIVE INTERACTION IN ACTIVITY THEORY (Engeström, 1997, 2015)

However, collaboration is a very complex skill/phenomenon which involves;

- ➔ Coordination
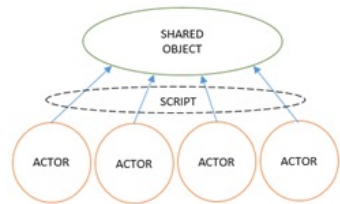- ➔ Cooperation
- ➔ Reflective Communication

COLLABORATIVE INTERACTION

LEVELS OF COLLABORATIVE INTERACTION IN ACTIVITY THEORY (Engeström, 1997, 2015)


Co-ordination:

- Individuals are gathered together to act upon a common object, but their individual actions are only externally related to each other. They still act as if separate individuals, each according to their individual task.

Co-operation:

- Refers to a mode of interaction in which the actors focus on a common object and thus share the objective of the collective activity, instead of each focusing on performing their assigned actions and roles.
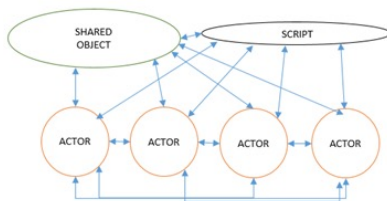
Co-construction (reflective communication):

- Interactions in which the actors focus on reconceptualizing their own organization and interaction in relation to their shared objects, as in the form of reflective communication.

Baykal, G. E., Eriksson, E., Barendregt, W., Torgersson, O., & Bjork, S. (2020, October). Evaluating Co-located Games as a Mediator for Children's Collaborative Interaction. In *Proceedings of the 11th Nordic Conference on Human-Computer Interaction: Shaping Experiences, Shaping Society* (pp. 1-11). https://dl.acm.org/doi/10.1145/3419249.3420118

ACTIVITY THEORY: APPLYING THEORY INTO DESIGN PRACTICE

APPLICATION OF ACTIVITY THEORY IN COLLABORATIVE INTERACTION AND TECHNOLOGY DESIGN

➔ Blended with Scandinavian approach to design; cooperation between technology design researchers and those being researched of an organization to help improve their situation, skills or activity (e.g., Ehn & Kyng, 1984; Bødker, 1987)

➔ Mediating role of physical artifacts (e.g., user interface) as well as social and cultural context in shaping human behaviour and cognition in terms of Human-Computer Interaction (Bødker, 1991), and artifact ecologies (Bødker & Klokmose, 2011)

➔ Ubiquitous activity-based computing (Bardram, 2007, 2009)

➔ Complex mediation of technical artifacts (Bødker,S. and Andersen,P.B., 2005)

ACTIVITY THEORY: APPLYING THEORY IN DESIGN PRACTICE

A CHECKLIST FOR DESIGN CONSIDERATIONS BASED ON ACTIVITY THEORY

(by Kaptelinin, Nardi, & Macaulay, 1999)

Queries to identify the main constituents of activity:

1a. Outcome: What services or products do we produce?

2a. Object and process: What raw materials or prerequisites do we start from? How do we produce the services or products from the inputs we have?

3a. Instruments: What kinds of physical tools and knowledge, skills, and so forth, do we need for this work?

4a. Subjects: Who are we—what different kinds of people are needed to produce these services or products?

5a. Social relations and means: When we work to produce the services of products, what kinds of rules, division of labor, communication, and so forth, apply between us?

Queries to identify the network of activities:

1b. Outcome: Who needs our services or products? Why do they need them—to produce some services or products for some others?

2b. Object: From whom do we get our "raw materials"? How do they produce what we need?

3b. Instruments: From whom do we get the tools and knowledge we need? How do they produce them?

4b. Subjects: Where do we come from—who educates and raises the kinds of people needed here? How does that happen?

5b. Social relations and means: Who sets the rules for us? How are the rules generated?

ACTIVITY THEORY: APPLYING THEORY IN DESIGN PRACTICE

Examples for studies that used Activity Checklist in design, evaluation and analysis:

- Design of a web-based information systems (e.g. Gould & Verenikina, 2003)

- Evaluation of the use of tangible user interface (TUI) developed to facilitate collaboration between a group of designers and planners (e.g. Fjeld, Morf, & Krueger, 2004)

- Analysis of empirical data gathered by means of ethnographic research (e.g. Maier, 2005)

Igira, F. T., & Gregory, J. (2009). Cultural historical activity theory. Handbook of research on contemporary theoretical models in information systems, p. 445.

ACTIVITY THEORY IN DESIGN

A CHECKLIST FOR SITUATING COMPUTER APPLICATIONS IN USE

(by Bertelsen & Bødker, 2003)

✓ situate work and computer application historically,

✓ situate the computer application in a web of activities where it is used,

✓ characterize the use according to the stereotypes of systems, tools and media,

✓ consider the support needed for the various activities going on around the computer application, and the historical circumstances of the computer application,

✓ identify the objects worked on, in, or through the computer application,

✓ consider the web of activities and the contradictions in and between activities.

Bertelsen,O. and Bødker, S. (2003) Activity theory. In J.Carroll (ed.), HCI Models, Theories, and Frameworks: Toward a Multidisciplinar Science. Amsterdam: Morgan Kaufmann. p. 315.

CASES: ACTIVITY THEORY IN TECHNOLOGY DESIGN

CASE: IDENTIFYING COMMUNITY OF PRACTICE (Bødker, 1989)

A ground-breaking HCI work of Susanne Bødker which argued that the user interface cannot be seen independently of the use activity (i.e., the professional, socially organized practice of the users and the material conditions for the activity, including the object of the activity), and the user interface fully reveals itself only when in use.

Used human activity theory to analyse human experience and competence as being rooted in the practice of the group that conducts the specific work activity.

Presented a framework for the design of user interfaces that originates from the work situations in which computer-based artifacts are used. The framework deals with the role of the user interface in purposeful human work.

Bødker, S. (1989). A human activity approach to user interfaces. Human Computer Interaction, 4(3), 171-195. https://doi.org/10.1207/s15327051hci0403_1

CASES: ACTIVITY THEORY IN TECHNOLOGY DESIGN

CASE: UNDERSTANDING THE ACTIVITY SYSTEM (Engeström, 1999):

One of Engeström's pioneering studies in CSCW which was about transformation of work in the children's hospital. He combined activity theory with expansive visibilization of work from individual actions to collective activity system to examine and understand the contradictions.

By doing so, he identified a set of developmental tensions and troubles in the activity system of the outpatient clinic, presented key points of the vision for the clinic's activity system, and iterative steps in redesigning the system.

The study concludes with reconceptualization of object and transformation of the motive of work and reorganization of the activity system which he argues that is not a straightforward process, but rather a cycle of work activites.

Engeström, Y. Expansive Visibilization of Work: An Activity-Theoretical Perspective. *Computer Supported Cooperative Work (CSCW)* **8**, 63–93 (1999). https://doi.org/10.1023/A:1008648532192

CASES: ACTIVITY THEORY IN TECHNOLOGY DESIGN

CASE: IDENTIFYING THE ACTIVITY'S GOAL AND MEDIATING ARTIFATCS (Bardram & Houben, 2017):

Bardram & Houben inspired by Engeström and utilized activity theory to identify how collaborative actions can be afforded by physical and digital artifacts in a specific socio-cultural context of a hospital setting.

Introduced the concept of "collaborative affordances" and identified core types of affordances (i.e., portability, collocated access, shared overview, and mutual awareness) and analysed paper-based, electronic and hybrid medical records accordingly.

Argued that the concept of Collaborative Affordances may be used to design collaborative digital and hybrid technologies both in the medical domain but also in others.

Bardram, J.E., Houben, S. Collaborative Affordances of Medical Records. *Comput Supported Coop Work* 27, 1–36 (2018). https://doi.org/10.1007/s10606-017-9298-5

ACTIVITY THEORY IN TECHNOLOGY DESIGN: FURTHER INSTANCES

➔ Work (e.g., Kuutti, K., & Arvonen, T. Identifying potential CSCW applications by means of activity theory concepts: A case example. In *Proceedings of the 1992 ACM conference on Computer-supported cooperative work* (pp. 233-240). https://dl.acm.org/doi/pdf/10.1145/143457.150955)

➔ Learning (e.g. Timmis, S. The dialectical potential of Cultural Historical Activity Theory for researching sustainable CSCL practices. *Intern. J. Comput.-Support. Collab. Learn.* **9**, 7–32 (2014). https://doi.org/10.1007/s11412-013-9178-z)

➔ Leisure
  - **Museums** (Rahm, J. (2012). Activity Theory as a Lens to Examine Project-Based Museum Partnerships in Robotics. In: Davidsson, E., Jakobsson, A. (eds) Understanding Interactions at Science Centers and Museums. SensePublishers. https://doi.org/10.1007/978-94-6091-725-7_10),
  - **Libraries** (e.g., Spasser, M.A. Realist Activity Theory for Digital Library Evaluation: Conceptual Framework and Case Study. *Computer Supported Cooperative Work (CSCW)* **11**, 81–110 (2002) https://doi.org/10.1023/A:1015288305397),
  - **Games** (Baykal et al. Evaluating Co-located Games as a Mediator of Children's Collaborative Interaction. In *Proceedings of the 11th Nordic Conference on Human-Computer Interaction: Shaping Experiences, Shaping Society*, pp. 1-11. 2020 https://doi.org/10.1145/3419249.3420118)

➔ Organizations
  - **Health care organizations** (Bardram, J.E., Houben, S. Collaborative Affordances of Medical Records. *Comput Supported Coop Work* **27**, 1–36 (2018). https://doi.org/10.1007/s10606-017-9298-5),
  - **Education** (Nussbaumer, D. (2012) An overview of cultural historical activity theory (CHAT) use in classroom research 2000 to 2009, Educational Review, 64:1, 37-55, DOI: 10.1080/00131911.2011.553947)

Summary/take home

Overall, incorporating *activity theory* into the design process helps to ensure that technology for collaborative interaction is designed with the social and cultural context in mind. Activity theory framework helps to begin with identifying the tensions or breakdowns within and between the activity systems to understand what aspect of the activity system is to be developed in the mediating technology with respect to how people collaborate in that context.

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