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Instruction at heart
Activity-theoretical studies of learning and
development in coronary clinical work

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To Ingela.

Abstract

The aim of the thesis is to study the role of instruction in the interconnection of instruction-learning-development. The thesis consists of six empirical papers and a summing-up and perspectivizing introductory paper. Five of the empirical studies concern so called heart conferences, clinical diagnostic meetings, which at the time of my study, 1995-1996, were arranged as telemediated conferences between a sub-team of surgeons and radiologists in a university clinic, and a sub-team of cardiologists and radiologists in a regional hospital. The outcome of the coronary diagnostic work in the heart conferences was patient diagnoses and decided-upon treatment (surgery, balloon dilatation, or conservative treatment). The sixth empirical study, conducted in the autumn 2000, investigates the design and redesign of a central artifact used in the heart conference, "the angio film," produced in the angio lab. A recurrent theme in the empirical papers is whether artifacts might be instructive and, if so, in what ways. The introductory paper is a hybrid between an ordinary summing-up paper of the findings in the empirical studies, and a perspectivizing presentation of activity-theoretical approaches to instruction, learning and development, elaborating on three basic aspects (learning as a collaborative phenomenon, the instructiveness of artifacts, and the relation between learning and development on an individual level, but primarily on an activity level). In conclusion, my study outlines an approach to learning based on new perspectives on instruction.

Acknowledgements

This study is considerably in debt to some important intellectual milieus and to many individual persons.

One such milieu is the widespread network of cultural-historical activity theory to which I have access and which has been an important incubator for my ideas on instruction, learning and development. Particularly, this is valid for the Center for Activity Theory and Developmental Work Research in Helsinki and its forerunner, the Activity Theory group in Finland, which provided inspiration and insights, and where many of my ideas and papers have been discussed. Also the Laboratory of Comparative Human Cognition (LCHC), University of California, San Diego, has provided an important intellectual meeting place by different means – personal contacts, the XMCA list (where I have been a lurker for many years), the journal *Mind, Culture, and Activity* (and its predecessor, the Quarterly Newsletter of LCHC).

Another fruitful milieu for me is the research group in Human work science oriented to information technology at our department, where I have learned about ethnography of work, and studies of work practice and technology. At its core are the Monday Seminar and the IAM group for interaction analysis (primarily based on videotaped work practice records).

I have had the privilege to have central persons from these milieus as supervisors of my thesis, Bo Helgeson and Yrjö Engeström. Besides their inspiring supervision work, they have made further contributions to my endeavor as a scholar. Bosse persistently encouraged what we jokingly call “near-sighted” studies of work practices. With Yrjö I have been discussing for 20 years, and all the research groups I have been engaged in have been substantially influenced by his work. Sometimes I feel that my thesis is best characterized as “footnotes to Engeström.”

In different ways the following persons have given valuable support to my study: Gunnel Andersdotter, Eevi Beck, Jeanette Blomberg, Yvonne Dittrich, Eva Ekeblad, Pirjo Elovaara, Sara Eriksén, Bengt Grensjö, David Hamilton, John Hughes, Lars-Christer Hydén, Honorine Nocon, Helena Karasti, Olle Lindeberg, Jenny Lundberg, Reijo Miettinen, Monica Nilsson, Kjell Persson, Mårten Pettersson, Dave Randall, Philippe Rouchy, Marcus Sánchez Svensson, Roger Säljö, Hans Tap, Jakko Virkkunen, and Jack Whalen.

I will especially mention Mikael Kehler and his colleagues at the Thorax Clinic at the Blekinge Hospital in Karlskrona, who gave me space and support when I studied their work practice and asked the naive and silly questions only an outsider is able to pose.

My English has been corrected and improved by Honorine Nocon and Sara Eriksén who have read large portions of the empirical papers and of the summing-up and perpectivizing cover paper.

Without the effective editing and layout work that Edith Sánchez Svensson and Hans Kyhlbäck have accomplished, this thesis would not have been timely produced.

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Last but not least, a thank-you to all in my close surroundings, who gave such encouraging support to an old-timer who finally had to do his homework.

A note on the empirical papers

Four of the papers have been presented in other contexts (Papers I, II, III, and V). In the versions presented here, minor corrections have been made in the first three regarding language and typos. In Paper III, an expression (three-vessel PTCA) has been changed, because in the vocabulary of the professionals it has a particular meaning, which was not clear to me earlier. Paper VI has only been presented orally earlier, and Paper IV is presented here for the first time, outside of the seminar of the research group at the Department of Human Work Science and Media Technology.

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Instruction at heart

Activity-theoretical studies of learning and development in coronary clinical work

Introduction

This study is about instruction, learning and development. The question is how these phenomena go together. More precisely, the study is about the role of instruction in the intertwining activity of instruction-learning-development.

Instruction was concretely at heart in the collaborative work I have studied empirically, coronary clinical diagnosis and treatment. From the position of observation I often placed myself in, I could see how the physicians jointly were examining a patient case in which looking at a video sequence showing the patient's coronary-artery was a central part. The collaborative work of the physicians is my point of departure in this study. Their work is complex. It is accomplished in diverse forms, with the help of multifarious tools, some specialized and high tech, but some very simple and mundane. Some aspects of their work are directly mediated by handling of concrete material and talk, while other aspects seem to consist of mediations in many layers by means of theoretical instruments and standard procedures. In the swarm of actions, talk and tools I try to discern how the physicians assist each other in doing their job. This assisting-each-other aspect of collaborative work is the focus of my study. I ask how these mutual instructions are accomplished and how they relate to learning in and development of the work activity.

Mainstream academic psychology has until now regarded learning as a phenomenon pertinent only or predominantly to individuals. Sociocultural and cultural-historical activity theory (CHAT) approaches take another stance. They conceptualize learning as a collaborative endeavor. Learning takes place in a "community of practice" (e.g., Lave and Wenger, 1991), or in activity systems (e.g., Engeström, 1987). As a consequence, individuals also learn.

If a common conception of learning is that it is an individualistic phenomenon, a corollary is that instruction or teaching is separated from learning. Either the separation has taken the form of a gulf between teachers and learners, between those who know and those who do not. Like in good old school days. Or else the separation has swept away teaching altogether or as much as possible – as in the cognitive revolution of education and learning in the sixties, Piagetian constructivism, and under the "learning environment" umbrella nowadays. They all share the idea that teaching is detrimental to learning. I will go beyond those "apartheid" ideas of instruction and learning and argue for the opposite: there is no learning without instruction. Thus in my CHAT-conception, instruction and learning go together.

However, I claim more. I will bring development into the phenomenon of instruction and learning. Usually, development in the context of learning is understood as individual and mental development. Far from denying this is important, I will propose another focus: development of the activity itself. An outcome is that individuals learn and develop, and at the same time there are "infrastructural changes" (Bowker and

Star, 1999) – activity systems established, communities built, tools and houses designed and redesigned, procedures invented, organizations re-ruled, and so on. In short, there are changes of activities and changes of minds.

My reading of cultural-historical and sociocultural conceptions of learning is that learning has three fundamental aspects: it is collaborative, artifact-mediated, and connected to the development or design of an activity. Within CHAT and sociocultural circles there is a fairly good agreement that 1) learning takes place in and as part of social practice, in communities of practice or in activity systems, 2) learning is mediated by artifacts, and 3) learning is connected to development. Thus learning is a practical activity enacted with the help of artifacts, which are material and ideal. Learning takes place between people, and is something that not only occurs “in the head” but also “in the world” (to use the terminology of Donald Norman, 1988). I conceive that there is a high degree of consensus about the first two characteristics of learning. However, the understanding of the coupling between learning and development is much more diversified, at least when it comes to more precise statements than the simple noting that there is a connection between individual learning and individual development.

These are my conceptions, “prejudices” or “hypotheses” if you like. In the study, I will argue for them, and challenge them, mainly within an empirical field of coronary diagnostic work, and mainly by testing their ability to provide a coherent description and analysis of the instruction-learning-development theme.

Background

Personal research trajectory

The present study has been nourished from two roots, one going a long way back, and the other of more recent origin.

One root is cultural-historical activity theory (CHAT) and circles of people interested in conducting research in a “utopian” or “developmental” way. It includes the cultural environment provided by the Nordic Association for Educational Research, and the Activity Theory meetings arranged in Espoo 1982, Aarhus 1984 and Utrecht 1985, which led to the establishment of ISCRAT with its congresses (Berlin 1986, Lahti 1990, Moscow 1995, and Aarhus 1998). It also includes – which have been of more immediate importance - the research and development projects I have been engaged in during two decades: the school project MIS (Man in a changing society) 1983-1987; the “productive learning” experiments at Umeå university (psychology education) and the University college of Sundsvall (journalist and public relation education) (1984-1990) and the MDA (People-Computers-Work) educational program at Blekinge Institute of Technology (1993-); the Elder Center North project

(1989-1994); and the Fifth Dimension in Ronneby (1997-).¹ A common theme of these projects is their developmental and utopian orientation. They were and are inspired by scholars of cultural-historical activity theory, especially the activity theory group in Finland (now the Center for Activity Theory and Developmental Work Research).²

This background is the origin of my interest in a question that in a sense has propelled my whole study - Is there, ever, learning without instruction? – and to my interest in a special kind of action research, developmental activity research.

The other source of my research trajectory is the research group at the Department of Human Work Science and Media Technology at Blekinge Institute of Technology. The research theme of the group is work practice and technology, and the focus is on ethnography of work, design of technology, and the relation between ethnography and design. A core feature of the research work in this environment is the focus on detailed studies of how work is accomplished and artifacts are used.

Field of the empirical study: coronary clinical work

The field of my empirical studies, coronary clinical work, has within a short period of time undergone a conspicuous transformation. It is framed by a technological, economical, and organizational process of change, from "taking home" to Karlskrona the coronary angiographies examinations that earlier were made at the University clinic at Lund, and ending up with an independent thorax clinic. It was the result of a very interesting and complex process of development. This may sound like a fairy tale. In a short period of time, economic and technological forces joined and managed to accomplish what only few thought was possible: a thorax clinic at a small regional hospital. To make it short, this is what happened.

New economic principles for health care service built on buy and sell relations were introduced and this motivated the Blekinge hospital to investigate if "taking home" of the coronary angiographies examinations that so far had been bought from the university hospital at Lund would be profitable. A requirement was that the angio examinations should attain the quality standards of the examinations made at Lund. The cardiologist from Lund who got the mission to make the investigation told about the start in an interview (in March 1995):

He moved from Lund where he had worked with coronary angiography in order to build up a corresponding activity in Karlskrona. It was however met with resistance from Lund. He made a cost estimate and found that the cost for a coronary angiography in Karlskrona (including the care at the hospital) would be 14000

¹ Sutter (1985), Sutter and Grensjö (1988); Sutter (1991); Helgeson, Eriksén and Sutter (1996); Sutter and Lindberg (1994); Nilsson and Sutter (2001), and Andersson, Eccles and Sutter (2001).

² Since 1995 also by Michael Cole and the Laboratory of Comparative Human Cognition, University of California, San Diego.

Swedish crowns compared to the 23000 that was paid to Lund. Coronary angiography in Karlskrona would thus result in reduced costs. At the time, Karlskrona had 200 coronary angiographies done so far, but there was a need for higher capacity at the planned angio lab. Therefore, he took contact with Kronoberg [a neighbor county] in order to fill up, and came up with 400 coronary angiographies per year. On that ground, a decision was taken to buy a lab which met the standard of the lab at Lund. Another requirement that they also met was that they could recruit a cardiologist and a radiologist with competence corresponding to the competence in Lund. (Fieldnote, 1-3-95)

The Angio Lab in Karlskrona opened in February 1993. In other respects the work continued as before, with the exception that the so called heart conference meetings that were held daily at Lund, were now reorganized in such a way that one hour each Friday morning was reserved for the patients from Blekinge and Kronoberg. As a consequence, at least one cardiologist and one radiologist traveled each Friday the 200 km from Karlskrona to Lund to take part in the heart conferences for their patients.

In parallel, there was another development going on, grounded on wishes to progress in tele-medicine. One of the actors was Telia, the biggest teleoperator in Sweden who wanted a test bench for a high-speed network, making possible for example high-speed transmission of video film for simultaneous watching in real time. There were also other actors, among them the two enthusiasts who worked with coronary radiography in Karlskrona. They pushed for a teleconference system which was equipped with a special device that made it possible to show and discuss the video films in real time long-distance. That would save them traveling to Lund every week. Already during autumn 1993 such a videoconference system was tested. When the activity had been technologically stabilized, it was run as a regular telemedicine activity from the beginning of 1994. During the three years 1994-1996 about 50 telemediated heart conferences were held every year with a total of 500-600 patients, giving a mean of 11-12 patients per conference (Kehler et al., 1996; for 1996 personal communication).

Also, a medicine-technological innovation had a high impact on what happened. It was the rapid development of balloon dilatation or PTCA (Percutaneous Transluminal Coronary Angioplasty), which was introduced and developed all over the industrial world as an alternative or complement to coronary surgery as a method of intervention. It had as a consequence that radiologists and cardiologists were allowed to do coronary interventions that earlier had been reserved for surgeons. Many forces and many voices – many more than I have mentioned in my short account – influenced the development in the same direction, and the outcome was an independent thorax clinic at Karlskrona, inaugurated in December 1996.

Thus, during a period of time of more than three years, 1993-1996, a special form of work meetings was accomplished between the regional hospital in Karlskrona and the university hospital in Lund. At these meetings a team of physicians made diagnoses

of patients suspected to be suffering from heart disease (narrowing or obstruction of coronary artery, aorta or mitralis). Unique for these working meetings was that the physicians were divided into two groups and that these two groups were situated in different places. The meetings were accomplished as ordinary telemediated conferences. In addition to that there was equipment, which enabled the physicians in Karlskrona to show a videofilm of the patient's coronary artery at the same time as the operator of the equipment, by means of a special device, could steer a pointer which was shown on the display at both sites. Thereby, a concrete aspect of the object of work came into focus: the coronary arteries and possible narrowing and obstruction of the vessels were made inspectable by means of x-rays of the working heart. The video was shown to and was discussed with the colleagues in Lund. Technology made the meetings potentially highly interactive. This activity was, as far as I know, a unique phenomenon within health care, not only in Sweden, and it consisted of a geographically distributed team of physicians who made collaborative diagnoses of coronary-artery by means of a specially equipped conference system. As mentioned, the activity came to an end when the hospital in Karlskrona got its own thorax clinic in December 1996.

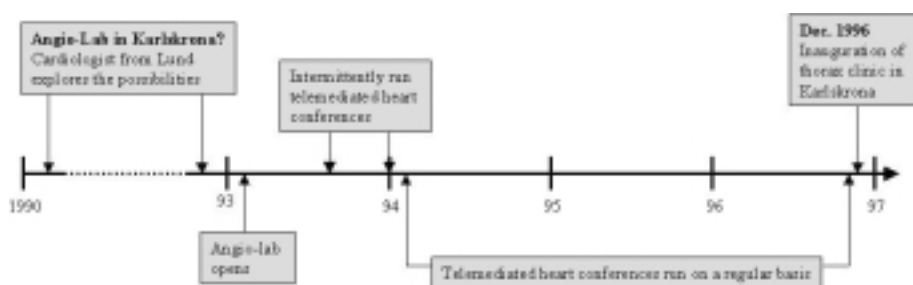


Figure 1. Development of coronary clinical work activity at the Karlskrona hospital

The empirical research settings

Two empirical settings related to coronary clinical work have been my main places of observation. The first is the heart conference where I had my place of observation in the Karlskrona site, which consists of a special room close to the radiology clinic. What can be observed in and from the site is shown in Figure 2. My second main place of observation was the Angio Lab, depicted in Figure 3.



Figure 2. The distributed heart conference viewed from the site at the Karlskrona hospital.

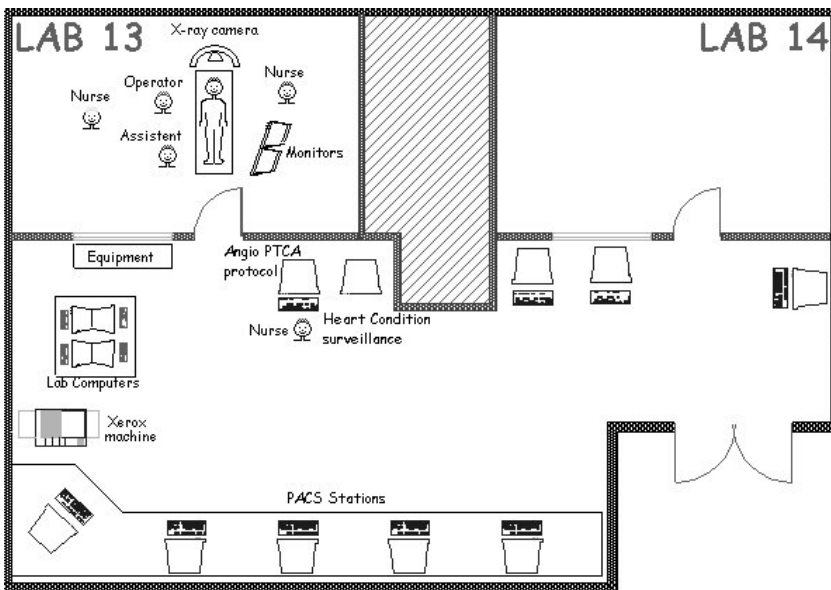


Figure 3. The angio lab – Karlskrona.

Aim of the study

The aim of this thesis is to sketch a conception of learning. It may seem like a paradox that I hope to achieve my aim by putting instruction in the foreground. However, the sketch is made from a perspective of cultural-historical activity theory, and empirically the sketch is based on a long-term study of instruction and learning in coronary clinical work. This framing sets limits for what counts as learning and for what is important to learning. Acknowledging that learning is a phenomenon full of nuances, my choice of perspective and empirical object of study bring out aspects that I find important. This means, for example, that learning mechanisms in neural networks (interesting to e.g. Clark, 1997), as well as learning seen as the formation of mentalities as a result of pedagogical interventions in a broad sense over historical periods (Ödman, 1995), or kinds of learning connected to overall societal patterns of production (Lyttkens, 1994), how ever interesting I may find them, are left out of my outline or are marginalized. My encirclement of learning phenomena is determined by my interest in learning at work, and in development of learning activity. It is also propelled by my interest in school learning and, even more, search for viable alternatives to traditional school learning. This stance of mine does not mean that other aspects of learning do not exist or are not important to study.

My sketch of a conception of learning will be organized as an attempt to answer the following questions:

1. How is the collaborative nature of learning established and sustained?
2. Can artifacts be instructive, and if so, in what ways?
3. How is learning connected to development?

Context and content of the articles comprising the study

The thesis is based on the following articles, which are referred to in the text by their Roman numerals.

- I Sutter, Berthel (1999). Instruction and learning in the development of telemediated coronary diagnostic work. *Researching Work and Learning. Conference Proceedings*. University of Leeds, UK, 10-12 September 1999.
- II Sutter, Berthel (2000). Instructions at work. A case of coronary diagnostics. In *Proceedings of the Fourth International Conference of the Learning Sciences (ICLS2000)*, (Eds., B.J. Fishman & S.F. O'Connor-Divelbiss), University of Michigan, Ann Arbor. Mahwah, NJ: Lawrence Erlbaum.
- III Sutter, Berthel (2000). Co-coaching at work. Instruction and collaboration in coronary diagnostics. *Occasional Papers from the Work Practice Laboratory*, Vol. 1, No. 3:2000, Department of Human Work Science, Blekinge Institute of Technology, 29 pp, Ronneby, Sweden.

- IV Sutter, Berthel (2001). Artifacts are made instructive. Constructing and reconstructing “angio” graphics in coronary diagnostic work. Unpublished manuscript.
- V Sutter, Berthel. Instructional artifacts. Paper accepted for the Computer Supported Cooperative Learning conference (CSCL2002), Boulder, Colorado, 7-11 January 2002.
- VI Sutter, Berthel. “Shall we do that then?” On the guiding function of the object of work. Paper presented at the 2nd Nordic-Baltic conference on activity theory and sociocultural research, 7-9 September 2001, Ronneby, Sweden.

Context and content of the papers

My research on coronary clinical work started with a project financed by the Swedish Work Environment Fund and the Swedish National Board for Industrial and Technical Development, “Cooperative Work and Modern Information Technology,” In this project led by Bo Helgeson one of the two examples of cooperative work studied was coronary diagnostics. The project was conducted during two years, 1995-1996, and was reported in three papers.

Sutter, Berthel and Helgeson, Bo (1995). Cooperative diagnostic work – shared workspace and telepresence. (Samarbete och teknik i tjänsteverksamheter. Ett seminarium i SAMT-programmet, 11 oktober 1995.) Faculty of Health Sciences, Linköping University.

Sutter, Berthel and Helgeson, Bo (1997). Being where when working together? Telepresence and ideal objects of work. Paper presented at the 1st Nordic Baltic Conference on Activity Theory, 7-9.2 1997, Helsinki.

Sutter, Berthel and Helgeson, Bo (1997). Samarbete och modern informations-teknologi. Om teleföremdlade kliniska hjärtkonferenser mellan Karlskrona och Lund 1993-1996. (Collaborative work and modern information technology)

For me, this project became an initial step during which I got to know the field of clinical work, and an exercise in the Work Practice and Technology perspective and its methodology, a local variant of which we were building up at the Department of Human Work Science in Ronneby. A second step was the activity-theoretical incision I made as an opening for my present research on the subject. This “theoretical incision” was formulated in a manuscript from February 1999 called “Without instruction there is no learning!” (Later modified to “Learning without instruction?”), a manuscript which has been discussed at seminars in Umeå, Ronneby, and (video-mediated) Helsinki.

Below is a summary of the contents of the empirically based papers included in the thesis:

Paper I: “Instruction and learning in the development of telemediated coronary diagnostic work”

The paper gives an overall picture of my empirical research on coronary diagnostics from the stance formulated in the “theoretical incision” presented in the “Learning without instruction?” manuscript. The emergence and development of the coronary clinical work at Karlskrona hospital is described. Two conceptual ideas are presented which henceforth will be part of the study: learning the given and learning the new, as well as co-coaching and collaborative mastering of the new. Methodologically, the study depends heavily on video records from the Karlskrona site in the telemediated heart conference between Karlskrona hospital and the University clinic at Lund. This is a feature of all papers, with the exception of Paper IV. One patient case is presented in its entire length of 15 phases, of which nine are analyzed in detail. Anecdotal empirical evidence is used to discuss apprenticeship (appropriation of the given) and everyday routine work and the unexpected (the significant new) of the work activity.

Paper II: “Instructions at work. A case of coronary diagnostics”

The paper explores the role of artifacts in human activity as an integrated part of human activity. The empirical part of the paper consists of a patient case that is analyzed in detail. The main outcome is: an analytical distinction between instructions as (“crystallized”) artifact-bound representations and “live” or situated instructions. It is argued that all instructions are doubly situated: both in the artifact-mediation of the profession and in the ongoing interactions at work. The exploration resulted in a suggestion that instruction takes place at least at four levels: 1) artifact-bound instruction; 2) highlighting, 3) a basic kind of interaction, to “make instructably observable” (Garfinkel); 4) instruction as a specific activity, instruction as part of an educational program. Finally, it is suggested that my way of tackling the problem, which by Suchman has been phrased “to develop a discourse that recognizes the deep mutual constitution of humans and artifacts without losing their particularities,” is to search for examples of the two entities that I define as various kinds of instructions, “crystallized instruction” and “situated or live instructions.”

Paper III: “Co-coaching at work. Instruction and collaboration in coronary diagnostics”

The paper explores the role of instruction in collaborative work activity. The empirical base is the same empirical patient case as Paper II, but more extensively dealt with. Within the framework of activity-theory some aggregates of work actions (“work practices”) suggested by Goodwin were studied: highlighting, the use of coding schemes, and articulation of graphical representations. Two conclusions were drawn. First, the suggestions from Paper II were strengthened: a distinction should be made between instruction as artifact-bound advice and instruction as “live” instructions; artifact-bound advice takes diverse forms including written language,

graphical representations, and ‘thing’-mediated representations. Second, instruction, both as a special activity and as instructional actions, is a central resource in collaborative work, or in other words, learning at work presupposes instruction (a challenge to the perspectives of apprenticeship and “legitimate peripheral participation.” Finally it is argued that there is a connection between objects of work and instruction.

Paper IV: “Artifacts are made instructive. Constructing and reconstructing “angio” graphics in coronary diagnostic work”

The aim of the paper is to give an account of the construction and uses of one kind of representational artifact at coronary diagnostic work, the angiography (“angio”), an X-ray based visualization of the coronaries after injection of a radiopaque substance. The angiography has turned out to be a central artifact in current coronary diagnostics, especially in the heart conferences, where patient cases are discussed, diagnoses are made, and treatment decided upon. All other papers are based mainly on video recordings from the heart conference, but the angio is only used in the heart conference, but produced in the angio lab. Therefore, new empirical research was conducted in the angio lab. My research methodology is to focus on a few angio cases, and record their history and transformations. My observations concern the whole cycle of the patient angiography, from its production and uses until the patient, at least temporally, is considered to have got a fair (final) diagnosis and recommended treatment. The study shows that the graphical artifact is not just constructed once and for all. It is first constructed as a digital computer-based representation, but is then reconstructed, added on to, transformed into paper format, used as a shared representation, and also used as a representation for individual use. The patient angio constructed in the angioloab is being prepared and used in the heart conference as a tool for diagnoses and as an object of work to investigate and transform. Further, it is used as a guide for the treatment, and is finally used as a summing up documentation of the history of the angio patient. I end the paper by giving a preliminary answer to the question if and how the angio graphic can be instructive: artifacts are instructive because the *are made* instructive.

Paper V: “Instructional artifacts”

The paper addresses the question if artifacts may be attributed some kind of agency. I take an activity-theoretical and instructional perspective, and argue that artifacts are used to guide actions. In other words, I claim that artifacts have instructional impact. In the introductory part of the paper an account is given of how three kinds of artifacts - physical artifacts, linguistic representations, and graphical representations – are instructionally used in coronary diagnostic work. The main part of the paper is an empirical exploration of how a fourth kind of artifact, organizing of work, is instructionally used. The empirical case of clinical diagnostic work was conducted as a video-mediated conference between two collaborating diagnostic sub-teams, one of which had made the coronary investigation by means of coronary angiography, and the other which was to take actions in the form of by-pass surgery or balloon

dilatation. Three entire heart conferences form the empirical base for the study. In the concluding part I discuss in what way it makes sense to say that organization of work and other artifacts have instructional properties.

Paper VI: “Shall we do that then?” On the guiding function of the object of work”

The paper explores how work activity gets its orientation. With the help of Ilyenkov’s conception of activity/object and Leontiev’s conception of activity as layered, I make an analysis of all patient cases presented in a heart conference with the aim of finding out *how* the motivating character of the object of work influences the aggregates of work actions. The voices of the patients as they are made audible in the clinical work are taken into account as one determination of the object of work. Finally, the paper discusses what the object of coronary clinical work is.

Instruction-and-learning

As I have said, instruction is at heart in this study. Although the main focus is learning and development, the study will go into the phenomenon of instruction in depth. This is no coincidence. The reason is my conviction that the instructional parts of learning are central, and that they currently are theoretically ignored or underestimated. Simply – to grasp the idea of learning and development, we have to get a better conception of instruction. That is why instruction is at heart. As I have mentioned, there is another reason why “instruction is at heart.” The empirical part of it is a study of coronary clinical work with a focus on learning and development. How do the clinical doctors do their job, how do they instruct each other, how do they develop their work, and how do they learn?

The background of my concern for instruction is the current shift of interest among researchers that seek alternatives to traditional school education. It is a shift from teaching/giving instruction to learning. During the 70’s and 80’s, Vygotsky’s idea of the zone of proximal development (ZPD) had a good and widespread reputation (Moll 1999). Vygotsky defined the concept in this way:

“The zone of proximal development of the child is the distance between his actual development, determined with the help of independently solved tasks, and the level of the potential development of the child, determined with the help of tasks solved by the child under the guidance of adults and in cooperation with his more intelligent partners.” (Vygotsky 1933; quoted from: van der Veer & Valsiner, 1991, p. 337)

The ZPD concept with its clear instruction-guidance implications was used as a guide for theoretical elaboration and empirical interventions within a broad spectrum of socially oriented educational conceptions (e.g., Cole & Griffin, 1980; Rogoff & Lave, eds., 1984; Wertsch, ed., 1985; Tharp & Gallimore, 1988; Moll, ed., 1990). But now

the ZPD seems not to be a frequent topic on the agenda of more in-depth research discussions, although there are exceptions (e.g. Wells, 1999).

There is a strange tendency among researchers looking for or building up alternatives to the transmission model of education that is still prevailing in school practice, although it is questioned as an ideal. This is a tendency of conceptualization of instruction as almost non-essential for learning, at the same time as they are taken for given as inevitable ingredients of every educational setting. The main reason for this depreciation of instruction, I presume, is the great difficulties and seemingly non-effectiveness of traditional school-instruction, either as it is empirically demonstrated or as it is experienced as part of the increasing doubt about modernist planning. There are also some connected shifts in *Zeitgeist*, of the more or less taken-for-granted on the cultural scene, and accompanying changes of research focus, contributing to this change. Among these connected changes are:

- ❖ The turn to constructivism in epistemology, be it a more general postmodernist orientation, a philosophical worldmaking pluralism à la Nelson Goodman, the discursive turn within social psychology, or the discourses of construction of scientific facts.
- ❖ The attraction of the idea of actions as situated and the related idea of situated learning understood as learning as a by-product of every other activity.
- ❖ Alternative ideas of communities of learners - renewal of apprenticeship in the form of legitimate peripheral participation, Lave and Wenger (1991); small local school communities, “the connected family,” Papert (1996); community networks and learning in virtual communities, Schuler (1996); non-scholastic learning, Nielsen and Kvale (1999) - to name a few of them.
- ❖ Experiences of learning with computers, and ideas of learning environments or tool-rich cultures as resources of learning (Koschmann 1996; Littleton and Light 1999; Jonassen and Land 2000; Bliss, Säljö, and Light 1999; diSessa 2000)

Vygotsky on instruction-and-learning

It may be fruitful to regard learning and instruction as closely intertwined phenomena, and not as distinctly separated ones. I think this is what Vygotsky does with his ideas of instruction, learning, and development and their interdependencies. However, I am not quite sure because it is not easy to get close guidance on that from Vygotsky’s writings when you cannot read Russian, as in my case. I have got to know that there is a Russian word Vygotsky frequently uses, *obuchenie*, meaning “instruction-and-learning” (Veer & Valsiner, 1991, p 330, note 2) or “learning through teaching” (ibid., p. 333). As I am not competent to make a text-based exegetic interpretation of his writings, I will try instead to recapture some of the basic tenets of his cultural-historical psychology underlying also his analyses of instruction and learning.

Vygotsky’s most basic theoretical claim, that of the cultural-historical origin and nature of the human psyche, sometimes characterized as his “basic law of higher psychological processes,” is that:

“The most important and basic of genetic³ laws, to which the study of the higher psychological functions leads us, reads that every symbolic activity of the child was once a social form of co-operation and preserves throughout its development, to its higher point, the social method of its functioning. The history of the higher psychological functions is disclosed here *as the history of the transformation of means of social behavior into means of individual psychological organization.*” (Vygotsky and Luria, 1930/1994, p. 138)

“The child applies to itself the method of behavior that it previously applied to another, thus organizing its own behavior according to a social type. The source of intelligent action and control over his own behavior in the solution of a complex practical problem is, consequently, not an invention of some purely logical act, but the application of a social attitude to itself, the transfer of a social form of behavior into its own psychological organization.” (ibid, p. 119)

In short, what Vygotsky claims is that developmental functioning moves from interpersonal to intrapersonal, through instruction and guidance by others, to self-regulated learning (self-instruction).

Aspects of this “most important and basic of genetic laws” are the concepts of the “zone of proximal development” and the “method of double stimulation”. I will go on by briefly discussing the idea of the zone of proximal development (ZPD), and after that bring in the idea of the method of double stimulation. First, then, the ZPD.

“According to Vygotsky, instruction in the zone of proximal development ‘calls to life in the child, awakens and puts into motion an entire series of internal processes of development. These processes are at the time possible only in the sphere of interaction with those surrounding the child and in collaboration with companions, but in the internal course of development they actually become the internal property of the child’ (1956, p. 450).” (Quoted after Wertsch 1985, p. 71).

I want to make clear that ZPD reasonably must be regarded as a special case of Vygotsky’s “most important and basic of genetic laws.” Thus, ZPD is created as a result of social interaction. If this is the case, one may ask how this happens, how ZPD is created. Here I have found that Vygotsky counts on at least three ways by which ZPD is caused to emerge. Common for all three ways of establishing ZPD are that they build on the “actual zone of development” but go further, and that they encompass a culturally founded experience that is mediated to the child, and that they also encompass imitation “understood in a broad sense” (Vygotsky 1987, p. 210).

One of the ways is through “direct social imitation,” although often delayed until the model is no longer present. An example can be to help solve a problem of chess through instruction. Another example can be Wertsch’s investigations of mother-child dyads solving puzzle-problems (1979).

³ “Genetic” in Vygotsky’s terminology refers to genesis, most often social and cultural genesis, not biological.

A second way of establishing ZPD is, according to Vygotsky (1987) through verbal instruction. The impact of verbal instructions can be seen in the formation of what Vygotsky calls “scientific concepts,” i.e. concepts that are systematically displayed within a school subject or a scientific discipline. A third way to shape ZPD is through play (role playing of observed social roles), and it seems to be the most basic way, if one is to take Vygotsky literally (1966, p. 16).

Thus, Vygotsky explicitly claims that “direct social imitation”, “verbal instruction,” and “play” can create the zone of proximal development. Often ZPD has been seen as if it were a zone only “in the child.” There may be wordings by Vygotsky pointing in this direction, but most reasonably an intrapsychological zone in a Vygotskian sense is an interactively based concept referring to the fact that humans can instruct each other, and that children can get involved in activities, which they do not fully understand (this is not restricted to children, of course). Hence, the apt expression by Cazden (1979/1997): “performance before competence.” What is intrapsychical is not bounded within the skull or within the skin, it is also “outside,” also social, also interpsychological.

The second concept that is closely connected to Vygotsky’s basic genetic law of higher psychological functioning and which I want to discuss is, as mentioned, “the method of double stimulation” (sometimes also translated as “the method of dual stimulation”).

In short it means that if, for example (and this is an example from experiments that Vygotsky has performed), a child is going to learn something, the child needs to use a mediator. The mediator can be a heap of cards that the child uses in order to keep track of a series of words that the researchers are reading aloud for the child, words that are to be remembered. One series of stimuli, the cards, may then facilitate remembering the second series of stimuli, the orally presented words. In this case the child gets a “double stimulation,” from the oral words and from the cards. Thus, a series of stimuli was used as a means to help in conducting some mental work. However, the means just isn’t there to be used. It has to be worked out as a means by the child in a process. In a way the child has to invent the means for itself. It is like René van der Veer and Jaan Valsiner (1991) say in their biography when discussing the method of double stimulation as one of Vygotsky’s fundamental contribution to psychology:

“The human subject always ‘imports’ into an experimental setting a set of ‘stimulus-means’ (psychological instruments) in the forms of signs that the experimenter cannot control externally in any rigid way. Hence, the experimental setting becomes a context of investigation where the experimenter can manipulate its structure in order to trigger (but not ‘produce’) the subject’s construction of new psychological phenomena.” (p. 399)

Let me break here for a moment to reflect about this “method of double stimulation.” This method has some outstanding characteristics. It is a method for trying to grasp

the developmental character of the learning process. It is also a more general method of cultural growth, in the sense that it seems to be the way mental development is happening. An important feature of the method of double stimulation, to which I soon will turn, is its embeddedness in human activity.

In order to get Vygotsky's own explanation of the "method of double stimulation" we need a lengthy quotation:

"In using this method, we study the development and activity of higher mental functions with the aid of two sets of stimuli. These two sets of stimuli fulfill different roles vis-à-vis the subject's behavior. One set of stimuli fulfills the function of the object on which the subject's activity is directed. The second function[s] as signs that facilitate the organization of this activity. (...)

When the method of dual stimulation is used (...) task is presented fully to the subject in the initial moments of the experiment and remains consistent throughout. The underlying idea is that the establishment of the task or the emergence of the goal is a prerequisite for the development of the process as a whole. In contrast, the means are introduced gradually. They are introduced as the words which have been provided prove inadequate for the subject's attempts to solve the task. There is no learning period before the experiment begins. Thus, the way the task is to be resolved is transformed. The stimulus-sign or word constitutes the variable. The task is the constant. This makes it possible to study how the subject uses the sign as a means of directing his intellectual operations. (...)

When the experiment is organized in this way, the pyramid of concepts is turned on its head. This factor is extremely important (...) does not occur through a gradual transition from the concrete to the abstract. The reverse moment, the movement from above to below, from the general to the particular or from the top of the pyramid to its base is as characteristic of this process as is the reverse moment toward the pinnacle of abstract thinking.

Finally, the functional aspect that Ach referred to is extremely important. The concept does not emerge in a static and isolated form but in the vital process of thinking and resolving a task." (Vygotsky 1934/1987, pp. 127-8)

I said earlier that "in a way" the child has to invent the means by herself. This is not the whole story. The child constructs the knowledge itself, but it does not do that all by herself. In this developmental process there is also the experimenters' interaction with the child (or other people's, if it occurs in everyday life outside the experimental setting). This interaction with adults or more advanced peers is crucial. It is through this interaction that the child is "dragged into" an activity and performs in a more advanced way than she has competence of her own to do.

The experimenters' (or the grown ups') interaction with the child is what makes the two series of stimuli merge. This is what Mike Cole calls the "embedding process" (1996, p. 277), meaning the embedding of the child's actions into a joint activity system. More of this later.

As I interpret Vygotsky, the transformations “from social to mental” happen when more capable companions help less capable in the ZPD, and when the method of double stimulation is put into use. The concept of the zone of proximal development goes together with the concept of the method of double stimulation. That means that *when your analysis focuses on ZPD, the relation between people is highlighted*, and the instrument and sign used in the interaction are put into the background. But of course they are there, because people influence each other through artifact mediation, and through the method of double stimulation. In the second case, *when your account focuses on the method of double stimulation, the instruments and the signs are in the forefront*, and the interactions between people are in the background. But each time, the ZPD and the method of double stimulation go together. They are, as I see it, twin concepts in Vygotsky’s cultural-historical psychology.

To sum up, you can say that the method of double stimulation has to do with instruction and learning by modeling how people learn and how they get instructed.

Learning without instruction?

I will continue my discussion of instruction and learning by looking more closely at two current and highly influential ideas about learning. These are the perspective of Jean Lave and Etienne Wenger and the perspective of Seymour Papert and his colleagues at and around the MIT Media Lab. Inherent in both these learning conceptions are two characteristics pertinent to our discussion. The first is that learning is regarded as being in need of only a minimum of instruction. The second is that the main resources for learning are situated in the learning environment, not having much to do with instruction.

The reason why I take the ideas of Lave & Wenger, and Papert as a point of departure for my discussion is because I think both these conceptions are important steps forward in our understanding of what learning is and how to promote it, especially their insistence on what Lave and Wenger call “an epistemological principle of learning,” namely that learning is built on participation in a cultural practice (Lave and Wenger, 1991, p. 98) or, as Papert puts it, since French is preferably learned in France, math ought to be learned in a “math land.” Included in their theoretical and practical work is a critique of a traditional school-conception of learning, where learning is understood as transmission of knowledge, and as achieved detached from its “conditions of emergence” and isolated from its fields of application.

The other reason why I linger with Lave & Wenger’s and Papert’s ideas in particular is that they, despite their appeal and great merits, are parts of the current tendency among scholars of learning to underestimate the importance of instruction in learning. My attempt is to use the ground gained by them in order to come further in understanding of the relation between instruction and learning. As a companion-piece to the prevailing deep explorations of what learning is as a part of everyday activity, I

would like to promote a corresponding investigation of *what instruction is as a part of everyday activity*.

I will use two quotations from Papert to display one of his central tenets on learning as a starting point for my further argumentation. The first quote is from his book *Mindstorms* (1980) and the other from *The Children's Machine* (1993).

“In this book we have considered how mathematics might be learned in settings that are real, socially cohesive, and where experts and novices are all learning. The samba school, although not ‘exportable’ to an alien culture, represents a set of attributes a learning environment should and could have. Learning is not separate from reality. The samba school has a purpose, and learning is integrated in the school for this purpose. Novice is not separated from expert, and the experts are also learning.” (1980, p. 179)

“Constructionism (...) does not call in question the value of instruction as such. (...) The constructionist attitude to teaching is not at all dismissive because it is minimalist - the goal is to teach in such a way as to produce the most learning for the least of teaching.” (1993, p. 139)

The first quotation may be interpreted as suggesting that spontaneous learning is all there is: “learning is not separate from reality.” From such a perspective, there seems to be no need for teaching. Such an interpretation of Papert’s approach may be corroborated from the text in the rest of the book. The second quotation, from the later book, however, states that there is, and must be, teaching too, although it ought to be kept at a minimum.

Lave and Wenger consequently argue “in favor of a shift away from a theory of situated activity in which learning is reified as one kind of activity, and toward a theory of social practice in which learning is viewed as an aspect of all activity” (Lave and Wenger 1991, p 37-38). In a different phrasing they put forward the idea that “learning is an integral part of generative social practice in the lived-in world.” (ibid., p. 35)

Lave states that “our understanding of both learning and teaching” is “problematic” and “inviting new analysis” (1996, p. 154). So far, she argues, there have been questionable patterns in research on teaching and learning. One of those is that “questions about learning are almost always met by educational researchers with investigations of teaching.” The other pattern she discerns is that “much research that purports to be about learning (...) deprives us at one and the same time of clear analyses of learners as subjects - and teachers as subjects as well.” (p. 158)

Lave’s own “short agenda for research on teaching” is to study “what teaching is, from the perspective of learners learning” (1996, p 158 and 150). The rationale for this research agenda, she expresses in the following way: “if teachers teach in order to affect learning, the only way to discover whether they are having effects and if so

what those are, is to explore whether, and if so how, there are changes in the participation of learners learning in their various communities of practice” (ibid., p. 158).

“Learning environments”

If learning is a more fundamental and important phenomenon than teaching, an idea that both Lave & Wenger and Papert can be said to argue, then it follows that “learning environments” must be important for learning.

One such perspective on learning environments, and an innovation within educational theory attracting many people nowadays, is the concept of “community of learners.” The least common denominator of this concept is that people are learning resources for each other. That people are learning resources for each other is, in my opinion, a fact. My objection toward the concept of learning environments starts only when it is not taken into account *how* people are learning resources for each other, and how artifacts are involved in the interactional play of instruction-and-learning.

Very close to the concept of “community of learners” is the idea of “community of practice” (Lave and Wenger 1991). In the opening of their book, Lave and Wenger claim that “the meaning of learning is configured through the process of becoming a full participant in a community of practice.” They stress that they choose the concept of legitimate peripheral participation specifically “to draw attention to the point that learners inevitably participate in communities of practitioners.”(1991, p. 29) Later (in Chapter 4) they explain that “structuring resources for learning come from a variety of sources, not only from pedagogical activity.” Therefore, they focus their attention on “the structure of social practice rather than privileging the structure of pedagogy as a source of learning.” This structure of social practice encompasses access to different resources, e.g. technological artifacts, and actually, “access to practice.” This is the ground for the claim that “mastery resides not in the master but in the organization of the community of practice of which the master is part.” (I will return to Lave and Wenger and their concept of apprenticeship and “legitimate peripheral learning.”)

Proponents of constructionism have also recently underlined the importance of communities of practice. In the introduction of the book *Constructionism in practice. Designing, thinking, and learning in a digital world* Kafai and Resnick write: “The idea of community has always been present in the constructionist vision. In *Mindstorms*, written in 1980, Papert discussed the Brazilian samba school as an example of a community of learners. But many of the early constructionist studies focused primarily on the development of the individual learner. It is only in recent years that idea of community has emerged as a major theme in constructionist research.” (1996, p. 6)

In his conception of constructionism Papert attaches special importance to the learning environment. “The construction that takes place ‘in the head’ often happens

especially felicitously when it is supported by construction of a more public sort ‘in the world’ – a sand castle, a Lego house or a corporation, a computer program, a poem, or a theory of the universe. Part of what I mean by ‘in the world’ is that the product can be shown, discussed, examined, probed, and admired. It is out there.” (1993, p. 142)

Gregory Gargarian, also a constructionist, has pointed out that the notion of microworlds was invented by Papert as an “answer to critics of Logo’s discovery learning. The main arguments of the critics were this: ‘Discovery learning is fine: it may even be the best way to learn. However, it takes too much time. If it took the whole of human history to bring us to our present knowledge, how can we expect children to ‘discover’ this knowledge on their own?’ Microworlds provide the means to control what is discoverable without giving up discovery learning.” (Gargarian, 1996, p 151)

Gargarian further states: “If the interactions within microworlds require instruction, then the microworld needs to be improved.” (ibid., p. 150). That Constructionism recognizes, although reluctantly, the need of instruction, but has no theoretical conception of what constitutes instruction, is for me a problematic position. A second problem for constructionism is, as I see it, that there is a hidden agenda of influence by implanting microworlds that are rich for learning. There is no elaborating in theoretical terms about this type of instruction the constructionists are practicing.

In “Skiing as a model of instruction,” Burton, Brown and Fischer (1984), write something that partly can be regarded as an answer to the objections I have just raised:

“Learning environments can be examined in terms of a paradigm called ‘increasingly complex microworlds’ (ICM). In this paradigm, the student is exposed to a sequence of environments (microworlds) in which his tasks become increasingly complex. The purpose of an individual microworld is to provide the student with a task he can perform successfully using a simplified version of the final skill that is the goal. This allows the students to focus on and master one aspect of the skill in a context that requires related sub-skills. As a result, the student learns when to use the skill as well as how to use it. The purpose of the sequence is to evolve the simplified skill toward the goal skill. The ICM framework focuses both on what is learned in any particular microworld and on how to choose the next microworld in the sequence.” (p. 137)

One has to conclude then, that even if learners construct their knowledge in a microworld and learn on their own, there is an orchestrating pedagogue behind the scene. The need for a conductor in any form, be it a teacher, a supervisor or whatever, reveals learning as an activity of a non-accidental nature. Learning is a social phenomenon; planning, interaction and societal objectives are involved. In the words of Cole & Engeström (1993, p. 23): “Learning is part of a larger, joint activity, called instruction.”

Although I acknowledge the ground gained by the explorations of learning in communities of practice, LPP and microworlds, I do think there is a need for a further step in the analyses. In all those approaches, it is pointed out that learning is a mundane phenomenon, that the subjects are actively construing their knowledge, and that learning takes place in a community of practice – all in contrast to how school-learning is conceptualized and practiced. All this is fine – but what is the role of other people when one is learning in a community of practice? Barbara Rogoff (1990, 1995), is one of those who have given an answer to this question by her insistence on “guided participation.” What is happening, according to Rogoff, is that instruction and learning occur on “three planes.” There is “apprenticeship” on the community and organizational plane. There is “guided participation” by those who take a tutorial role face-to-face, but it happens also by means of “side-by-side” joint participation, and by means of invitations to cultural and social values from “more distal arrangements” (1995, p. 142). Finally, there is “participatory participation” on the side of the individuals who are learning.

In more theoretical terms, my objections can be summarized in two points. My first point is that the approaches do not make a distinction between on the one hand learning as a general phenomenon, i.e. as a side effect of every other human activity and, on the other hand, learning as a specific activity. In other words, they do not differentiate between learning restricted to only actions and learning as an activity, which includes learning actions. My second point is that they underestimate or ignore the influence of instruction on learning or the close connection between instruction and learning.

Before I continue my discussion, there is a need to define instruction/teaching and learning.

What is learning?

Regi Enerstvedt (1985, 1988) is to my knowledge the one who most clearly has stressed and elaborated upon the distinction between learning as a universal act (learning for all living organisms) and learning as a special activity. He explains *learning as a universal act* by saying that “[a]ll *active systems* (organisms including human individuals, societies)” also produces “information activity in which we find evaluations, choices, and decisions.” He suggests:

“I propose that we call self-transformation *derived from* such an information activity “learning.” Such a transformation is unique to living beings (...) *Learning is the self-transformation derived from a system’s own information activity.*” (1988, p. 11)

Enerstvedt claims that a second kind of learning, *learning as a specific activity*, is characterized by having “a goal different from all other activities, namely the goal: *transforming of the self.*” (ibid.) But he finds it “difficult to define learning activity.” (p. 13) In an earlier text he has proposed “a short definition of learning activity,”

namely: “*Learning activity is motivated learning.*” (1986, p. 192; italics, B.S.) The problem in defining learning activity seems to stem from the fact that there are at least two answers to the question of what the goal of this motivated activity is: the mastering of knowledge or the method for mastering of knowledge. (1988, p.12)

According to Enerstvedt, we thus need to make a distinction between learning activity on the one hand and learning as a universal act, i.e. as learning actions within any kind of activity, be it the activity of play, learning, work, or whatever, on the other.

Vasily Davydov (1988, p. 30) introduces a second kind of distinction of importance to learning. It is a matter of development. He claims that learning as activity presupposes a developmental dimension:

“What is special about learning activity is that the pupil appropriates *theoretical knowledge* in the process of its realization. The content of this knowledge is the *emergence*, the *becoming*, and the *development* of some object.

When, however, we observe the appropriation by pupils of such knowledge as is presented to them by the teacher in an already clearly formulated and ‘finished’ form, in which the emergence and development are missing, then we can conclude with assurance that the pupils are *not* engaging in *learning activity*.”

If this developmental dimension is missing in the learning process, if the “lessons learned” concern a fixed content, then what is happening is not learning activity, according to Davydov. What is going on is a more superficial form of learning built upon empirical generalizations rather than theoretical generalizations, aiming at mastering content rather than mastering a new method. As can be seen Davydov’s criterion on what may count as learning activity is a strong criterion. According to him, learning at school almost never meets that criterion (1977, 1999, p. 125).

Also Bernd Fichtner (1984, 1988, 1996) maintains that a developmental aspect is essential to learning activity. I will give a short free-hand sketch of his arguments before I go somewhat into his detailed argumentation. According to Fichtner, the emergence of learning activity in Europe during the nineteenth century implied that learning was associated to development in an earlier unknown way. During the Middle Ages, the content of learning was stable and inflexible, laid down from the beginning. In the center were sacred texts that rendered the core of the canon. These texts were so to say without history – in the beginning was the Word. They established the fundament of the tradition, were fixed and ready as Athena when born out of the head of Zeus. Given such a tradition, learning meant reproduction of texts. Learning by heart of hymns can stand as an emblem of this kind of activity. Learning under these circumstances could not transform the content of learning, nor could it change the learner himself. Fossilized knowledge “is degraded to ‘stuff’ and the pupil becomes a container to be stuffed” (1988, p. 44). This kind of learning did not have much to do with development. With the introduction or emergence of the

Humboldtian educational tradition, this was changed. “Learning first had to be directed to a scientific knowledge as ‘subject matter which all own doing always has to follow’ but an orientation on learning how to learn was – at the same time – of the very same importance” (1984, p. 58).

After stating what human learning is as a general phenomenon, Bernd Fichtner (1996, p. 11) continues: “Learning activity means a historical form of this appropriation, namely a form of learning that is characterized by reflections on the process itself, reflections on itself as a subject, and reflections on the result.”⁴

Built on a historical analysis of the emergence of learning as activity, Fichtner comes to the conclusion that “substantiation of knowledge” and “development of knowledge” are the units of analysis, which are constitutive of learning activity. However, he points out, “‘substantiation’ and ‘development’ were separated as bases of analyses; they belong, however, essentially together.” (ibid., p. 46). Let us see how he weaves his story by using his three “reflections-on”-elements.

Reflections on the process itself. That means “substantiation, foundation,” and it “denotes ground, bases and safeguards, clarifications and prerequisites. Substantiation thus requires reflection: what is real knowledge and how can it be distinguished from that which has not earned this designation?” (1988, p. 45)

Reflections on itself as a subject. “Knowledge is always knowledge of something and always a subject’s knowledge. This subject is never the isolated individual. Knowledge which only one person can possess is not knowledge. Knowledge has its origin and beginning in the necessities of social life, in societal practice as an original unit of practical transformation of external objects, and of the cognition and communication necessarily connected to it. Knowledge is accordingly neither an immediate phenomenon of consciousness nor an independent existing object. ‘Substantiation’ denotes its fundamentally mediated nature.” (ibid.)

Reflections on the result. “It follows from the fundamentally mediated nature of knowledge that it can be learned and taught only in its development.(...) But which are the essential relations that determine the development of knowledge in appropriation? For one, it is the relation of knowledge to its accompanying object domain; for another, it is the relation of knowledge to the active subject. (...) Both relations, that of knowledge to reality as well as that of knowledge to subject, are realized, developed, and regulated in activity and, conversely, both relations determine activity itself. The development of knowledge always implies that activity itself also develops. Learning activity is thus no mere consummatory mechanism or

⁴ “Lerntätigkeit meint eine historische Form dieser Aneignung, nämlich ein Lernen, das durch eine Reflexivität gegenüber dem Process selbst, gegenüber sich als Subjekt und gegenüber dem Resultat gekennzeichnet ist.”

simple linear sequence of events, but rather is itself a diverse, rich, but also contradictory, process of development.” (ibid., p 46)

To sum up, the activity of learning is concerned with the fact that knowledge is produced and has a history. In order to gain access to knowledge one has to know its “circumstances of production” and its mediated character. Knowledge develops and so does the learning subject – the individual subjects and the collective subject – and, accordingly, the knowledge-generated activity itself.

In his dissertation, “Learning by expanding,” Yrjö Engeström (1987, p. 125) *defines learning activity as “an activity-producing activity.”* In another phrasing he says (Engeström 1987, p. 155-156): “In learning activity, development itself becomes the object of learning.” Thus, the outcome of learning activity is an activity. In my opinion, this definition of and the stance it expresses to learning and development is very fruitful and very radical. I will come back to that later.

All of the researchers that I have referred to in this section, have development as an essential aspect of learning activity. When learning activity is going on, something is transformed – the content of learning, the individual subject, and the activity system that ‘contains’ the learning activity. Engeström explicitly takes the aspect of expansion the furthest: learning activity is an activity-producing activity. The outcome-activity can be the learning activity itself that is changed into a new learning activity. This is what Davydov aim at with his experimental teaching in school, and it is what Humboldt achieved. The outcome-activity can also be another activity, for example work activity, which the activity of learning transforms or produces. I believe this can be regarded as a “quantum leap” in the relation between learning and development. From a focus on the transformation of the individual (which is at the heart of “learning” in our culture) to a focus on the transformation of an activity system. In the first case, the learning activity system also changes, and in the latter case, individual members of the activity system also do. One can say that the specific activity has changed from learning/development to development/learning.

As a summing up of this section, we can state that there are at least two kinds of learning to discern: action-level learning involved in every activity, and learning as a specific activity. As a specific activity, learning has as its object the self-organized reproduction and development of the very activity system (Engeström) or an active system’s (individual person or a community) transforming of itself (Enerstvedt). The consequence is that learning as an activity is intertwined with development. And in this intertwining of learning and development, the focus can be either on the development of individual people or on activity systems.

What is instruction/teaching?

Enerstvedt (1988, p. 13) makes a distinction between education on the one hand, and teaching on the other hand, the later being a public form of education.

“I propose that education activity be defined as a specific activity whose goal is the transforming of a system’s activity in such a way that the system can (better) perform the same or another activity. The system could be a society, a group, human individuals, and animals.”

Teaching is defined by Enerstvedt as: “a (stage or level) of *publicly organized educational activity*.”

N. L. Gage, in a chapter on “Theories of Teaching”, *Theories of learning and instruction* (NSSE Yearbook 1964, p. 269) quotes from a dictionary that defines “teaching” as: “The art of assisting another to learn. It includes the providing of information and of appropriate situations, conditions, or activities designed to facilitate learning.”

The definition that Tharp and Gallimore (1988, p 21 and 31) propose is that: “Teaching consists in assisting performance through the ZPD. Teaching can be said to occur when assistance is offered at points in the ZPD at which performance requires assistance.” And: “Teaching must be redefined as assisted performance. Teaching consists in assisting performance. Teaching is occurring when performance is achieved with assistance.” In a later work they use the expression “assisted performance” as a synonym for teaching (Gallimore and Tharp 1990, e.g., p. 176).

I am convinced that Gary D. Fenstermacher, as can be concluded from an article in the Handbook of research on teaching, third edition, would disagree with the latter two definitions of learning. (1986, p 39): “Because the term ‘learning’ functions in both a task and achievement sense, it is easy to mix the two and thus contend that the task of teaching is to produce the achievement of learning, when in fact it makes more sense to contend that *a central task of teaching is to enable the student to perform the tasks of learning*.” If I correctly understand what Fenstermacher says, it is that the “achievement of learning” - or in the words of Gallimore and Tharp, “performance” – is not the objective of teaching. The objective of teaching is instead to teach the student how to learn.

In my interpretation, Gage, and Gallimore & Tharp focus on the level of actions. And for Gallimore and Tharp “responsive teaching and instructional conversation” (, 1986, p. 111) are the main means of teaching. Fenstermacher focuses on another level of learning, meta-learning or learning activity, and consequently on another level of teaching. This is also what Davydov does. According to Davydov (1988, pp. 30 and 31) “solving the learning problem” is central for pupils to learn actions that may be developed into a learning activity. And about the learning problem he says: “The main characteristic of a learning problem is that, in the process of solving it, pupils

discover a *general procedure* (or *principle*) that can be used for the solution of a whole range of individual concrete problems of a particular class.” Accordingly, Davydov’s conclusion concerning “the main method for instruction in school” is:

“The main method for instruction in school ought to be that of introducing pupils into the situation of the learning problem and the organization of learning acquisitions, in short, *the method of getting pupils to solve learning problems.*” (Italics in original; underlining by B.S.)

Fichtner’s conception of instruction is a pendant to his conception of learning. His historical analysis showed that before the nineteenth century instruction aimed at the “substantiation/foundation” of already prepared knowledge, i.e. as transmission of stuff: “Learning remains reproductive and receptive, it is fixed immediately upon contents ” (1984, p. 51). Pupil-centered instruction that has been suggested as a reaction against the traditional school transmission of stuff, will not do according to Fichtner, because it means that instruction abandons the content and degenerates into “light-weight conversation or entertainment” (Unterhaltung) (1988, p. 44). The historical perspective that Fichtner outlines gives the context for determining what kind of instruction has become urgent:

“At the beginning of the 19th century school became a societal arrangement serving the education (Erziehung) and upbringing (Bildung) of all. This purpose received its institutional, organizational, and contextual shape in a public, general educational system of compulsory schooling that took form within the contradiction of bourgeois society. School now had no longer to do with particular societal domains such as trade, industry and the arts, but rather for the first time had to realize a universal relation to society as a whole. School was given the task of a ‘general production’ of knowledge, capabilities, and normative attitudes in all individuals (...) School thus acquired a quality that was new in comparison with all of its previous forms.” (1988, p. 42)

This new quality of education is, according to Fichtner, “development of personal sense,” which for the first time became an overall societal task, and this has consequences for instruction:

“The general-educational school approaches the purpose of education and upbringing in a fundamentally mediated way⁵ because instruction as an immediate sense-forming process is not possible. ‘Sense’ cannot be taught; the development of ‘personal sense’ must be conceived pedagogically in terms of the appropriation of ‘objective meaning.’ In instruction, pupils are dealing with a new societal form of knowledge that is relatively new, historically speaking: *this is the content of instruction.* They accomplish this in an equally new form of learning: learning activity.” (ibid., p. 43; italics by B.S.)

⁵ This is the ground for Davydov’s insistence upon “theoretical generalizations” and not only “empirical generalizations” (Davydov, 1977).

Conceptions of instruction and learning face the problem of the unit of analysis or the practical unit of intervention. What is expected to be learnt – a list of nonsense syllables, an arithmetic problem, reading of texts, the basic skill and stance of an occupation, the social competence of being a good citizen? And what kind of instruction will promote that, and how? Instruction appropriate for school, for apprenticeship, or for development of work practices obviously have different “units of instruction.”

Fichtner’s interest in instruction and learning is first and foremost oriented toward education at school, while Engeström and colleagues at the Center for Activity Theory and Developmental Work Research in Helsinki (e.g. Miettinen, 1999) have an idea of learning and instruction that explicitly goes beyond traditional schooling. It also includes learning, intervention, and development of work activity.

Engeström (1994, p. 5) explicitly distinguish between two kinds of instruction: “There are two kinds of education. One is the influence people experience in the context of other activities. (...) Another form of education is systematic *instruction*. Instruction, or teaching, that aims at conscious, goal-directed learning. Its task is to motivate, direct and facilitate studying.” Concerning the “range” of learning and instruction, or its unit of analysis and intervention, Engeström has expressed that “the proper unit of developmentally effective, expansive instruction is not a discrete task, but a whole cycle of activity generation, of learning activity, corresponding to the phase-structure of the zone of proximal development.” (1987, p. 188; italics removed). It is worth noting that in Engeström’s conception of expansive learning and expansive instruction is included also an expanded notion of the zone of proximal development, which is defined in the following way:

“the distance between the present everyday actions of the individuals and the historically new form of the societal activity that can be collectively generated as a solution to the double bind potentially embedded in everyday actions.” (1987, p. 174)

The distinction between activity and as actions/operations has been put forward by A. N. Leontiev is, in a principal way, not only restricted to instruction and learning. Thus, the distinction is between action/operation on the one side, and activity on the other. Activities are of a collective nature and are realized or conducted through actions by individual people. The motive or object of the activity is constitutive for the activity. In the famous example of A. N. Leontiev (1981, p. 210) of a primeval collective hunt, the motive/object for the hunting collective is probably (Leontiev is not explicit on this point) reproducing the tribe by getting food or skin for clothing. For people involved in an activity, the motive/object is most often not conscious. It works behind their back so to speak. On the action level the goal is conscious, and goals may differ for the individuals or for groups of individuals. If we go back to Leontiev’s hunters again, there was a group that had the role of beaters, and a second group that was hiding in the ambush prepared to kill the animals. All individuals involved in the activity of hunting of course also perform different actions (one hides

standing behind a tree, another crouches down behind a big stone, and so on). How they operate in their actions depends on the detailed circumstances, and the operations are non-conscious and performed habitually.

What I have suggested here is that it may be fruitful to make distinctions related to learning and instruction. The first distinction will be to recognize learning and instruction as parts of every activity, i.e. as actions embedded in an activity. The second distinction implies that learning and instruction are distinguished also as special kinds of activities. I think these distinctions are also important for an understanding of the relation between instruction and learning. The first distinction opens up for an understanding of that the kind of learning that occurs in school is not only connected to what is taught. Learning occurs also as a consequence of participation in school-going. The second distinction helps us recognize that learning as embedded actions is not the only learning that occurs. There is also learning as an activity, the self-managing of a subject's learning project (and the subject can be an individual person or a collective subject, e.g. an organization).

Instruction and learning – two distinctions

I want to highlight two distinctions that I think are fundamental for an understanding of instruction and learning. The first of these came up in the overview of definitions of learning and instruction/teaching. It is a distinction between instruction and learning as particular activities on the one hand, and instruction and learning as actions embedded in other activities on the other hand. The second distinction is the distinction between instruction and learning of the culturally given on one hand, and instruction and learning of the societally new on the other.

I will discuss the second distinction here, and I will start by contrasting learning at school and learning at work.

Teaching and learning at school have a special character. Schooling means a large-scale institutionalization of teaching of what the society regards as some basic abilities that need to be learned in that society, but that are not spontaneously learned (Hamilton, 1990). Which of those basic abilities are to be taught may be contested, but when they have been laid down in school regulations and curricula, they represent something *given* that the teachers have to teach and the students have to learn. Learning what is already given is thus the distinctive mark of school learning, and instructions are provided by more competent people, the teachers.

Vygotsky's concept of zone of proximal development (ZPD) can be adapted to instruction and learning at school. When that occurs, Vygotsky's idea that the more competent person may be a peer has often been used. This has consequences for authority and power distribution in the class. What is given during such circumstances is more negotiable and less fixed. No matter how changed such pedagogy relying on peer-to-peer interaction may be, it does not change the fact that the acquisition of the more or less given is the goal of school learning.

Instruction and learning at work have, I will argue, in principle a different character. The only thing that is given in work is that there is nothing else given than to get the work done. You may use old standards, tools, ways of organizing and so on when you are working, but there is always something new to be taken into consideration. This newness is a feature of the production. It may be covered or reduced in different ways, but it is there. This is particularly salient in working life of today. Here I do not refer to stereotyped work, like work at the assembly line, because it is not very connected to learning actions and activities at all. Of course there is learning there too, but it means incidental learning rather than transformative learning, e.g. new operations and learning how to endure and survive, important things but not what I am focusing on here.

Let us say there is a ground for the distinction between what I term traditional teaching and learning, usually connected to schools, and learning of the new, connected to learning in modern working life (but also higher education). How are we then to think about the ZPD and about instructions? I think we can use Engeström's expanded definition, mentioned earlier, which he has phrased in the following way:

“At the level of a whole community of practice the zone of proximal development is a contested area between the traditional practice and alternative future directions.”
(1994, p. 128)

What does instruction look like when learning the new, when achieving “future practice,” an activity that is “collectively and expansively mastered” (Engeström 1987, p. 284)? Maybe it could be what I will call “in-house instruction”?

Following Enerstvedt (1986, 1988), education may take place, not in its public form of teaching, but still with the goal of transforming “a system's activity in such a way that the system can (better) perform the same or another activity.” This kind of education, *in-house instruction*, in contrast to school instruction or other sorts of publicly organized instruction, has the aim of educating staff or other people in order to change some part(s) of an activity system. Thus, the aim of in-house instruction is learning activity, i.e. “an activity-producing activity” (Engeström, 1987, p.125). It is a kind of “instruction of ourselves.” It is preceded by the formation of a collective agent of the activity who takes charge of educating the activity system, in parts or as a whole. The outcome is in-house instruction. It is one way of accomplishing the “transforming of a system's activity in such a way that the system can (better) perform the same or another activity.” This self-initiated development means that the activity system is ‘teaching itself’. In-house instruction, therefore, also indicates intentional learning.

When I have seen such “self-initiated teaching-and-learning” (Sutter 1994), it has not been in a “pure” form. It has been in the form of an organization “asking for help.” Some people in the organization with the ambition of enhancing the quality of the work of their organization took the initiative to seek an educational intervention. But

the staff of the organization did not accomplish the transformation all by themselves, they engaged consultant advisers from outside. These consultant advisers provided support in the change process, by modeling the activity in theoretical terms, by pointing at good examples from similar activities or by other means, in short, by instructing. Notwithstanding the help from the outsiders, the activity may be regarded as a beginning of in-house instruction, a special kind of instruction and learning at work.

The distinction between instruction and learning of the culturally given on one hand and instruction and learning of the new on the other hand, has been made clear especially by Yrjö Engeström. As I see it, it is consequence of his definition of the activity of learning as an activity-producing activity and of his elaboration of learning connected to work activity. I believe it would have been difficult, if not impossible, to make this line of demarcation between *traditional learning and teaching* and *collaborative mastering of the new*, if Engeström had only conducted research within a school context. The distinction changes the distinction between learning and development, which can be described by a changed quotient: from learning/development to development/learning. It should be observed that the distinction, although it has its origin in studies of learning and development at work (if I am right), is valid for learning and development in general, be it at school, at work, or in some other activity. I sum it up in Figure 4.

Traditional school-instruction is a way to organize learning of what is societal important but that is not spontaneously appropriated. The same holds true for in-house instruction at work. In both cases it is about learning as activity. Learning as a by-product of participation in an activity is about learning of actions and strings of actions. It is the most common way to learn. One learns what is given in the culture by participating in the culture. On occasion, spontaneous innovations occur as actions in response to challenges in work practice (see, for example, Sutter and Lindberg, 1994).

	LEARNING AS APPROPRIATING THE GIVEN NEW	LEARNING AS COLLABORATIVE MASTERING OF THE SOCIETAL NEW
Learning as special activity	E.g., organized as traditional school-instruction	E.g., organized as in-house instruction at work; Learning by expanding
Learning actions and operations	Learning as by-product of participating in activities	Spontaneous innovative work actions

Figure 4. Instruction and learning connected to the “given new” and the “societal new”

Methodological approach

In this section I will describe the approach and the methods I have used in my empirical studies, and also say some words about the structure of the present introductory paper.

As suggested by the title, this work has a dual objective. One part is to give a description of coronary diagnostic work, how the members co-coach (support) each other in everyday work, how they learn and develop the activity and their own abilities. This part comprises the six papers grounded on empirical research. The other part is to make a contribution to an activity-theoretical conception of instruction-and-learning and its relation to development of the activity in question. This part consists of the present paper, which is an attempt to sum up the findings and put them in dialogue with selected literature from the research field.

The dual objective of this thesis creates a tension that is visible in the introductory paper. On the one hand, I will sum up the achievements from my empirical studies concerning instruction, learning and development. For that I need to write a cover paper. On the other hand, I will take part in the theoretical debates on these topics. For this purpose I need to write a rather comprehensive text and relate it to the outcomes of my empirical papers. That would mean a comprehensive paper or a book, far more extensive than I can provide in this study. How to overcome the gap inherent in my dual ambition? My attempt to bridge the gap is to select a sharp focus – instruction – and use it as an entrance to the broad research area of learning and development.

Learning cannot be directly observed. This makes it necessary to find methods to get a grip of the phenomenon. My mode of procedure is to study instruction, which is reasonable in the light of my conviction that instruction-and-learning comprise a twin process. The idea thus is that as I am interested in instruction, learning and development as part of the ongoing activity of the coronary diagnostics, I have chosen interaction analysis of video logged work activity as my main method. I rely on the instructional part of the interconnected activity of instruction and learning. In this way, instruction, displayed as actions and operations, can be directly accounted for, and also, I claim, indirectly learning.

That instruction is important in instruction-and-learning and *that* mediating artifacts are parts of actions and activities is inherent in the cultural-historical activity-theory perspective I use. *How* it occurs cannot be specified by referring to the perspective or paradigm. It has to be explored, and I do that by means of empirical studies of coronary clinical work at the Blekinge hospital in Karlskrona.

My empirical studies have been conducted during two main periods, November 1994 to August 1996 and September-October 2000. The first and longer period had its focus on the heart conferences, which at the time were accomplished as telemediated diagnostic meetings (heart conference study). The second (short) period focused on

design and redesign of a central artifact, the “angio”, and the connected work activity that took place in the Angio Lab (Angio Lab study). This is the general pattern of time allocation of the studies; however, during the first period I also studied what was going on in the angio lab, and during the second I attended heart conferences; and between the two main periods I visited and made observations at the angiolab and the heart conference sporadically.

Figure 5 shows the distribution of the empirical studies over time, and relates them to the transformations of the coronary clinical work activity.

21 of the weekly hold heart conferences that are part of my empirical investigation are marked in Figure 5. 17 of them were video-recorded, and the other 4 were recorded only by means of fieldnotes. The methods used in the study are ethnographical. I have written fieldnotes, made videorecordings of conferences, made interviews, have been “hanging around,” collected documents⁶ used in the clinical work practice, have had informal talks with physicians and nurses, and also, during periods when I have not frequently been at the sites, kept me updated of “what’s on” through telephone talk with my main informant. The aim of the ethnography has been to “come close” to work practice, find out “how the job is done” – what artifacts are used, how the work is organized, how the content of the work is established, how the interaction between the participants looks like, and so on.

The studies I undertook in the angio lab differ from the studies in the heart conference, where I relied heavily on video-documentation. From my physical placement in the Karlskrona site of the heart conference, my “object of study”, the diagnostic work at the telemediated heart conference was possible to get a grasp of. However, when I did empirical studies in the angio lab, and especially when my object of study is the angiographic artifact, I have to proceed in another manner. The production and use of the angio artifacts are distributed in space and time, and different people are involved, on different occasions. Therefore, my point of observation cannot be stationary. The methods I have used are observations and fieldnotes, questioning after the events, interviews, and collecting of graphic artifacts. I have been “hanging around” at the workplace, asked for details and expressions to be explained, and I have asked the members for comments on texts I was writing.

In the heart conference site I had a sort of privileged position from where I was able to watch many of the actions of the participants (although I did not have access to the site in Lund except from the “window” the conference screen provided). When the work activity cannot be studied in detail in real time, as often was the case in the

⁶ All documents I have got access to have been made anonymous as information that relates the document to an individual has been taken away by the physicians.

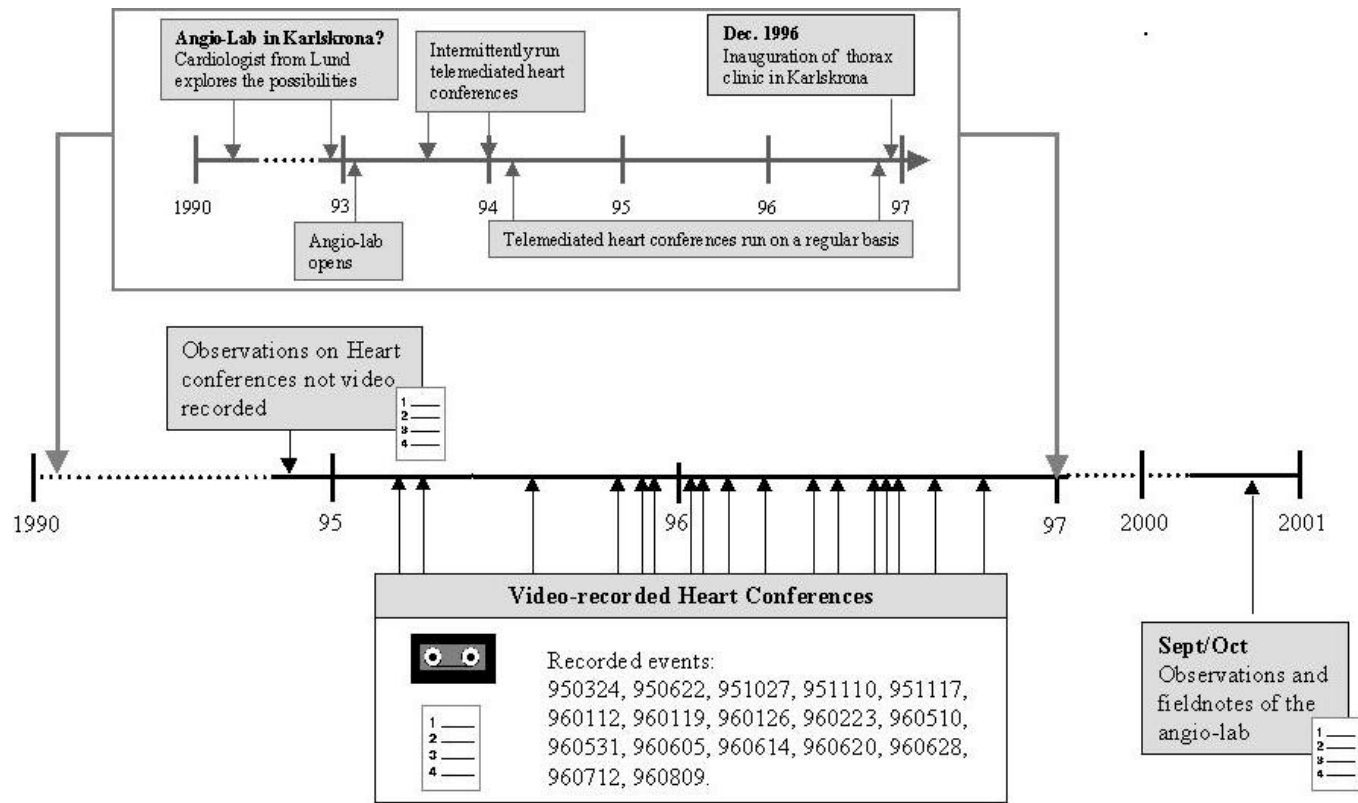


Figure 5. Distribution of the empirical studies over time and related to development of the coronary clinical work.

angio lab, an alternative way of working must be applied. In the angio graphic study I therefore combined ethnography with a methodology inspired by Petroski (1999), namely “archeology of artifacts.” The idea is, when work practice cannot be studied in real time, to follow the traces of the activity, and study the transformations of the artifacts. In my case, the production and redesign of the angio graphics have been in focus. According to Petroski, artifacts can be “read” by people who are culturally literate, and therefore the work activity of which the artifacts are an outcome can be reconstructed. If one does not have access to the best thing, the present work activity, Petroski argues, you can have “the next-best thing”, the artifacts that are produced and used.

By way of conclusion to this methodological section I will take up two things of importance, the unit of description and analysis, and my position as observer.

The unit of analysis. What is the appropriate unit of analysis if one is interested in instruction-learning, and the development of the work activity? Difficult question. What I have had as empirical unit of analysis is the heart conference with its 10-15 patient cases. If one wants to go into detail, and I do, a whole heart conference is practically impossible to analyze and present (I make a “reduced try” in Paper VI), and even a whole patient case is too much if the analysis should be substantially detailed (also here I offer attempts that are compressed, partly giving an overall picture more superficially, and partly a detailed analysis; Paper I and Paper V). Detailed analyses work best for short pieces of interaction.

If one wants to study activity (the systems of actions and operation that make up repeated cycles in a culture) as well as actions and operations, one needs details and a general view. Thus one needs something “between the artificially-isolated fragment of discourse and the ambiguously-global argumentative social fabric” as Engeström (1999, p. 173) puts it. His idea about the alternative is “the middle ground of the situated activity system” (ibid.). I agree. The question is how to conduct research on the middle ground.

The clinical work I am studying consists of many layers and phases. If the ultimate move for the patient is surgery, balloon dilatation or some other treatment, the heart conference makes a kind of “center of calculation” (Latour, 1987) for consideration of the step to take. The heart conference is like Churchill’s “war cabinet” during the Second World War. From the cabinet an overview was possible to get, and the war could be “seen” by means of innumerable reports and pieces of information, which were put together into a battlefield map. In a similar way the heart conference is a center where the status of the patient’s heart condition can be “seen” by means of best available information that are produced during a long period of time by different informants (GP’s, cardiologists at local hospitals, specialists on x-rays, scint tests, and so on). All information passes from the periphery to the center where the large jigsaw puzzle is being laid with the aim to grasp the significant features of the patient situation and suggest a move for how to proceed.

The work activity I am studying consists of many layers and many phases. In the center are the heart-conference diagnostic meetings and the surgical operation room. A little more peripheral are the angio lab and the physiology clinic, where lab test are taken. More in the periphery is the examinations made at the local hospitals, and by the general practitioners, not so far from the life worlds of the patients. I think it is clear from what I have said so far, but it is worth pointing it out again, that all clinical work done on all other places than the heart conference room and the angio lab has been out of my "field of observation." What I have been able to see are traces from this work, to the extent it is displayed by the participants in the heart conference or the angio lab. It is a shortcoming of the method I have chosen. I only get access to fragments of the health care system's "processing" of the patient, and I don't see the person-patient in his life world. A strength of the method and the point of observation I have chosen is that it make possible to observe coronary clinical work in a phase where it is compressed or thick or loaded, in the sense that it is a work at the center where "all" earlier data concerning the patient is gathered. The fragment I am studying is "thick" (like the thickness of Geertz's "thick description") and substantial. To utilize this resource is the idea of my ethnography. The relation between the work activity I am studying and the more overall work activity concerning the patient and his problem is important, and I need to use other methods to grasp the significance of that context for the problem I have chosen.

Thus, by means of my methods I get a glimpse and eventually an insight into the work practice that I am interested in, especially at the clinical meetings named heart conferences. From my position as observer in the site I was able to see, and with help of the video records, to reconstruct a short sequence of the prolonged clinical work with each patient. It is a short event, lasting about 5 minutes, while the cardiologist presents the patient history, and the angio-film of the patient's working heart is presented and discussed. I observe a condensed version of the clinical work that has been distributed in time and place and between many staff people at health care institutions.

My role and position as observer. In the heart conference I was, if not a fly on the wall, at least a peripheral person from the university coming and sitting at the auditory seats with my video camera. In no substantial way my presence influenced what happened in the heart conference. The same is true about my presence at the angio lab. Certainly, I was there for a longer time period, I was more actively communicating with the staff, posed questions, asked about details, got material I asked about, engaged in discussions, and in that sense I was involved in part of the interaction that was going on at the lab. However, the angio-investigation activity was not conducted differently because of my presence. The receptions and investigations of the patients were as they used to be, and so was the handling of the documents in paper- and electronic forms.

Learning the given new

What does it mean to say that learning is a collaborative phenomenon? In this section of the paper, I will start to answer the question on action level so to say. I will look at how people interact, and how the interactions may make up mutual instruction for how to do the job, be it in school setting, at the workplace, or in another setting. In my discussion, I will have the backing of Donald Schön's idea of coaching in a Design Studio, and of Michael Cole and his colleagues' idea of a cultural-mediational model.

In later sections, I will explicitly come back to the idea of collaborative learning, and then, in addition to the face to face interactions that make up instructional actions, let the collectivity of learning include the activity system in which the actions are enacted, and more explicitly also the artifacts that are used.

Coaching in a “Design Studio”

In opposition to what Donald Schön (1983) calls an “epistemology of technical rationality” (basic research produces theories which, in the next step, are applied in practice), he presents an elaborated sketch of an “epistemology of practice.” The aim of this new epistemology is to better characterize the features of the practice situation – “complexity, uncertainty, instability, uniqueness, and value conflict” (ibid. p. 18). A further aim is to promote a kind of artistry that “the zones of indeterminacy in practice” call for. For that reason Schön has developed a “reflective practicum,” the main features of which are “learning by doing, coaching rather than teaching, and a dialogue of reciprocal reflection-in-action between coach and student (Schön 1987, p. 303).

“Coaching”, as it is conceptually developed by Schön, is a special kind of instruction, first related to a “design studio” of education in architecture, but later expanded to other sorts of professional education. Therefore, “coaching” has a central place in the development of a new epistemology, an epistemology of practice.

Schön's “coaching” is a concept both about handing over of experiences and of joint exploration. It is a conception that is explicitly situational. It takes into account that the situation “talks back.” More precisely, coaching is “keyed to the tasks *this student* is trying *at the moments* to carry out” (1987, p.164; italics by B.S.). Thus, “coaching” means on-the-spot improvisation and reflection-in-action, or as I would phrase it, “live instruction.” Coaching involves the ongoing practical actions as well as the knowledge that the coach puts at stake when demonstrating or telling in action. The knowing of the coach shows up in action: in his design outlines, his feed back on the back talk of the situation, his telling, and his displayed reflection-in-action and reflection-on-action. I think that the “dialogue with the situation” - including the dialogue between the “instructor” and the student, a basic characteristic of coaching that Schön stresses in his 1987 book - suggestively is captured by Schön's concept of

coaching. On some occasions he talks about the “learning/coaching enterprise” and the “learning/coaching process” (1987, pp. 294 and 295).

I will give a presentation of Donald Schön’s conception of coaching by starting with two ideas that I think are fundamental in his notion. The first idea is the *learning paradox*, and the second idea is Schön’s conviction that coaching is built upon *authenticity*. He describes the learning paradox in the following manner:

“The paradox of learning a really new competence is this: That a student cannot at first understand what he needs to learn, can learn it only by educating himself, and can educate himself only by beginning to do what he does not yet understand. /.../ Thus, he must jump in without knowing – indeed, in order to discover – what he needs to learn. “(1987, p. 93)

In order to learn something that is not so easily understandable as simple facts but something more comprehensive, the student needs to go out into an unknown terrain characterized by “vagueness and ambiguity” and try to find out what to do and where to go. Even if the student can count on getting guidance, “the student must begin to design before she knows what she is doing, so that the studio master’s demonstrations and descriptions can take on meanings useful to her further designing.” (1987, p. 99) The student must “suspend her disbelief” and get going to gain experience and information on which to base good decisions (1987, p. 94).

Corresponding to this predicament of learning, there is a predicament of coaching. Schön again:

“The studio master has a predicament complementary to the student’s. He knows that he cannot at first communicate to the student what he understands about designing. He knows that the student, like a postulant asked to make a leap of faith in order to attain understanding, can get good reasons for acting only by beginning to act. However much the master may dislike asking the student to give up his autonomy, he must invite him to enter into a temporary relationship of trust and dependency” (1987, p. 95).

The master’s dilemma is that he wants the student to be critical and independent of him, but must start to let him be dependent and trust in him. Further, the master has to communicate what he knows to the student, at the same time as he also knows that the student will not be able to understand him at first.

Now to the authenticity-problem. Authenticity has to do with the fact that “[m]essages are conveyed primarily through actions – studio master’s demonstrations and the student’s efforts at design” (1987, p. 96).

The student and the coach must thus form a joint project of experimentation and go into a dialogue. It is a dialogue, which according to Schön has some distinctive marks:

“it takes place in the context of the student’s attempts to design; it makes use of actions as well as words; and it depends on reciprocal reflection-in-action” (p. 101).

In this dialogical process “several kinds of learning are interwoven (p. 102).” What is interwoven is described by Schön’s in three condensed sentences, which I will “cut up” into six points to make the ingredients more visible:

- ❖ “The student learns to recognize and appreciate the qualities of good design and competent designing,
- ❖ in the same process she also learns to produce those qualities.
- ❖ She learns the meanings of technical operations
- ❖ in the same process by which she learns to carry them out.
- ❖ And as she learns to design,
- ❖ she also learns to learn to design (...).” (p. 102)

In *The reflective practitioner* (1983), the chapter “Design as a reflective conversation with the situation,” Schön provides an illustration of how those kinds of learning may happen. It is an example in which a master of architecture design, called Quist, instructs his student, called Petra. This is Schön’s description of the episode:

“This design review lasts for about twenty minutes, and may be divided into several phases. In the first of these, Petra presents her preliminary sketches and describes the problems she has encountered. Quist then focuses on one of these problems. *He reframes it in his own terms* and proceeds to demonstrate the working out of a design solution. There follows a brief interval of reflection on the demonstration to date. Quist then sets out the next step Petra will have to undertake (...)” (p. 82; italics by B.S.)

What can be said to happen when Quist reframes the problems is that he connects to Petra’s actions and the sketches they have resulted in, and he “imports” them into his own activity system. What is created is the outcome of the joint actions of Petra and Quist. Although Quist seems to have an overall intention to instruct Petra, the content of the instruction cannot be specified in advance. Quist has to work in several steps, and for each step he has to take into account the just achieved outcome of his interactions with Petra and the artifacts. What is in the instruction is jointly constituted. Schön further comments on the episode: “The language of designing is a language for doing architecture, a language game which Quist models for Petra, displaying for her the competences he would like her to acquire.” (p. 81)

Evidently, Quist has an “educational program” for Petra consisting of “competencies he would like her to acquire.” However, the nature of those competencies is open and not specified before it is constituted in the interactions of “giving instruction.” If there

is a plan for Quists situated interaction with Petra, the plan is a weak resource for him here.

Schön explains that Quist is “displaying for her” what he would like her to acquire. Explicitly he is not able to tell her, he can only show it in action. What is important is transpired by the master’s actions, by his demonstrations. It is as if the future is speaking through his actions, and as his actions are interactively influenced by Petra’s actions. He cannot beforehand know what will be “transpired.” He is guided more by gut feelings than by exact knowing.

As already is pointed out, whatever the course of the learning events, the basis for the joint project that the student and the coach form, is, according to Schön, “authenticity” and “suspended disbelief” (“trust”). The content of the joint project of experimentation is “vague” and “ambiguous.” One reason for this vagueness is that “instructions are always incomplete” and that “every demonstration is ambiguous” (p. 111).

According to Schön (1987, p. 167), the coaching task is a threefold task:

- ❖ “Addressing the substantive problems of a designlike task,
- ❖ tailoring his moves to the student before him, and
- ❖ building a relationship conducive to learning.”

The first part of the coaching task is related to the professionalism of the coach; he “knows that” and he “knows how” and probably he often also “knows why.” The second part concerns artistry; coaching is a live endeavor. The third part connects to the affective dimensions of the practicum; the coach has to address the fact that learning is a serious business that provokes feelings.

The main method for the coaching/learning project is “combining Telling/Listening and Demonstrating/Imitating” (p. 111)

...”the coach’s showing and telling are interwoven, as are the student’s listening and imitating. Through their combination, students can learn what they cannot learn by imitation or following instructions alone. Each process can help to fill communication gaps inherent in the other.” (p. 111)

A coach has many ways of “telling,” as Schön underlines. Telling can take the form, for example, of questioning, answering, advising, listening, demonstrating, observing, imitating, criticizing, instructing (1987, pp. 105 and 114).

Schön has developed three “approaches to coaching” (p. 295), approaches that he calls “joint experimentation,” “Follow me!” and “hall of mirrors.” What these approaches stand for, he explains in the following manner:

“In joint experimentation, the coach’s skill comes first to bear on the task of helping a student formulate the qualities she wants to achieve and then, by demonstration or description, explore different ways of producing them.” (p. 296)

“In Follow me! the coach’s artistry consists in his capacity to improvise a whole designlike performance and, within it, to execute local units of reflection-in-action. So here the relation between a whole performance and its parts, between the whole and aspects of the whole, are crucial.” (p. 296)

“In the hall of mirrors, student and coach continually shift perspective. They see their interaction at one moment as a reenactment of some aspects of the student’s practice; at another, as a dialogue about it; and at still another, as a modeling of its redesign. In this process, they must continually take a two-tiered view of their interaction, seeing it in its own terms and as a possible mirror of the interaction the student has brought to the practicum for study. In this process, there is a premium on the coach’s ability to surface his own confusions. To the extent that he can do so authentically, he models for his student a new way of seeing error and failure as opportunities for learning.” (p. 297)

In my interpretation of Schön, coaching is one answer to the problem of the learning paradox and to the problem of authenticity. Coaching is the role of the instructor “when a practicum takes the form of action research in a learning/coaching process” (1987, p. 295). This joint project of the coach and the student is for real. The student must suspend his disbelief and accept the invitation of the coach to “enter into a temporary relationship of trust and dependency” (1987, p. 95). The coach is involved as a whole person, with his strengths and weaknesses. He cannot be a bystander providing pieces of knowledge and good advice when appropriate. He is involved as much as the student is, and he must mean what he does. In other words, the coach’s artistry demands authenticity.

It should be noted that the concept of coaching here thus is different from coaching as it is practiced as “management of learning”, without the coach necessarily being highly competent in the trade, and without forming a reciprocal ensemble with the student(s).

Two aspects of Schön’s coaching-concept appeal to me. First, it is a fairly elaborated concept of instruction and learning, and second, it is based on an “epistemology of practice.” Schön’s “coaching” is a concept about handing over of experiences and which is explicitly situational, that is, it takes into account that the situation “talks back.” Instruction inherent in coaching involves the ongoing practical actions as well as the knowledge that the coach puts at stake when demonstrating or telling in action. In other words, the knowledge of the coach shows up in action: in his design outlines, his feed back on the back talk of the situation, his telling, and his displayed reflection-in-action and reflection-on-action. I think that the “dialogue with the situation” suggestively is captured by Schön’s coaching-concept, although the more precise meaning of the dialogue with and the talk back from “the situation” still needs to be worked out. It seems as if the concept of coaching is oriented at that which in activity

theory is called the object of work. The actions of the coach and the student alike are directed at the given – the circumstances and the actual sketches – and at the design project that is to be created. The coach and the student are working together, by making moves, listening to the back talk of the situation, and in the reframing of the situation. However, the working togetherness is not a salient feature in Schön's accounts on what is happening. He stresses instruction and learning on behalf of the collaborative work being done.

Perhaps this is the reason to one thing that I find puzzling in Schön's conceptualization, namely that the novice is remarkably silent. Let us take his paradigmatic example, the design master Quist and the student Petra in the design studio (Schön 1983, Chapter 3: "Design as a reflective conversation with the situation"). Part of the "situation" are Petra's design sketches, but her talk-in-action is totally out of the picture. The back-talk from the student is totally missing in this paradigmatic example of Schön. It is as if Petra's voice does not count, she is learning, not contributing to the work result. It is as if Quist is the more knowledgeable companion in every moment, and Petra is the less knowledgeable companion all over. I cannot judge in this specific case of course, but in general, I am sure one has to count with some kind of mutuality, in the sense that who is more knowledgeable and who is less knowledgeable is an open question, and shifting from moment to moment. In any case, I am looking for a concept that enables one to consider the shifting capability among the members according to the unfolding of the "situation," and the mutual assistance the members are giving each other. That is the reason why I have coined the expression "co-coaching."

There are other concepts that might possibly be rebuilt to fit my requirements, for example mutual "guided construction of knowledge" (Mercer 1995), mutual "guided participation" (Rogoff 1990, 1995), or "dialogic inquiry" (Wells 1999). For my taste, however, they are too much associated with upbringing and teaching at school compared to Schön's concept that deals with professionals in action (with the exception of the Quist-Petra example). And as I said earlier, the fairly theoretically elaboration of the concept of coaching makes it appealing. Therefore, "co-coaching."

The practice situation, as described by Schön, is, as we have seen, characterized by "complexity, uncertainty, instability, uniqueness, and value conflict" (1983, p. 18). As a consequence, the ground is prepared for dynamics of actions – there are back talks, on the spot experimentation and improvisation, reframing, and much more. Notwithstanding the dynamics of actions, change and development are not a central feature of the practice situation. It is as if Schön's description remains on the level of actions, leaving the activity aside.⁷

⁷ I owe this idea to a hint from Yrjö Engeström.

Establishing a “Construction zone”

The concept of “zone of proximal development” (ZPD) is a key concept in cultural-historical and sociocultural theories of human activity. In my opinion and in my interpretation, ZPD is a special case of what Vygotsky and Luria (1934/1994, p. 138) called “the most basic of genetic laws” of higher psychological functions, namely that “every symbolic activity of the child was once a social form of co-operation.” In other words: the basic law of psychology is that joint activity precedes individual consciousness.

In this section I will present two examples of educational interventions built upon the concept of the zone of proximal development, accomplished by Cole and his colleagues at the Laboratory of Comparative Human Cognition at University of California, San Diego. I call the first “the construction zone” and the second “co-constructing reading in a field college” (this, too, being a construction zone, i.e., a ZPD).

An illustrative example of what may happen when “instruction meets learning” is given by Newman, Griffin and Cole in their book *The construction zone* (1989). Simply put, their idea is that through joint actions, the actions of the novice are “included” in the activity of the more knowledgeable person(s). In that way, the novice is helped to participate in an activity.

This explanation provides a solution to what has been called a learning paradox, namely that a child endowed with a simple psychological structure, through learning can expand this structure into a more complex one. The putative paradox lies in the fact that a structure, which is simple or less developed, “contains” the more complex or developed structure. Newman et al. show that the paradox is only a paradox if one imagines that the structure at hand is a structure exclusively in the mind of a single person. However, as Newman et al. suggest, there are good reasons for claiming that psychology does not reside only within a person’s skull, it take place between people too, and between people and their artifacts.

The child with her “simple psychological structure” is involved in an interaction going on “outside,” an interaction compassing other people and artifacts. By partaking in this “interactional dance” aiming at solving problems, the child learns and develops her “psychological structure” into a more complex one. Thus, the main thing to be pointed out is that a child’s simple intra-psychological structure expands into a complex intra-psychological structure via an “outer” activity system. Or, better: A child whose ability is such that she can collaborate by means of different actions that fit into an activity of certain complexity, is thereby developing her intra-psychological structure into a more complex one. In the words of Newman et al., “the teacher incorporates children’s actions into her own system of activity” (p. 63):

“The children’s actions can function within two different understandings of the significance of the task: the child’s and the teacher’s. Both are constrained by sociohistorical understandings of the activity setting in which they are interacting. The fact that any action can always have more than one analysis makes cognitive change possible. Children can participate in an activity that is more complex than they can understand (...) While in the ZPD of the activity, *the children’s actions get interpreted within the system being constructed with the teacher. Thus the child is exposed to the teacher’s understanding without necessarily being taught.*” (p. 63f; italics by B.S.)

one can sum up by saying: “Learning a task is accomplished in interactions” (Newman, Griffin, and Cole, 1984, p. 192-193). And what is being taught (“without necessarily being taught”) is, in this example, the abilities to work systematically on combination-of-variables tasks. Thus, what is accomplished are both the form of interactions and the content – i.e., the object of work, or the subject matter of the learning curriculum.

As can be seen, the “learning paradox” is basically the same as Schön’s two predicaments, the “predicament of learning” and the “predicament of coaching.” I will suggest that the overcoming of the paradox and the predicaments is one and the same: incorporate the less knowledgeable person’s actions into an activity system.

Another example of a “construction zone methodology” is about co-constructing reading in a community of practice. It is about design of an “environment” for learning in a community called “Field College” that Michael Cole and others at the Laboratory of Comparative Human Cognition have built in the beginning of the 1980’s as a means to promote children’s learning to read. What they built was an activity system that “invited” low-achievers in reading to participate in a collective reading-and-talking activity, together with undergraduates and a researcher, using a Question-Answer-Reading procedure. The Field College activity was based on the ideas (Cole 1996, p. 273) that:

- ❖ “Reading acquisition is a joint activity”
- ❖ “It must use artifacts”
- ❖ “It must be proleptic”⁸
- ❖ “It must orchestrate social relations to coordinate the child with the to-be-acquired system of mediation in an effective way.”

A method or a way of organizing the community of readers called The Question-Answer-Reading procedure was used. The procedure contained several steps: motivating discussions about the goals of reading acquisition; distribution of roles between the participants – one had the responsibility for words that were hard to pronounce, a second for hard-to-define words, a third for explaining the main idea of

⁸ Prolepsis means “the representation of a future act or development as being presently present” (Cole, 1996, p. 183)

the text, and so on. And of course, the roles were redistributed in the round that followed.

What has to be achieved in reading has analytically been described by Cole (1996, p. 275). The point of departure is two

“to-be-coordinated systems of mediation that exist when a novice begins to read from an expert. (A) The child can mediate interactions with the world via an adult. (B) The adult can mediate interactions with the world via text.”

The analytic and instructional strategy is in the next step

“the given and to-be-developed systems of child mediation are juxtaposed and the given adult system is then superimposed, to reveal the skeletal structure of an ‘interpsychological’ system of mediation that, *indirectly*, establishes a dual system for the child, which permits the coordination of text-based and prior-world-knowledge-based information of the kind involved in the whole act of reading.”

How does a child grasp the idea of reading? By understanding the abstract core of reading described by Cole? Of course not. “Breaking the code” of reading - integrating from-below analyses of letters, phonemes, words, and so on into from-above syntheses (reading for meaning) – is not an individual and technical skill. “To look at reading as a technical ability to decode letters is to trivialize the text as a sociocultural phenomenon” (Säljö 2000, p. 187; translation by B.S.). Reading is a collective activity. By this activity the intellectual achievement of a single child is integrated into a joint achievement. To paraphrase Vygotsky: reading appears twice, first as a process between people, then as an interpersonal process.

Cole (1996, p. 277) explains the crucial point of the instruction or the design of the reading process:

“In order to move from the script and other artifacts to the process of reading instruction, we embedded the procedural script in a complex activity designed to make salient both the short-term and long-term goals of reading and to provide a means of coordinating around the script.”

And he continues:

“It is in this embedding process that we make the transition from focus on the structural model of reading (...) to focus on reading acquisition as a joint activity.”

This “embedding process” also means *the embedding of the child’s actions into a joint activity system*. That is what learning to read is about. The question is *how to make the process of reading between people happen?* Sometimes it happens

spontaneously in a highly literate society, for example when a child is using the many written words and texts available through ads, comic strips, newspapers, and so on, and is supported in using those artifacts by grown ups at hand. As we know however, most often the way of spontaneous reading acquisition does not work. Most often the reading process is not spontaneously organized at all between a child and more capable people or not efficient enough to make internalization of the process happen.

When the spontaneous way, the “natural” way, does not work, there is need for a cultural invention. There is need for something new, something man made, something artificial. Historically this happened with the emergence of the school system. And now, when schools seem to fail, when a new form of illiteracy is pointed out as one of the not wanted outcomes of school-going in the modern societies? The challenge is thus how to construct a better “artificial intelligence system” (Cole 1996b) than schools ordinarily can provide, a system that can help more children “break the code” of reading. An answer to those questions might be: Why not try something akin to the Question-Asking-Reading procedure? Why not organize a “field college”?

Instruction and “members’ methods”

In this section I will present three ways of problematizing what it means to follow an instruction, and how we as teachers or experimenters may know when an instruction is understood. The first reflection comes from an, at the time, experimental psychologist, Jan Smedslund, the second comes from two ethnomethodologists, Ronald Amerine and Jack Bilmes.

The relation between “how things are” and their logic in discourse has been discussed by Jan Smedslund (1970). He is criticizing research traditions like “reasoning”, deductive thought, and “Piagetian psychology”. Take for example research on “syllogistic reasoning.” Given the premises, one wants to see if the tested subject can draw the correct conclusion. To make sure that the subject has understood the premises, the experimenter takes appropriate measures, i.e. repeat the premises, let the premises be “empirically inspectable” for the subject of the experiment. This made, the researcher can conclude when the subject gives the wrong answer, that the subject is not capable of “syllogistic reasoning” in that situation. To this, Smedslund rises objections. Given a clash between the tested person’s answer and the expected answer provided that the premises are grasped, the experimenter draws the conclusion that there is a lack of logic capacity of the subject. This is true only if the test subject grasp the premises. But does he? How can we know? That the experimenter has done what he can to make the subject understand the premises, does not guarantee that what is planned is what actually happens. A “wrong” answer can as well be a sign that the premises were not understood. So, instead of taking logic as a variable and understanding as something stable, Smedslund suggests the opposite: logic must be presupposed. People are logical. If they seem illogical, the reason is that one does not understand what they understand. Thus, there is a circular relation between understanding and logic. Instead of trying to remedy people’s “logical deficiency”,

the conclusion is that one ought to talk to them and try find out what they understand and what they mean.

This was an example of the circular relation between discourse and practice. Now I will bring another example, which I will call the circular relation between instruction and learning. It has been discussed by Amerine and Bilmes (1990), and I will follow their argumentation. Their empirical example is the teaching of elementary science in third grade. Let us start there, with an experiment called “Keeping Dry Under Water.” It is described in the following way by the authors, and I need to give them space:

“A napkin is to be pushed down into an eight-ounce plastic tumbler and the tumbler then inverted and plunged straight down into a plastic bowl half filled with water. The tumbler is to be held in the water for a second or two and then lifted straight out. The napkin will remain dry. It will be obvious to a competent adult that these instructions include a number of details that are not essential to the experiment. One could achieve the same result by plunging a 10 ½-ounce soup can with a rag in the bottom into a bathtub three-quarters full of orange juice or keeping it there for an hour or two. Much of the content of these instructions is therefore determined by practical considerations, which are irrelevant to the projected outcome. But one cannot presume that a third-grader would know this. (...) There is nothing in the instruction sheet that tells (or allows one to deduce) what will happen if the tumbler is tipped while under water. Yet it is precisely this knowledge that is required to correctly understanding the meaning of the word ‘straight’ in this context. (...) Our understanding of the meaning of ‘straight’ in the instructions is informed by our knowledge of what will happen if the cup is tipped.” (pp. 327-328)

Actions are open until they have happened, and thus they can be stated only after the fact, after they have been enacted. Plans, instructions, and other kinds of in-advance accounts are always “under-determined,” even more so than after-the-fact accounts. Life is so rich that it is possible to talk about it only by taking something for granted. An account or instruction must therefore by necessity leave things out. But how can the person who gets the instruction know what is left out or what is arbitrary? Successfully following an instruction, which Amerine and Bilmes point out, can therefore be described as “constructing a course of actions such that, having done this course of action, the instruction will serve as a descriptive account of what has been done, as well as provide a basis for describing the consequences of such actions.” (p. 326)

My conclusion is that following instructions is a collective enterprise. One may be part of an activity system or a community of practice, and take for granted what is taken for granted in the instructions, and therefore, manage to enact them. One may also be a newcomer and interactively construct, together with others, a course of action that at the same time is enacting the instructions and gives an account of them. Thus, according to Amerine and Bilmes, following instructions means to be able to fill in the incompleteness of the instructions that are taken for granted in a community of practice, or learn how to do that in the course of enacting the instruction.

Co-coaching in coronary diagnostic work

In Donald Schön's conception, coaching takes place between a master and a student in a design studio. We can open up the perspective and let it include people working together, oriented at their object of work, and mutually supporting each other. Then we have something like "mutual coaching" or *co-coaching*, the mutually supporting instructive actions that colleagues in a professional community of practice provide as part of their everyday work. The concept presupposes a certain amount of equality among the members, not on all occasions but in the long run. I imagine that co-coaching can take place on action/operation level, and also under some circumstances as an activity.

In this section I will deal with co-coaching on the level of actions, and I will give a short example to illustrate how it may look like. I will emphasize that the example exposes what goes on *action-level*. You may get a feeling of the goal of the physicians' actions, but what activity the actions are part of is not possible to see. (The example has been used in Paper I.)

Example 1

5	Radiologist (Karlskrona)	sick at the departure of the diagonal branch
6	Surgeon (Lund)	is it D1 is it only
7	Radiologist	it is D1 yes
8	Surgeon	mm (1.0) I buy that

What we can see here is that the radiologist, who is presenting the angio video, is using oral speech to indicate that a vessel is sick. (On the video one can also see that he is pointing with a cursor at the screen.) The surgeon asks if it is a special vessel called Diagonal 1, D1, which is being displayed. The radiologist conforms that this is the case, and finally the surgeon agrees. It seems as if he agrees that the vessel is D1 and that the vessel is sick. I think that what is seen in Example 1 can be described as assisted performance on action level. The radiologist is instructing the participants what to look at by means of the angio-film sequence he is presenting, and also how to possibly judge what there is to see (line 5). The surgeon asks if the vessel the radiologist has presented as "sick" is the vessel called D1 (the first Diagonal on the Circumflex) and nothing else (line 6). The question of the surgeon is a instruction to the radiologist to answer, and in the answer he confirms the surgeon's presumption (line 7). Finally the surgeon concludes that they all agree: they have made the decision that D1 is sick (line 8). It is co-coaching on the level on one vessel. How this decision or stating of the fact will be connected to their overall assessment of the patient case and to what they will recommend as future treatment is here still an open question.

Instruction and learning are not the main issues here for the professionals. The main issue is work. The instructional-learning actions of the physicians are actions embedded in collaborative work activity.

Artifact mediation in learning: Instructive artifacts

That instruction-and-learning, as all activities and actions, is social and artifact-mediated is foundational within activity-theoretical and sociocultural approaches. What does it mean to say that something is “social”? It is to say that there is an ongoing mutual interaction between people. But, as Mantovani has pointed out, “social reality extends far beyond interpersonal relationships” (2000, p. 16). This means that you have to bring culture, or the sum of artifacts and their uses within and between the systems of activities, into the picture. However, it is seldom studied in detail how the artifact-mediation works in instruction and learning. If one in practice brings in such a conceptual foundation stone, it will have consequences for instruction and learning. In this section, I will spell out some consequences of such an endeavor, and will do it in terms derived from Vygotsky and his “most important and basic of genetic laws.” As said earlier, this “basic law” includes, as certain aspects, both “the zone of proximal development” and “the method of double stimulation.” First, let us view instruction and learning from the perspective of the zone of proximal development. That means:

- ❖ When learning occurs, instructional actions are also involved. Such a conception is of course a corrective to the idea that learning is all (or almost all) that counts.
- ❖ Interactional actions are important in the activity of instruction. Any idea of a detached instruction, be it in the form of traditional school transmission of “knowledge” or modern distance learning, is simply wrong. “Instructors,” in whatever name they operate or try to disguise themselves, are always there; there is “no time out” (Garfinkel 1991, p. 11).

Second, let us view instruction and learning from the perspective of the method of double stimulation. That means:

- ❖ Artifacts that mediate instruction and learning are of diverse kinds. “Tools” and “symbols” (or “signs”) are two broad categories of artifacts that are used in instruction and learning.
- ❖ How the mediational processes work in instruction and learning is something to be explored, taking the concrete circumstances into consideration, as for example how artifact-mediated instruction succeeds to improve what Vygotsky and Luria (1994, p. 106) call “practical and verbal intelligence.”

Interpreted in this way Vygotsky and Luria open up for an understanding of the role of artifacts in instruction and learning. Their works are full of episodes showing

interventional uses of artifacts as mediational means of instruction and support to patients with clinical problems.

Even today, when the importance of “learning environments” and tool-rich cultures of learning are stressed as opposed to traditional schooling’s focus on schoolbook texts, remarkably little is reported on how artifacts, besides talk, are used in instruction and learning. But there are good examples.

I think it is okay to define learning as “the mastery of tools in situated practices” as Säljö (1999, p. 136) does, and which also has been suggested by Brown, Collins, and Duguid (1989, p. 33).⁹ Is the implication then, that if one provides a “learning environment” with access to tool use, one will get appropriate learning as a result? I will answer with Säljö (1999, pp. 157-158) that “learning will never be automatized even when using technologies” (...) To facilitate understanding, the expertise of a teacher or a more knowledgeable conversation partner would still be required.” Thus, a tool-providing learning environment needs to encompass support from more knowledgeable companions, be it organized as apprenticeship, co-coaching, or whatever.

In the idiom of “information society,” one can say that in education we need to shift focus from the one-sided reliance of the school-book medium to “multi media.” In doing that, I suggest, we would better treat these media not as standing-alone tools used by isolated individuals, but include into the tool-rich cultures also the collaborative resources of knowledgeable companions mutually instructing each other.

There are ideas about the role of artifacts around nowadays. In this section I will present some ideas that have been influential on my own thinking about artifacts, and which have shown up in my empirical studies.

Popper’s World 3

In his autobiography Karl Popper tells that he finds it “important to distinguish between the mental process and the thought content (as Frege called it) *in its logical or world 3 sense*” (Popper 1976, p. 182). And he continues:

”And I often find myself mistaken in the belief that I ‘have got it’, that I have grasped a thought clearly: when trying to write it down I may find that I have not got it yet. This ‘it’, this something which I may have not got, which I cannot be quite certain that I *have* got before I have written it down, or at any rate formulated it in a language

⁹ They claim: “To learn to use tools as practitioners use them, a student, like an apprentice, must enter that community and its culture. Thus in a significant way, learning is, we believe, a process of enculturation.” (ibid., p. 33)

so clearly *that I can look at it critically from various sides*, this 'it' is the thought in the objective sense, the world 3 objects which I am trying to grasp." (ibid.)

Popper's idea is that an epistemology ought to make a distinction between "three worlds": "the world of physical objects" (World 1), "the world of subjective experiences" (World 2), and "the products of the human mind" (World 3). Popper insistently claims that the interesting knowledge from an epistemological point of view is not the psychological knowledge of World 2, but the "objective knowledge" of World 3.

Popper has summarized his ideas in "three main theses" (Popper, 1972, pp. 111-112):

1. "traditional epistemology with its concentration on the second world, or on knowledge in the subjective sense, is irrelevant to the study of scientific knowledge."
2. "the study of a largely autonomous third world of objective knowledge" - scientific problems, problem situations and theories, scientific discussions, critical arguments - "is of decisive importance for epistemology."
3. "An objectivist epistemology which studies the third world can help to throw an immense amount of light upon the second world of subjective consciousness, especially upon the subjective thought processes of scientists; but *the converse is not true.*"

Thus, Popper has insisted on the importance of a reality besides subjective mind and besides material things: a humanly produced objective reality that he calls World 3. I find this idea illuminating as it makes explicit that knowledge is not solely in the mind but something produced, and that our interactions with the produced products are crucial: "I suggest that one day we will have to revolutionize psychology by looking at the human mind as an organ for interacting with the objects in the third world; for understanding them, contributing to them, participating in them; and for bringing them to bear on the first world." (ibid., p. 156)

The shortcoming of Popper's view, as I see it, is what Bloor (1974) has called "Popper's mystification of objective knowledge," meaning the ignorance of the social aspect of knowledge, that the human mind is a mind in culture. When Popper exemplifies his argument the actor is a solo person.

The interesting question is: What makes World 3¹⁰ objects so special? How can they support people in their work, in their life? Popper's answer is:

¹⁰ I use the terms World 1, World 2 and World 3. This is what Popper himself does in his later writings. "I have adopted Sir John Eccles's [1970] suggestion to speak of 'World 1', 'World 2', and 'World 3', instead of the 'first world', 'second world' and 'third world', as I did prior to Eccles's publication of *Facing Reality*, in which he made this suggestion." (Popper and Eccles, 1977, note, p. 38.)

- ❖ They can indirectly influence World 1 (Thus they are real, they are objective.)
- ❖ They are the stuff of which to re-make other World 3 objects.
- ❖ They constitute the culture, they support learning,
- ❖ Working with World 3 objects is to take part in the traditions of World 3, to participate in civilization.
- ❖ They make “cultural learning” possible (where the material genetic basis transcends itself).

In my view, Popper conceptualizes his World 3 artifacts in a too autonomous way. True, he says they are only “partly autonomous” (why he makes this restriction is not clear to me). My critique that they are regarded as too autonomous concerns that Popper describes them as “unembodied”. When he at the same time regards them as made and re-made in an active process, the making will be that of an Auguste Rodin-thinker, doing nothing but sitting and letting the thoughts being active. As if thinking would not require material objects to work with, especially pencil and paper, and other people to talk with, but is just something going on within the head. From a CHAT perspective this is more than problematic: there are no disembodied thoughts.

In a remarkable section in Popper and Eccles, Section 13, “Grasping a World 3 Object,” Popper claims the following:

- ❖ “Our World 3 is man-made in its origin” (in contrast to Plato’s conception¹¹)
- ❖ “We may understand the grasping of a World 3 object as an active process, we have to explain it as the making, the re-creation, of that object.” (p. 44)
- ❖ “One could say of the material genetic basis that here it transcends itself: it becomes the basis of cultural learning, of participation in civilization and in the traditions of World 3.” (p. 46)

What Popper here says is thus that objective knowledge is a creation of man, and that it is an active process, a process of making or design. Furthermore, he states that he was “doubtful for a long time” and did not publish anything about World 3 until he “arrived at the conclusion that its inmates were real; indeed, more or less as real as physical tables and chairs” (1976, p. 183). When I later will present the Russian philosopher Ilyenkov, we will see that tables for him are “ideal objects,” where “the ideality” comes from the man-made “tableness”. World 3 objects for Popper belong to the highest stages of “cosmic evolution”, stage 5, “Human Language, and Theories of Self and Death”, and stage 6, “Works of Art Science (including Technology)” (Popper and Eccles, 1977, Table 1, p. 16). The making of a table will thus not produce objective knowledge, according to Popper, but according to Ilyenkov it will. World 3 is a separate world, not an aspect of World 1 and 2. No wonder that it is

¹¹ Popper writes: “Plato was the first, it seems to contemplate something analogous to our Worlds 1, 2, and 3. He sharply contrasts the world of the ‘visible objects’ (the world of material things, corresponding closely, though perhaps not completely, to our World 1) and a world of ‘intelligible objects’ (vaguely corresponding to our World 3). In addition, he speaks of the ‘affections of the soul’ or ‘states of the soul’, corresponding to our World 2.” (Popper and Eccles, 1977, p. 43)

“disembodied”. And, according to Popper, it is only through mind (World 2) that World 3 can encounter World 1. In Popper’s words (1976, p 185): “I admit even that it is solely through world 2 as an intermediary between world 1 and world 3 that world 1 and world 3 can interact.”

For me, it is surprising that Popper takes much of what is often called the “body-mind problem” for given: that bodily movements, actions and activities are essential for “mind” to work. Instead he concentrates on the “mind’s” relation to the cultural heritage of World 3 objects. “It is the problem of the emergence of the self which, I suggest, can be solved only by taking language and the objects of world 3 into account, and the self’s dependence on them” (1976, p. 191). This focus is of course a strength in Popper’s theory of “objective knowledge”, but it also leaves the body aside as it were. Popper has written very little about the body, and its actions and operations. Only occasionally he touches the issue.¹²

I do not know what Popper would say about Heidegger’s idea that thinking is hand-work, and Latour’s extension, that “what is in the hands are inscriptions” (Latour 1990, p. 46). Perhaps he would say that these aspects are obvious but not important for intellectual work. He simply seems to take them for granted.

Ilyenkov’s “ideal objects”

Ilyenkov has addressed the phenomenon of artifacts and how to conceive of them. He claims – I build on Bakhurst (1991) - that there exist three kinds of phenomenon in the human world: physical objects, mental representations, and ideal objects. These three entities have points of similarity to Popper’s World-3 ontology: World 1 of natural things and material artifacts, World 2 of subjective experiences connected to consciousness and feelings, and World 3 comprising products created by the human mind.

Bakhurst (1991: 180) claims that Ilyenkov’s account of the ideal starts with “two key tenets: 1. ideal phenomena can have an objective existence in the world; 2. they owe this existence to human activity.”

¹² “Thus everything speaks in favour of the indispensability of the mind in the household of the higher organisms, and also for the need to let solved problems and ‘learned’ situations sink back into the body, presumably to free the mind for new tasks. A theory of this kind is clearly interactionist: there is interaction between the various organs of the body, and also between these organs and the mind. But beyond this I think that the interaction with world 3 always needs the mind in its relevant stages – although as the examples of learning to speak, to read, and to write show, a large part of the more mechanical work of coding and decoding can be taken over by the physiological system, which does similar work in the case of the sense organs.” (Popper 1976, p. 192)

"Ideality is a characteristic of *things*, but not as they are defined by nature but as they are determined by *labour*, the transforming and form-creating activity of social man, his purposeful, sensuously objective activity." (Ilyenkov 1977, p. 97)

Material artifacts (fabricated things) are according to Bakhurst the best examples to illustrate what an ideal object is. There is a difference between certain pieces of wood and a table, and this difference emerges as a result of human praxis, the carpenter's work practice and people's uses of the table. To be able to distinguish a table from a piece of wood, one has to make a table or to use it or learn it through the praxis of "language games." The table is an ideal object. It exists objectively. And the objectivity of the table is produced socially, interactively, through human fabrication and use.

What constitutes ideal objects can thus be illustrated with the example of words. As physical entities in forms of sound waves or scratches on paper, words are just as arbitrary as the wooden material of the table. Their material forms are not crucial. The word can be expressed in blind characters and the table can be built of steel and glass. What matters is the human uses that endow the material with meaning. In Bakhurst's words:

"in being created as an embodiment of purpose and incorporated into our life activity in a certain way - being manufactured for a *reason* and put to a certain *use* - the natural object acquires *significance*. This significance is the "ideal form" of the object, a form that includes not a single atom of the tangible physical substance that possesses it ... (p. 182)

Thus, there are, according to Ilyenkov, three kind of entities in the world: material entities (objective), mental entities (subjective), and ideal entities (socially produced; e.g. pieces of wood plus certain work activity make a table).

Material and mental entities have been commonly recognized, and they form a part of common sense. That there exists an identity, which Ilyenkov calls "ideal object" however, has been disputed or denied, and difficult to agree upon. One of the reasons why it is so, this is my guess, is that Ilyenkov in order to chisel out his own stance in the philosophical debate in Soviet Union during the 50's and 60's and 70's, intentionally connected to Hegel's "ideality" concept. As I understand it, Ilyenkov wanted to stress the activity-character of the object, and therefore he used Hegel's term. Perhaps one can say that he wanted to bring back the active/activity part of human endeavors from philosophical idealism that already Marx had put as a goal in his critique of Feuerbach's philosophical materialism.¹³

¹³ "Hence it happened that the *active* side, in contradistinction to materialism, was set forth by idealism – but only abstractly, since, of course, idealism does not know real, sensuous activity as such." (From the first of the Theses on Feuerbach. (Marx/Engels, 1976, p. 618).

According to Ilyenkov an object always has activity-character and, therefore, it is called "ideal object." Also the reverse is true: activity always has material character, because there is no disembodied activity. Put in other words, there is a transformation between activity and object. Ideality exists, says Ilyenkov (1977, p. 98) "only through the unceasing process of the transformation of the form of activity – into the form of a thing and back – the form of a thing into the form of activity."

Wartofsky's conception of artifacts

Marx W. Wartofsky (1979) has made an analysis of artifacts that I find fruitful. He distinguishes between primary, secondary and tertiary artifacts. Artifacts used directly in productive work are called primary. Thus, they are tools in a broad sense that we use practically and physically. As examples of primary artifacts he mentions "axes, clubs, needles, bowls, etc." (ibid., p. 201).

Wartofsky's conception of artifacts is a part of his long-termed project, "historical epistemology" (p. xiv). The article where Wartofsky most extensively presents his ideas about artifacts is titled *Perception, representations, and the forms of action: Towards an historical epistemology* (1973). The main theme in the article is that human perception is a form of action. Wartofsky regards perception as a historically developed ability, where the biological and physiological perception is only a beginning. After it, the specific human perception takes over, which according to Wartofsky develops in parallel with her production and reproduction. A basic characteristic for human being is, therefore, that she produces and reproduces her own conditions of life by means of creation of artifacts, tools in a broad sense. When artifacts are used directly in production, they are, as already is mentioned, primary artifacts.

However, artifacts are also *representations*. As such they embody forms of actions, they illustrate a practice that has taken place, and, furthermore, they "invite" to future practice. As representations the artifacts are also reflective, that is, they are representations for ourselves "of what we do, of what we want, and what we hope for" (1979, p. xv). When artifacts function in that way, Wartofsky calls them "secondary."

Artifacts are representations, for objects in the environment and for our action with these objects. These representations are used by human beings in their perception. As a consequence, when the artifacts are developed, also human perception is developed. This is the reason for Wartofsky's claim that "*artifact* is to cultural evolution what the *gene* is to biological evolution" (p. 205).

For us, who grow into a culture, it follows by necessity that the tools we use are "telling." Tools tell about actions performed when the tools were produced and used, they tell about how the tools have been used and suggest how they can be used in the future.

To sum up, tools function as tools directly for production or reproduction of conditions of life, and as such they are primary artifacts. Besides, tools have a representing function, as secondary tools they tell about past uses and invite to future use.

Wartofsky means that representation occurs concretely, for example through use of prototypes. Prototypes are showing the result of invested labor and at the same time they show to them who are able to “read culture” how labor has been accomplished. The prototypes tell: this is the result of labor, and this is the way the work has been done. Representation may also take place by means of handing over of usage: this is the way to use the tool. In both cases, the handing over is taking place as apprenticeship, where the newcomers learn to know which actions can be mediated by a certain tool. Common for secondary artifacts is thus that they are essential for instruction in a broad sense.

There is also a third kind of artifacts, tertiary artifacts. They pick up an aspect that can be seen also in secondary artifacts and isolates this aspect, namely to represent what could be done with the artifacts. It is about possibilities, an imagined world, a world of play. It is not about day-dreaming, it is dreaming with anchoring in a real world, in the end. It is about a virtual world where rules of the real world can be rethought. It is a what-if world, a world for innovators and project-makers.

Artifacts are representations of human activity, they are public archives of human activity, they are of “fossilized human activity.” In Wartofsky’s (1979) words:

“The production of such artifacts for use, I argued, was at the same time the production of representations, in that such artifacts not only have a use, but also are understood as representing the mode of activity in which they are used, or the mode of their production. Thus, spears and axes are not only made for the sake of hunting and cutting, but at the same time represent both the method of their manufacture and the activities of hunting animals or chopping wood.” (pp. xiii-xiv)

It is important to notice that representations in Wartofsky’s conception are not mental entities, they “are not in the mind. (...) They are externally embodied representations.” (p. 202)

Thus, external representations are fundamental in Wartofsky’s historical epistemology. Actually, he claims that “human learning is essentially mediated by representation” (p. xviii) and “there is no knowledge without representation” (ibid.). But what is then a representation, “what is it for something to be a representation in the first place?” Wartofsky’s answer is in a nutshell:

- (1) “*Anything* (in the strongest and most unqualified sense of ‘anything’) can be a representation of anything else.”

- (2) “It is *we* who constitute something as a representation of something else. It is essential to something’s being a representation, therefore, that it be *taken* to be one.”
- (3) “Representing is something *we do* (...) nothing *is* a representation except insofar as we construct or construe it as one.” (p. xx-xxi)

I think it is important that we do not misunderstand Wartofsky. He claims that there are primary, secondary, and tertiary artifacts. This does not mean that artifacts have a fixed character, that they are either of primary, secondary or tertiary kind. Artifacts have a common quality: they are made by man. As a human, one can see or find out if a thing is a natural thing or an artifact, but one cannot determine once and for all if an artifact is primary, secondary or tertiary. Artifacts are produced and used in many ways. If a person uses paper from newspapers to paper the walls of a room, does he use the text of the newspaper as linguistic artifacts to convey a message? Probably not, but a detective or semiotician may find out that there is a message, and thus that the linguistic artifact representation is the important aspect, not the primary-artifact use for papering.

A quotation from Wartofsky may make that clear:

“My view of representation, however, is not that all representation is linguistic” (...) Minimally, however, I may suggest that representation is already involved in the very character of non-linguistic artifacts, insofar as they are themselves symbols, or are parts of systems of symbols, in which the artifacts themselves present meanings, intentions, relations, and come to represent to us the modes of practice involved in their production and use. This external representational form, the embodied model, so to speak, is not yet a linguistic artifact, though as a kind of physical inscription, it presages the kinds of signs which become elements of a constructed language, and insofar, provides the genesis for pictorial, hieroglyphic, and alphabetic forms of language, i.e. for diagrammatic, or written linguistic forms.” (p. xvii)

As we can see, Wartofsky’s ideas of artifacts and historical epistemology are radically different from what is commonly held for true. Representations are not (at least not primarily) in the head; the germ of cultural evolution is not the biological gene, but artifacts produced by humans. And representations have not only linguistic form.

Perspective on artifact-mediation

I claim that artifacts are instructive when they are used in an activity. In Paper IV, I demonstrated that *graphic artifacts* are instructive because they are made instructive. Here I will be more explicit on this issue and generalize from graphic artifacts to artifacts in general. In addition, I will problematize the idea of what it means that an artifact is instructive.

Artifacts are made instructive. That is one thing. This means that artifacts get instructions “built in,” in contrast to natural objects not cultivated by man, and which

therefore are not made instructive. If this is valid, is it then possible to conclude that artifacts are instructive? I think one cannot. It is more precise to say that artifacts, by being made instructive, are made *potentially instructive*. But the potential instruction “dormant” in the artifact must be “awaken.” Such an awakening requires work and a pre-understanding of the cultural context of artifact usage. It is only people interacting with the artifact – in a social context, either directly in interaction with other people, or indirectly; even when one is “bowling alone” one is playing a social game - that may turn its potential instruction into a real instruction. Past work, crystallized in artifacts, faces an ongoing activity, in which people are able to gain instructions that are built-in aspects of the artifacts.

Artifacts have a component, then, which is “active-inert.” It seems that humans often are able to discriminate this “resting active” aspect of the artifacts. It is as if there is a feeling of affinity between past and present work mediated by the artifact. I will try to explain what ground may exist for such a feeling of affinity, and I will bring into the discussion examples from other authors. My first attempt owes to Jerome Bruner and concerns language as an artifact. My second attempt concerns material-physical artifacts and it is built on an example from Sartre. My third example comes from Nishizaka and concerns a fragile organizational artifact.

Linguistic artifacts. In the article *The Ontogenesis of speech acts* (1975) Jerome Bruner discusses the structural similarities (isomorphism) between the figure-ground structure of perception and the topic-comment structure in language. Let me try to explain what that means. Remember the ambiguous drawing psychologists and others like to present, the figure that either can be seen as an old woman or a beautiful lady, or the figure that looks like a vase or alternatively as profiles of two faces turned towards each other? You cannot see both of the figures in the same glance, but you may switch between them. This is a feature of human perception. Something similar holds true for language, in the phenomenon of topic-comment. If one enters a group of people speaking the same language as oneself, and who have been talking for a while when one arrives, it may happen that one hears what they are saying but do not understand what they are talking about. In that case, one hears the comments but do not get the topic they are making comments upon. It is like the ambiguous pictures – one can see the lines but not the picture a friend says he sees there. In order to understand the comments, one needs to get the topic, and in order to see what the lines really are, one needs to see the figure. This is what isomorphism means here – there is a similarity in structure between figure-ground in perception and topic-comment in linguistic interaction.

The same holds true, Bruner claims, for the structure of co-actions in relation to linguistic universals or semi-universals as act, agent, object, and recipient. The structure of some interactions between people and the structure of perception display a similar pattern like the structure of language (as described by a special kind of grammar called “case grammar”) – that is Bruner’s suggestion. He gives an example of how a mother and a child play with a ball. They are rolling the ball to each other. First the mother has the ball, and then she rolls it to the child, who takes it. Then the

other way around – the child rolls the ball and the mother takes it. There is a structure in these sequences of actions that resembles the structure of language. The mother (agent) is rolling (act) the ball (object) to the child (recipient). And in the next turn the child is the agent and the mother the recipient, but there is still the underlying structure of agent-act-object-recipient. Therefore, the structure of language and the structure of human interaction display isomorphism. From its birth the child learns (experiences) the structure of human interaction before he learns (experience) the structure of linguistic interaction. Similar applies to perception. This would then be the reason why children acquire their mother tongue language in such a short period of time.

What I have found in my empirical studies is something similar: there is a relation between instructional actions and artifact-bound representations. In terms borrowed from Bruner, one may speculate if there is a structural similarity between the past and the present forms of human activity. It can be one way to explain the puzzle that “things have something to tell” and what they can tell about is human activity. How come that we on the basis of “inert artifacts” are able to make interpretations of past human activity? An answer might be that artifacts are fossilized human activity (plus “nature”), so when we see artifacts as representations (“secondary artifacts”) we are able to discern their basic “activity-like” structure. (To this adds, I presume, that a person in a community of practice or in the context of social practice will be assisted by getting hints from other participants.)

Material-physical artifacts. In two books from 1960 Sartre has developed a theory or conceptualization of the relation between the inert practical field and human praxis. To me his concepts seem very fruitful for a cultural-historical activity theory analysis. I will not be able to elaborate on that in this study, but I will use an example from Sartre to illustrate how material-physical artifacts can be understood as taking part in the interactive play between people. This section is about artifact-mediation and the sub-section is about material-physical artifacts. Of course I could have chosen one of the numberless examples prevalent in my empirical material. From the logs presented in the papers, the reader can see, or get a hint of, the trivial fact that material-physical artifacts are used in human actions. On that trivial base, I am after a description of how this, the most common of all things, can be understood and described. In other words, what is the other side of the trivial fact that actions are mediated by physical-material artifacts? What is the “magic behind” human-artifact interaction making up culture? An answer to that question is not easy to give. Attempts are made in terms of human-machine interaction and actor network theory. I will give a hint of Sartre’s way of approaching the phenomenon.

The Sartre example I will use is a short telling about “it is hot – open the window”. It is a short example that spans not even three pages of the text. It is included in a section dealing with the “human project” and the “progressive-regressive method,” which both have to do with how man, according to Sartre, is characterized by his project, his jump towards the future, his transgression of the given circumstances, at the same time as the project is determined of the circumstances. Therefore, the need of a

method that can grasp the features of this phenomenon, a method that is oriented forward, is progressive, and also gets hold of historicity, is regressive. Now to the short example. This is what happens, described in ordinary prose.

In a room there are some men heavily absorbed in discussions. The room is small and the windows are closed. Suddenly, one of the men raises, walks to the window and opens it. (That is all.)

This is how a short account of a trivial event may look like. Sartre's account takes up the other side of triviality. I quote a central paragraph:

“In every way, if I am to go beyond the succession of gestures and to perceive the unity which they give themselves, I must myself feel the overheated atmosphere as a need for freshness, as a demand for air; that is, I must myself become the lived surpassing of the material situation. Within the room, doors and windows are never entirely passive realities; the work of other people has given them their meaning, has made out of them instruments, possibilities for an other (any other). This means that I comprehend them already as instrumental structures and as products of a directed activity. But my companion's movement makes explicit the crystallized indications and designations in these products; his behavior reveals the practical field to me as a 'hodological space,'¹⁴ and conversely the indications contained in the utensils become the crystallized meaning which allows me to comprehend the enterprise. His conduct unifies the room, and the room defines his conduct.” (Sartre 1968/1960, p. 153-154)

Before I take up what Sartre is telling us, I want to say something about the example he provides. In a way it is not a good example, namely in the way that the concrete details, the concrete artifacts are not accounted for. However, this is the style or touch of Sartre, the philosopher and author. What we can get from the quote and from other passages that make up the whole example, but which I do not take up here (it would have broken all limits) are that there is a room, a door, some windows (and from other parts it is clear that there are also), a table (blocking the straight way from the man who raised to the window). However, the artifacts close to the participants, the artifacts they use when they are intensively devoted to interacting with each other, are not mentioned at all. From the example one cannot see what they are so absorbed to and how their committed interaction is accomplished. An imagined visitor who Sartre puts in his example calls them “library rats,” so we can infer that books, articles, papers, pens and pencils may be artifacts in use.

Now let me comment on what Sartre is saying.

There is a move in two directions: “I *comprehend* them [doors and windows] already as instrumental structures and as products of a directed activity”; and 2) “my companion's movement makes explicit the crystallized indications and designations in these products.” And then Sartre takes up the first movement again: “conversely

¹⁴ Hodological – from *hodos* (Greek) a way, path – a mapping of paths and routes.

the indications contained in the utensils become the crystallized meaning which allows me to comprehend the enterprise.” And finally Sartre describes the move as a dialectical move: ”His conduct *unifies* the room, and the room defines his conduct.”

So what does Sartre say? The artifacts are products of a directed activity, which I as an observer understand. However, which indications and designations that are inherent in the artifacts are not quite clear until a person in the room explicitly makes them clear by his actions. In terms of the vocabulary I just have introduced: The active-inert or potentially instructive features of the artifacts (window, door) are made explicit, and, by that, the interaction is specified. The person who opened the window, unites, by his action, the artifact to the situation. That which in the first move was only potentially instructive, has now turned to be instructive and clearly understandable.

Organizational artifacts. How spatio-temporal organization of artifacts and human bodies becomes “instructions for seeing” has been nicely shown by Nishizaka (2000). His example can be said to represent an arrangement that is of short duration, and where the “designers” of the arrangement are the participating members. There is no “master designer” with a privileged position (e.g. a teacher; admittedly there is the researcher, but in this case he is outside, for all practical purposes) and there is no organizational blueprint or standard procedure. It is somewhat similar to the temporary arrangement of the patient line in the heart conference, a kind of improvisation with the small means available. (Described in Paper V.) As a contrast there is technology, sustainable artifacts for sustainable activity. Here one has a designer (and often many re-designers).

Human activity comprises innumerable artifact-mediated actions. The artifacts used are mainly mundane and only a small amount has high tech character. This is also the case in my study of coronary clinical work. It is a study that started as one of many project funded within a Swedish framework of “Collaborative work and modern information technology,” and it studies highly qualified professionals using a lot of advanced technology. Nevertheless, also in this high-professional and high technology-laden work, the “high impact of low tech” (e.g., Jensen, 2001) is considerable.

How is learning connected to development?

In this section I will discuss some research approaches that consider how learning is connected to development. Some of them are intended more to learning and development of individual persons and some to more collective subjects.

Developmental teaching

Vygotsky's conception of the relation between learning and development is well known: instruction-learning goes ahead of development; only insofar learning goes on in the zone of proximal development it can have impact on intellectual development; "scientific concepts" (systematic concepts which are part of science and learned at school in contrast to "everyday concepts") can "go ahead" and pull everyday concepts to a higher level.

His ideas are developed further within cultural historical theory, in our days not the least by Davydov and scholars of education that are inspired by his ideas. The approach is called "developmental instruction," "developmental teaching," the "formative method of experimental teaching" (Lompscher and Hedegaard 1999, foreword), "activity-and-formation strategy" (Lompscher 1999b), "the double move in learning" approach (Hedegaard 1990, 2001), or "learning-directed experiments" (Davydov 1999, p. 127).

All societies have to deal with handing over of experiences and knowledge from one generation to the next, and in our societies this transmission takes place in a historically developed institution, the traditional school. The developmental teaching approach is, as far as I have seen, mainly devoted to learning at school framed by traditional schooling. Roughly speaking, it is "learning the given" orientation more than "learning the new" orientation. The reason is not that learning-the-new orientation is not acknowledged, it definitely is. It is rather that the teaching experiments are organized within a context of the present school institutions, although there are opening-up-of-school experiments (e.g. Moll and Greenberg 1990; Hedegaard 1996). "Approaching learning activity, the most important aspect is to understand the conditions of its right organization in the classrooms," says Davydov (1999, p. 123), and he continues by asking: "What is the idea of such an *adequate arrangement*?" (p. 125; italics of the author.)

The strength of the developmental teaching approach is its insistence that "the basis of developmental teaching is its content" (Davydov 1988, p. 19). The approach builds on the idea that children's learning should be arranged by "subject matter analysis" (e.g., Chaiklin 1999) and by challenging the student's misconceptions in order to follow the traces of the original achievements of knowledge building. In Davydov's words:

“Learning tasks, whose solution implies a full-scale learning activity, requires that pupils analyze the conditions in which the particular concepts of theoretical knowledge originated, and that they appropriate generalized ways of acting. In other words, while solving learning tasks school children discover original or relevant relationships inherent in the respective material.” (1999, p. 128)

Developmental teaching is a classroom learning approach, and as such it is focused on “learning the given.”

The problematic aspect of this approach is, in my opinion, when it too much separates teachers from learners, the school from the rest of society, “the given” from its historical transformations, so that the teachers behave like positivistic scientists, as were they detached from the activity they really are part of. There are many delicate balances making up the discretion of teaching. There is the fine balance between tracing the origin of a concept and a fact, and presenting them as something fixed that are to be learnt. There is further the balance between the teacher as an (in many situations) more capable companion that himself is learning and the teacher acting as if he were detached from the instruction-and-learning activity in which he is actually involved.

Lompscher (1999a, p. 266) has proposed an alternative to the traditional school transmission strategy, an alternative which he calls “activity formation strategy.” It is a strategy that attempts to open up for relating the given to the new and instructors to learners. It is an “arrangement of learning activity (...) as formation of the learning activity itself” (ibid. 268). This means an expansion not only of the minds of the individual children, but also of the instruction-and-learning activity.

As Vasily Davydov (1988, p. 34) has pointed out, learning activity can, “under certain conditions, produce new products with societal value.” It can be organized as a “peculiar merger of learning activity and productive activity, which has *creative* character (...)”

We can thus see that there are two developmental orientations in the developmental teaching approach. First there is the development of student qualities by means of content-orientation and “germ cell analyses.” (The latter refers to an analysis in search of a “molecule” of the object in question, a unit that can give a genetic explanation of the phenomenon. Two paradigmatic examples are the germ cell of “commodity” which unites use value and exchange value in Marx’ analysis of capitalism, and the germ cell of “word meaning” in Vygotsky’s analysis of speech and thinking.) It is this orientation that seems to be dominant in the research tradition of developmental teaching. There is also a tendency aiming at the development of the teaching-and-learning activity itself. In that case, it is similar to or a variant of “learning by expansion” (Engeström 1987).

A risk in many kinds of teaching is that the pedagogical ambitions undermine the basic condition of dialogic interaction. As we know, this is what is witnessed being

happening too much in the school of today. It is a risk also for alternatives to traditional school-education, especially if they accept the framework of the traditional school institution and do not succeed in open it up or expands it boundaries, and the more if they concentrate their research projects on “hard-structured” subjects like mathematics and physics and not on “loosely structured” subjects like history and ethics. In my opinion, the “developmental teaching” approach does not face this challenge seriously.

I think that a discussion of the problem with departure from a distinction between what I will call “assisted performance” and the “construction zone” may catch the point (the expressions originate from Tharp and Gallimore (1988) and Newman, Griffin and Cole (1989) respectively). The different kinds of “assisted performance” share the common feature that the assisting persons are standing apart from the children, as if they were not involved in the instruction-and-learning activity themselves. In contrast, the “construction zone” refers to an activity system where “the teacher incorporates children’s actions into her own system of activity” (Newman et al., p. 63). The assisting person is here a part of the game, and that is also the central idea to make productive use of. The more knowledgeable (on the whole) persons are inviting the less knowledgeable (on the whole) to an activity where they all are involved. It is like a dance, experienced people are leading, and everyone is taking part. Interpersonal processes of the dance are transformed into psychological processes also for the allegedly more knowledgeable persons; also they will learn and develop. And, as in the case of the samba schools which Papert brought up (above, p. 19), also the experts are learning. There is no time out (as Garfinkel says), not even for teachers who think they are bystanders.

Learning the given and learning the new

What I have called “learning the given” is a kind of instruction-learning activity that was established – and here I follow Fichtner (1996) and his Humboldt-interpretation - in and through the modern school. A picture of this kind of instruction-learning activity has been observable here and there in this dissertation. Now I want to give it a more comprehensive summing up. In doing that, I would like to have access to one more piece of the jigsaw puzzle. It is a piece that I have got from diSessa (2000). He uses a metaphor of learning, which I think can help us grasp the transformation from *other-regulation* to *self-regulation*. In a passage where he is talking about “committed learning” he says (ibid. p. 83, and the italics is in the original): “A primary focus of committed learning is *the fabric of activities in which one learns.*” As I want to let the concept “activity” have the meaning it gets within an activity-theoretical framework, I will rephrase diSessa’s expression but keep its aptness, and use the phrase *The fabric of practices in which one learns*. Thus, the idea is that in order to learn, one has to organize the practices one is involved in and by which one learns. By using this terminology, one can say that learning the given, or more precisely, the “instruction-and-learning (the given) activity,” goes from other-regulation to self-instruction. In the earlier phases the organization of practices in which the participants are involved

and by which they learn is initiated and sustained by the instructors. Little by little the learners take over, and in the end they are in charge. Instruction-and-learning has passed from other-regulation to self-regulation. The learners have learnt to learn.

Common for the education-related cases discussed is their adult and culture-given perspective: There is something to learn and the grown ups know what. Such situations of learning are of course important and frequent. However, there are other situations where nobody knows what is to be achieved. Such is the case when learning something genuinely new is at stake, not only something new for the less competent persons involved, but learning what is not “already there” for anyone. As nobody else I know, Yrjö Engeström has never stopped underlining the importance of analyzing and promoting this kind of learning. And his answer, learning by expanding, comprises collective mastering and learning of the new, of designing transformations. For him historicity of learning is at the very core of the research and development approach of Developmental Work Research (see e.g. 1991). He has demonstrated that instruction-and-learning as part of work activity has a special character, and that instruction-and-learning as it develops in the transformation of work may be used as an advanced model for how the new can be learned and created, thus also at schools or other educational settings. This is the key of his idea of “learning by expanding.”

As we have seen, Vasily Davydov (1988, p. 34) underlined that learning activity can, “under certain conditions, produce new products with societal value.” It can be organized as a “peculiar merger of learning activity and productive activity, which has *creative* character (...).”¹⁵

Are these two prospective imaginations only naive hopes for a future school? Maybe it is better fitting into outside-school activities, and even possible only there? The experiences of Cole and his colleagues make suggestions in that direction. At first they tried cultural-historical perspectives and methods in school settings, as in the chemicals combination experiment they reported in the Construction zone book. In that case they worked indirectly, by designing the experiment and supporting the teacher. When working with the Question-Answer-Reading procedure in Field College they as researchers took the responsibility for the everyday educational activity, not only for the research part of the project. Although the fact that the Field College activity was academically successful for the children, the activity did not fit into the school structure. Finally, the researchers were, that is my reading, “pressed away” or “gently thrown out” (Cole 1996, LCHC 1982).

Their next move was to open up a new dimension of instruction-and-learning, namely a dimension of meaningful learning and co-construction of a miniature culture aimed at play and development. In this “Fifth Dimension,” learning what is given is not the main point (but it is nevertheless an achieved academic outcome, as empirical tests indicate, e.g. Blanton et al., 1997), the main point is development and the creation and learning of the new.

¹⁵ As I cannot read Russian I have no access to how this concretely may turn out in practice.

My conclusion is that if one is going to take Vygotsky’s “basic law” seriously, one needs to relate learning actions of a more restricted kind, of a smaller unit, i.e., an individual person’s strings of learning actions, to the development of the embedding activity system.

I have come to the same conclusion (Sutter 1999), when I have been approaching the problem of learning from another points of view: Who is learning - an individual person or a larger unit? What is being learnt - something already known of others or something new and innovative also for other people? Figure 6 summarizes.

	LEARNING THE GIVEN NEW	LEARNING THE SOCIETAL NEW
Instruction as special activity	Well articulated tasks or well established practice	Sketchy, suggesting, “in principle”-tasks. Managing of real-life disturbances, breakdowns, troubles, contradictions
Instructional actions and operations (embedded in every activity)	Discovery of the given; solutions to well-defined tasks	Questioning, critique; no clear-cut solutions

Figure 6. Instruction and learning related to the “given new” and the “societal new”

Figure 6 is built up of two distinctions. First, the distinction between instruction as activity and instruction limited to actions and operations. Second, what is being learnt – that which is new for “newcomers” but already known for old-timers, or something which is new for everybody.

What can we gain from Figure 6? Let us start with the “given new”-column. An activity of instruction of the “given new” starts with what is given: well articulated tasks or well established practices. Some old-timers in the community knew what tasks to do and how to do them. By instruction (as activity), a canon, a curriculum, a tradition or some tricks of the trade are handed over to newcomers, pupils, apprentices or whatever the less knowledgeable people are called. As actions, “learning the given new” occurs embedded in an activity system by the use of artifacts and training of skills in a community of practice. We can see that “learning the given new”-column is a shorthand for typical apprenticeship. What we also can gain from Figure 6 is that learning the given new uses resources for learning in the “environment” in the form of other people’s instructional actions and operations.

In learning the given, there is room for discoveries from the learners. It means that learning may be creative. However, the creativity is framed by well-defined tasks. It is about creative learning of what is already given. It is good if this can be

accomplished, because any society needs that kind of learning, but it is also good to realize that there are restrictions, which may hamper this creative learning.

The “learning the societal new”-column of Figure 6 has to do with innovations. The activity of instruction involved here has a different character than a “given new”-instruction. You cannot give detailed instruction, because the details aren’t known yet. The instructor (project leadership, management, etc.) can, in the start, only frame the problem and sketch what is to be done, and after hand adapt to what comes up and reframe the task when necessary. The framing of the learning is not here in form of well-defined tasks, there are no such tasks, there are no clear-cut solutions. Learning, therefore, comprises questioning, critique, and also attempts to reframe the mission that is to be accomplished. Intensive interactions between involved participants are unavoidable. When learning the societal new, the instructional actions and operations of the other members are of outmost importance.

School learning can be characterized as oriented to the past. It is predominantly supported by verbal instructional activity. Learning at work displays a different pattern. It recognizes that the activity of instruction is not restricted to verbal instruction, but also includes instruction built into artifact affordances and institutional procedures (Jonsson, Linell, and Säljö, 1991). Work is oriented to the future. The instructional activity that supports work is built into artifacts and institutional procedures used in the work activity. Furthermore, the mutual support the participants are giving each other when doing the job is salient.

Learning as a specific activity has as its object the self-organized reproduction and development of the very activity system or an active system’s (individual person or a community) transforming of itself. A consequence of this way of defining the activity of learning is that learning as an activity is intertwined with development. If we to this statement add what I have discussed in and around Figure 6, that instruction and learning go together, we can conclude that learning is intertwined with development, and so is instruction.

Learning and “knowledge building”

In a chapter of *The Handbook of Education and Human Development* (1996) Carl Bereiter and Marlene Scardamalia make a distinction that I find fruitful for thinking about learning. It is the distinction between “learning” and “knowledge building.” The fruitfulness lies in making two fundamental kinds of learning visible through this conceptualization. The dominant conception of learning in our society is connected to the container metaphor of content in individual mind, and of schooling as a practice of learning. “[P]edagogy has evolved as a craft for cultivating mental content” as Bereiter and Scardamalia (1996, p. 487) say. This is a conception of “folk psychology” and of the practice of school learning. What Bereiter and Scardamalia propose is “an expanded set of concepts that we believe are necessary in order to move educational thought and practice significantly beyond where they are today”

(ibid. p. 485), and central in what they come up with is that “promoting individual learning (whether it is done individually or through group processes) is one thing and fostering knowledge embedded in transferable social practices is another” (p. 491). Let us elaborate on what makes the difference significant between “promoting individual learning” and “fostering knowledge embedded in transferable social practice.” I will do that by using an example from the authors. Imagine a scientist or a scholar and imagine a student. In their work, the former produces knowledge, but they also learn. Thus, they are engaged in knowledge building and learning, although “learning” is not generally conceived as substantial in their work. The “job” of the students, however, is learning, but neither the students nor the public think of it in terms of production of knowledge. However, exactly this is what Bereiter and Scardamalia propose, that the school has to have “a dual role” (p. 505) – promoting learning as well as fostering knowledge building.

I think this is a marvelous idea for educational practice. This assessment of mine should be of no surprise to the reader taking into consideration what I have said about learning the given and learning the new. It is obvious that the authors’ differentiation between learning and knowledge building is similar to the distinction activity theorists have made and I have discussed above.¹⁶ The problem, however, is to accomplish both learning and knowledge building, both learning the given and learning the new in traditional school settings. Later I will outline my activity-theoretical perspective on this question, but first, in this section of the paper, I will examine the authors’ suggestion of how to introduce a dual role of the school, which means in adding to learning, also “working productively with knowledge” (p. 490).

Bereiter and In that way, the strength of the Popperian epistemology can be used, a strength that in my opinion consists of pointing out the importance of World 3, or as I would prefer to phrase it, of ideal objects in human activity. Unfortunately the knowledge-building conception does not overcome the weakness of Popper’s epistemology – its disembodied and isolated “ideality.” In several passages in Bereiter and Scardamalia (1996), this is, to me, obviously the case. I will bring one example of many possible ones:

“Popper’s three-worlds schema offers a unifying framework in which we may conceive of a connectionist mind (World 2) acting knowledgeably and logically with respect to knowledge objects that have a kind of autonomous existence outside both individual minds and cultural practices.” (ibid., p. 510)

Notice “outside cultural practice”! From a cultural-historical activity-theory perspective it does not make sense to claim there exist knowledge objects outside

¹⁶ “Neither folk theory nor sociocultural theory makes a distinction between knowledge building and learning,” Bereiter and Scardamalia claim (1996, p. 501). This statement may be true or not depending on what counts as sociocultural theory. At all events, at least the activity theorists Engeström and Fichtner do, as I have shown.

cultural practice. Bereiter and Scardamalia seem to be aware of that, because they try to introduce – half-heartedly in my opinion – a mediating world, “World 2.5,” which is a “world of knowledge embedded in practice” (p. 494-495). However, what this embeddedness in practice means, they do not make anything of in the Handbook chapter, for example, that development of “knowledge objects” also includes use of artifacts, community building, etceteras, in short, development of an activity system. Educational consequences of “World 2.5” could for example be that a newcomer in a “community of knowledge building” would participate legitimately by doing explicitly and circumstantially what the experienced scientist or scholar to a large part does in a condensed and internalized way. In other words, in order to teach and learn an “intellectual skill” you need to teach and learn all practical and material details that in the end sum up to that skill. If one excludes mysticism, there is no other way to the “knowledge object” than via practical actions and handling of material objects within a community of practice or an activity system.

The “reduction of principles to procedures” that Bereiter notes as a common property of educational practice,¹⁷ is, in my opinion, due to isolation of school knowledge from the *activity* of knowledge production. Therefore, Bereiter and Scardamalia’s wonderful idea that school should be devoted to both learning and knowledge building must face the *problem of building up an activity of knowledge production within the school system*. And by an activity of knowledge production I do not refer to shortcuts in the form of a provisional community of a Science School-Lab or something like that, where conducting an activity is based on teacher-student relations and the provision of historical conceptual artifacts. I do not say this is impossible.¹⁸ What I say is that one has to ask whether the activity one is building up is an activity conducive to knowledge production or not. And of course, depending on the age of the students involved, there is a balance – how much learning, how much knowledge building?

In another article, Scardamalia and Bereiter (1994) indeed face the problem of building up an activity of knowledge production within the school system. It is about a “knowledge-building community” in which a student-built database is at the center. To me it seems to be a very promising attempt. That it is built on “new knowledge media” of which it is a known and certified fact that students are interested and learn the technology fast (e.g. Holm Sørensen & Olesen, 2000), in my opinion, enhances the possibility that the knowledge produced will not be crippled by school constraints. It is in glaring contrast to the example mentioned in the Handbook on “knowledge building in mathematics,” where it is said that knowledge building in elementary mathematics “would mean producing the kind of things mathematicians produce – theorems, structures, algorithms, proofs, along with such subsidiary objects as explanations and justifications” (p. 507). Would it realistically be possible to change this *school activity of elementary mathematics* into an activity of mathematical

¹⁷ http://www.telelearn.ca/g_access/pioneers/bereiter.html

¹⁸ My colleagues and I have tried to build communities at school, which promotes knowledge-building activities (Sutter and Grensjö, 1989; Sutter, 1991). I am sure there are several such attempts. One of my favorites is (Hunter and Xie, 2000).

knowledge production, a highly specialized activity, within the school system? (My experience from school education disposes me to answer: by no means!)

Development of coronary clinical work

In this section I will give two accounts of the development of coronary clinical work. The first is an account from an outsider or management perspective, and it outlines the development in statistical figures and by means of national guidelines and recommendations. The second account is from the perspective of the work of the professionals, and it focuses on how the object of work is changed.

Changes of coronary clinical work in statistical figures

In 2001 the highest authority in Sweden on health-care, Socialstyrelsen (The National Board of Health and Welfare) presented National guidelines for coronary-artery diseases. In these National Guidelines are outlined the changes that have taken place concerning coronary-artery disease and its treatments. Three things are of particular interest for my analyses.

The *first* is the relation between bypass surgery (CABG; coronary artery bypass graft) and balloon dilatation (PTCA). This thing is important because the clinical team in the heart conference has to make a decision where the main alternatives are bypass surgery and balloon dilatation. Here emerges the question if the relation between these treatment methods is static or if it has undergone changes, and, consequently, what that would mean for the coronary clinical work activity?

Second, on the basis of experiences from the clinical practices, which have undergone marked changes, and from studies of effects of the different methods for treatment of coronary-artery disease, recommendations are issued through the National Guidelines. These recommendations are of course for the future, but they also sum up tendencies that have been on their way for a while, tendencies that were part of the clinical trade for the period of my study.

Third, the changes in treatment technologies and skills also have had consequences for the organization of coronary clinical work. What is said about that in the National Guidelines?

National statistical figures

The ground for statistical figures in Sweden on coronary-artery disease seems to be good. Physicians I have talked to claim that the few centralized registers give a reliable picture of the matter of fact. It is reported that 1998 about 6600 PTCA and about 6200 CABG were made, and that the estimated need of PTCA and CABG is 12000 and 7700 respectively (National Guidelines, p. 166). It means that in rough figures there is need for 60% balloon dilatation and 40% bypass surgery in the near future.

The development of treatment technology in form of CABG and PTCA has been astonishing. (This is valid also for medical treatment according to the National Guidelines, but this is beside the point of my analysis.) Within a few decades, the numbers of bypass surgery and balloon dilatation have increased substantially in Sweden, as in most Western countries. A 10-20-fold increase can be seen during a period of 15 years (Figure 7).

	Bypass surgery (CABG)	Balloon dilatation (PTCA)	Total
1980	503	0	503
1985	1970	165	2135
1990	4359	1098	5427
1995	6029	3582	9611
1998	6200 (approximately)	6600 (approximately)	12800 (approximately)

Figure 7. Number of bypass surgery and balloon dilatations in Sweden. (Source: BLT 970417 plus National Guideline 2001)

From Figure 7 is apparent that the proportion of PTCA has increased as a coronary treatment technology. From a modest beginning in 1985, when PTCA did not reach even 10 percent of bypass surgery (CABG), five years later the proportion has raised to almost 20 percent, and still five years later it increased to almost 60 percent. Now PTCA is even outnumbering bypass surgery. In proportion, of the two treatment-methods used, PTCA comprised 8%, 20%, 37%, and 52% percent for the years 1985, 1990, 1995, and 1998 respectively.

As a historical notice, the PTCA can be said to be a relatively new method. The first PTCA interference was made 1977 by a Swiss physician. The first PTCA in Sweden took place in Lund 1984. (Source: Sydsvenska Dagbladet 5.7.95)



Figure 8. Development on the number of PTCA interventions per year. Data from the National PTCA register. (National Guidelines, p. 169).

It is reported that the number of CABG interventions in Sweden has been relatively stable, around 6500 CABG per year (National Guidelines, p. 168). Evidently, this is what is valid for the last five years or so. From these figures one can say that the number of bypass surgery connected to coronary-artery, has increased dramatically but since some years, it has reached an asymptotic level. With a delay, a similar developmental process can be seen for PTCA as is shown in Figure 8. (The asymptote is not seen in the figure. It is predicted from what is said in National Guidelines about the dimensions needed and possible in the foreseeable future.)

A rough estimation of the relation between CABG and PTCA of all cases which have had treatment results in the following figure, which I have made on the basis of information from the National Guidelines.

	One-vessel Disease	Two-vessels Disease	Three-vessels Disease
To CABG	20 %	40-50 %	75-80 %
To PTCA	80 %	50-60 %	20-25 %

Figure 9. Distribution between CABG (bypass) and PTCA (balloon dilatation) of all cases treated. (The figure shows a collapse of figures from six regions; the variations between regions are sometimes great, so the table should be read carefully. Basic source comes from National Guidelines, p. 172)

In short, Figure 9 shows that balloon dilatation is the dominating procedure when only one vessel of the coronary artery is diseased. The opposite is true when all three vessels of the coronary artery are diseased. Then bypass is dominating, and it is about “full revascularization.”

Changed guidelines for changed practices

The new National Guidelines are build upon an extensive Scandinavian study, FRISC II (1999) published in Lancet. The results of the FRISC II study are backed up by results from the Swedish National register for coronary intensive care, and from the preliminary results from an American study, TACTICS. The biggest change that the National Guidelines lays down in the new guidelines from 2001 is a concentration on coronary angiography and invasive coronary-artery revascularization – catheter-carried angioplasty (PTCA) and coronary-artery bypass graft (CABG) – in early stages of unstable coronary artery disease.” (p. 138)

During a few decades, a new tool for diagnosis and treatment of coronary sickness has been deployed and applied. It is the tool that is produced and applied in a new clinical laboratory, in Karlskrona called the Angio Lab. In the beginning it was used mainly as a diagnostic tool for radiological investigations of the heart, “coronary angiography.” But more and more it was also deployed as a treatment method, PTCA, by which blocked coronary vessels could be expanded.. The abbreviation PTCA, therefore, in the literature stands for the x-ray investigation of the angio (Percutan

Transluminal Coronary Angiography), and for the treatment procedure, which can be seen as a continuation of the former, balloon dilatation (Percutaneous Transluminal Coronary Angioplasty). However, in the National Guidelines, PTCA refers to balloon dilatation.

The importance of PTCA as a diagnostic method is presented as a firm established fact in the National Guidelines, p. 50): "Percutan Transluminal Coronary Angiography is the most reliable tool for describing the anatomy of the appearance of the coronary-artery tree, and thanks to that the prevalence, extent and spreading of atherosclerotic changes of coronary-artery."

From the National Guidelines, it is evident that the *division of labor* between regional hospitals, county hospitals and health care centers is being transformed. "Coronary-artery angiography is being made at most of the county hospitals in Sweden. It means a decentralization which has contributed to a legitimate and increased availability of this examination method" (p. 50). The changes in the organization of coronary diagnostic work can be a matter of where an examination or some treatments are to take place, it can be a matter of collaborative work and consultation by means of distance technology, and it can be a matter of division of labor and collaboration in one and the same workplace. The development opens up possibilities for increased specialization also at the smaller hospitals, something which in its turn increases the need for collaboration. It is all about a process of differentiation and integration of activities connected to health care.

Local figures

The figures from the pre-thorax period in Karlskrona, for the years 1994-1996, shows that about 50 heart conferences per year were held. 500-600 patients were presented each year, with an average of 11-12 patients per conference. (Kehler et al., 1996)

The picture for the Karlskrona hospital, for the years of 1997-2001, the first five years after the establishment of the Thorax clinic, is summarized in figure 10.

For the first two years of its existence, the Thorax clinic at Karlskrona had a PTCA-quotient just below the average in Sweden, around 40%. "I wouldn't mind a little more, 50 percent. Abroad, 70 percent is not unusual," said the chief radiologist at the Thorax clinic (personal communication, 990602). As can be seen in Figure 10, he had his request granted for the last three years.

If only "clean" PTCA cases are counted, i.e. where coronary-disease cases that have problems with mitralis or the ventricle functions are taken away, because they need surgery and therefore are given surgery also for the coronaries, then the proportion PTCA is about 60% (personal communication, 011123). 60% PTCA and 40% bypass surgery is also a figure that Socialstyrelsen (The National Board for Health and Welfare) estimates for the foreseeable future (in their Appendix table 1).

	Coronary operation	Balloon dilatation (PTCA)	Proportion PTCA
1997	(369)	202 (210)	35 % (36 %)
1998	392 (361)	269 (260)	41 % (42 %)
1999	422	374	47 %
2000	509	518	50 %
2001	496 (011123)	480 (011123)	49 %
prognosis 1/12/01	550 (prognosis)	540 (prognosis)	

Figure 10. Balloon dilatation (PTCA) and Coronary Operations at the Thorax clinic, Karlskrona hospital 1997-2001. Thorax clinic, local database statistics. (Figures within brackets were provided in 1999. The other figures are from November 2001.)

Interesting for my discussion is the fact that in coronary diagnostic and treatment work, the two mentioned methods or technologies, i.e. coronary angiography and PTCA, have dramatically changed the work practice during the last decade. Although others methods and technologies add to the outcome, they don't seem to be as important to the current issue. What the statistic figures are showing, can also, at a more detailed level, be seen in the collaborative work in the distributed clinical heart conferences I have studied.

The changed object of coronary clinical work

How does the focus of the work, its accomplishment and aim, influence how the work gets done? In other words, how does the activity influence what is done as actions and strings of actions? Put in still another way, in what way does it make sense to talk about "the guiding function of the object of work"?

The object of work is determining the activity, according to Leontiev, and it is a central concept in activity theory. However, the concept is not easy to grasp, it is bridging the given "raw material" and the possible transformations of the future. Indeed, it is a "moving target" as Engeström says (2001, p. 132). I will discuss the object of coronary clinical work by means of a concrete example. It is a short episode from a patient case.¹⁹

Example 2

- 27 (R) and this is also (0.5) sick
- 28 but it's 'little
- 29 he has written "over fifty"
- 30 it yeah it may depend on what to compare with
- 31 (S) they are large-sized the vessels
- 32 (R) they are large-sized the vessels
- 33 thus you have

¹⁹ The Patient 3 case is presented in Paper I, III and VI for different analyses. The sequence I will use here in is identical to the sequence used in Paper I.

34 (S) [at the catheter it doesn't look stenotic
 35 (R) exactly because you have about one decimal one decimal seven
 36 at the catheter
 37 so the width is rather good
 38 (S) hmm
 39 (R) so it (0.5) perhaps one ought to PTCA this one too
 40 and then here at the end then comes
 41 (S) but that will be many to do
 42 you have to do LAD, the diagonal, the marginal and
 43 (R) [no yes those 3
 44 (S) yeah
 45 [(1.0) shall we do that then?

First a short background to what is going on in the sequence shown in Example 2. The situation is this. A patient case is being discussed in a heart conference. Present at the conference are a radiologist and a cardiologist in Karlskrona and a surgeon in Lund. The cardiologist has already presented the background of the patient history and also reported actual test results that may be of importance, and now, when we are invited by means of the example to watch what is going on, the radiologist is in the middle of presenting the patient case as it appears on the angio film. The physicians have already examined the former part of the angio film and have found that two coronary vessels are significantly sick. Now they are discussing a new vessel, called the Marginal.

The coding scheme Fifty Percent is used. This means that a systematic procedure is used by the physicians "to transform the world into categories and events that are relevant to the work of the profession" (Goodwin 1994, p. 608). The physicians know that if the blockage of the vessel gets a measure of 50% or more, experience has shown that this is serious and, therefore, the vessel should be classified as significantly sick. Thus, it is a rough categorization. If the measure is under 50%, the physicians are recommended to quit, if it is 50 and more, they are expected to assess it as significantly sick.

On this occasion the coding scheme 50% is on the merge to being put aside. The reason seems to be that the measure (a measure got with help of a computer program) does contradict what is got by eye, and also because the vessel is unusually thick so that even if the blockage is regarded as significant, it nevertheless has so much space left that it is expected to provide a sufficient amount of blood. However, instead of letting the vessel pass as not significantly sick, the radiologist suggests that also this vessel should get a PTCA. The surgeon first makes an objection ("but that will be many to do") and starts to count up the vessels. After having numbered three vessels he prepares to mention a fourth, "and," but is interrupted by the radiologist, "no yes those 3," and then they decide to PTCA all the three vessels. It was not a routine decision, rather an innovative one. Some years earlier it would have been almost impossible.

The physicians had to take into account a lot of things, among others some general goal or objectives, which are stated in this way in the National Guidelines 2001 from the Swedish National Board of Health and Welfare: “The objective of the treatment is to save life, alleviate symptoms, prolong life, reduce damage, avoid complications, and prevent new illness.” (Socialstyrelsen 2001, version for managers, p. 18) To this come the many circumstances from the particular case, for example:

- ❖ Relative or absolute measure of the blockage (computer supported assessment or assessment by eye?)
- ❖ The patient has earlier already had a PTCA and would prefer another one instead of bypass surgery.
- ❖ In the light of the fact that three vessels are assessed significantly sick, what decision to take, PTCA or surgery?
- ❖ A responsible handling of the rivalry and differences in professional perspectives that exist between surgeons (Lund) on one side and cardiologists and radiologists in Karlskrona on the other (“you got a new try then”). (Studies have shown, and they are summarized in National Guidelines from “Socialstyrelsen,” 2001, p. 175, that surgery has better sustainability in the long run, and also better relief of symptoms. However, during and immediately after the invasive treatment, PTCA is much more lenient to the patient).
- ❖ Thus, what we can interpret here are many actions that clearly are guided by “what it all is about”, or in the vocabulary of activity-theory, the motive of the object of work, in addition to the many concrete circumstances that exist.

As I see it, the physicians are mutually instructing each other what vessels to look at, how to judge their conditions, what measures to take into account, how to balance the details, how to get to “the whole picture” of the patient’s heart-disease, how to weight in the wish of the patient, and so on. In my opinion, what is going on is co-coaching, guided by the object of work, and it is not just on the level of smaller details and more well-defined tasks, but takes the form of interaction oriented at what has to be achieved, which is framed only vaguely, and in consideration of available particulars.

The physicians made a decision paying attention to the given circumstances and the possible risks and solutions. In short, they were co-coaching each other while keeping the “moving target” of the object of work in mind. In my understanding, that is the way the guidance of the object of work is accomplished.

Learning and development of the societal new

I deal with the collaborative nature of instruction-and-learning first by approaching instruction as structured, consisting of different forms – activity, actions, and operations. For me this structure functions as a springboard to realize the intertwining of instruction and learning. Then I face the problem of power and authority: Who is instructing whom? In the next step I revisit the question of learning the given and learning the new, thus coming to the relation between learning and development.

Forms of instruction (and learning)

In the 1980's there was a kind of "horizon of expectation" upon which it made a point to underline and explore what it may mean that learning is part of everyday activity and not necessarily presupposing instruction, like Papert, Lave, Wenger and others have explained. Today, I think it worth pointing out another feature, namely that there is not only learning as a side effect of every activity, i.e. learning actions embedded in all kind of activity, but there is also learning as a specific activity. Correspondingly, there is not only instruction in the form of a specific activity, but there are also instructions in the form of actions/operations as parts of every interaction. Figure 11 gives the idea.

	INSTRUCTION	LEARNING
ACTIVITY	Motivated instruction or Intentional instruction activity Developmental work research Co-coaching	Motivated learning or Intentional learning activity Learning by expansion
ACTIONS/ OPERATIONS	Coaching Assisted performance	Learning not separate from, but as integral part of generative social practice (e.g., Papert; Lave) "Mittlernen" (Holzkamp)

Figure 11. Forms of instruction and learning.

I started this paper with a conception of learning, which I attributed primarily to Seymour Papert and to Jean Lave and which I understand as a sound reaction to the transmission-concept of traditional school education. They claimed that learning is situated, not something apart of the ongoing activity in which it unfolds. Albeit an important underscoring that learning cannot be understood as detached from lived practice, I found that their conceptions pay too little attention to instruction as necessary resources of learning. Expressed in another way, Papert and Lave seem to operate mainly or only with two of the four fields of Figure 11, learning as actions/operations and instruction as activity. In my opinion, they miss or

underestimate that learning can be an activity. They do not make a clear distinction between intentional learning and “Mittlernen” (Holzkamp’s [1995] expression, like the critical psychologists do. They also miss that instruction are part of everyday interaction, that instruction (like learning) can occur as actions embedded in every activity.

Instruction as part of everyday interaction is also part of “members’ method” to “make instructably observable” – to use a technical terms from Garfinkel (1996). The meaning is that to be able to communicate something to a companion, one has to point out – in some way, through methods used by the members in the local community of practice – that; *this* is what I am talking about, and *this* are what my comments are about it. In other words, one needs to “make instructably observable” what one is talking about and what one is doing. Otherwise the talk and doings are not made intelligible. To make instructably observable is a ground for all kind of human interaction.

Instruction as part of all kinds of interaction can also be described as “assisted performance.” (I use this expression differently from Gallimore and Tharp, who introduced it and wanted it to mean teaching as activity.) In interaction one adopts to one’s co-actor, and I think that the mutual adaptations that take place can be understood as mutual instruction on the level of actions.²⁰

My conclusion from what is said is that *when learning occurs, instruction is involved.*

Who is instructing whom?

Instruction as activity and as actions cover a wide field of concrete actions -- from societal settings that function as instructing settings, to planned interventions in different forms, to “suggesting” affordances of the material artifacts, to “demanding” institutional settings, to live instructional actions. What is “mutually constituted” by the participants in a certain situation is open, as all actions are. But the openness is an openness with restrictions. The apparently present participants are not the only influencing forces that are present. There are also “former participants” involved who make their voices heard through their activities, now crystallized into habits, traditions, artifacts, organizational patterns, institutions and the like.

From my interpretation of Vygotsky’s “basic law” follows that people influence each other, and that their influences are mutually constituted. In this “influencing process” nobody can determine beforehand which influences will emerge, they are jointly

²⁰ The term “intentional” used in Figure 11 in the expressions “intentional instruction activity” and “intentional learning activity” comes from Holzkamp and refers to instruction as activity. The term may be misunderstood because it suggests that actions are not intentional. But in my use of the term, in accordance with activity theory terminology and as shown above, actions are intentional.

constructed, possible to record only after the fact. But in this “influencing process” there are many forces at work in any given moment.

A more precise way of approaching the problem of who is instructing whom, is to ask, as do Newman, Griffin and Cole in their book *The Construction Zone* (1989), *When is a task? What they found in their study was that even if the task was a central part of the planned instruction activity, it was also the case that “the presence of ‘the task’ in an activity must be jointly achieved and maintained”* (Cole 1996, p. 262).

Very often for children, goals originate in interaction with adults, as we observe in instructional interactions. In less constrained settings, children may hold more to their own goals (...) But even in cases where the child’s goal is not a result of adult appropriation, goals are suggested and constrained by material and social circumstances. In the chemicals combinations task, when the children found the goal of determining they had all the pairs, the goal arose from the whole task they were engaged in. (...) The appropriation process is reciprocal, and cognitive change occurs within this mutually constructive process. While instructional interactions favor the role associated with the teacher, we cannot lose sight of the continually active role of the child.” (Newman, Griffin, and Cole, 1989, p. 58)

In analyses of conversations, the idea of *repair* is standard and the same applies for talk-in-action. I think there is a need for the concept of repair in analyses of instructions too: How do the parties in teaching and learning adapt to each other, what kinds of methods do they use in establishing “good enough” co-actions and understanding? This is another way to ask, like Jean Lave does, “what teaching is, from the perspective of learners learning” (1996, p. 150).

Sometimes when I use the term “instruction,” I think it would be preferable to emphasize the oral situatedness of those actions realizing the instruction activity, and by that following Lucy Suchman’s (1987) idea of situated actions and the now frequent use of “situated learning.” In order to highlight the live character of the instruction, it may be termed “situated instruction.” One reason to use the term “situated instruction” would be to emphasize the situatedness of the instructional actions. This is because I have objections to the idea of restricting instruction to a “plan”, a prefabricated account of what to do, and the realization of this plan in a teaching practice. Instead of the plan-and-its-realization view, I see instruction as a phenomenon established in interaction. This means that if one gives an intended instruction, one’s actions are not an instruction before the person with whom one interacts receives it as an instruction. Thus, I see instruction as co-constructed in interaction. In the absence of such a mutuality, one gets a situation as in the comic strip, where a person says he has taught a dog to whistle, and the interlocutor says that he cannot hear the dog whistling, whereupon the first person replies that he did not say that the dog was able to whistle, only that he has been taught to do so.

Expressions like “situated instruction” and “situated actions” have their time and place. When it is widely thought that actions may be unsituated, it is informative to use the expression “situated actions,” and in that way point out the situated character

of actions. This being said and understood, however, it may be inadequate to speak of “situated actions,” because it may give the impression that there are actions that are not situated. That is the reason why I don’t use the expression “situated instruction” except on very special occasions.

Learning in (and between) communities of practice

Learning takes place in a social context, almost all agree on that. When it comes to how this social context is best described, the opinions go far apart. I will discuss four approaches to the communality of learning: Lave and Wenger’s legitimate peripheral participation, Ole Dreier’s and other critical psychologists’ learning as transformation of personal trajectories of participation across contexts of social practice, Michael Cole’s romantic science and utopian methodology, and Yrjö Engeström’s expansive learning and developmental work research.

Apprenticeship in terms of Legitimate Peripheral Participation

The influential concept of learning that Lave and Wenger’s (1991) presented a decade ago and has been elaborating on still further (Lave 1993, 1996; Wenger 1998), “legitimate peripheral participation” (LPP), has grown out of ideas of situated learning and of apprenticeship. The errand of the 1991 book is to argue for a conceptual development of learning – from situated learning to learning as legitimate peripheral participation. In contrast to more conventional conceptions of learning, the LPP perspective on learning “concerns the whole person acting in the world” (p. 49) and, consequently, it operates with an “expanded scale of time” (p. 121). If academic psychology (behaviorism and many times also cognitive psychology) and educational experiments reported in scientific journals in one end of a scale preferably works with “small pieces” of learning units and short intervals of learning and remembering, LPP is to be placed in the other end of the scale.

LPP is explicitly intended to be an extension of the idea of situated learning at least what regards the following two aspects:

- 1) It is not only the individual person who learns, learning takes place in a community of practice. This means that the “person has been correspondingly transformed into a practitioner” (p. 122), who is situated in a community of practice.
- 2) Learning takes place in a social world, and this *world is structured in a way that is determining for learning*. LPP thus starts with the idea that learning is situated, but goes further and asks how the situation is structured. Lave and Wenger are “trying to furnish the social world” and in so doing they stress the fact that a community of practice is delineated by the reproduction cycles of the community.

Lave and Wenger claim that the “epistemological principle of learning” (p. 98) is participation in cultural practice. Learning is situated, and the “place,” the “situation,” is (within) a community of practice, which in its turn is delineated by the reproduction cycles of the community (p. 98). However, the: “the structure of production and the structure of apprenticeship do not coincide as a whole” (p. 86). “Apprenticeship learning is not ‘work-driven’ in the way stereotypes of informal learning have suggested; the ordering of learning and everyday practice do not coincide.” (p. 96) The structure of work and the structure of the community of practice are not identical. What is important to realize, they underline, is that the structure in which a person “is “placed” or “moving” or “acting” is of ultimate importance – for the person’s participation and, therefore, his or her learning, and for the an analysis of these phenomena. In their own words:

The structuring resources for learning exist in practice, but the work-driven practice is not the only practice. There is more going on than production in apprenticeship. “[L]earning must be understood with respect to a practice as a whole, with its multiplicity of relations – both within the community and with the world at large.” (p. 114)

Learning concerns the actual communities of practice, not the formal ones. To the extent there is a gap between the two; learning is also a consequence of participants’ handling of the conflict between the real community of practice and the formally claimed community of practice. In other words, learning originates from participation in the real community of practice, and also from the utilization of the resources that this conflict provides. If there is a conflict of this kind, coping with the conflict is one aspect of participation in the community of practice.

“The challenging problem has been to address the structural character of that world at the level at which it is lived” (p. 123). What structural characteristics are there in the social world of a community of practice in which persons are participants? Among them mentioned by Lave and Wenger are:

- ❖ Forms of membership
- ❖ Construction of identities
- ❖ Location and organization of mastery in communities
- ❖ Masters, finished products, and more advanced apprentices
- ❖ Problems of power
- ❖ Access to practice and to technology
- ❖ Transparency
- ❖ Developmental cycles of communities of practice
- ❖ Change
- ❖ Contradiction between continuity and displacement

In my opinion, the “concept” or “analytical perspective” of LPP (p. 39) has been very fruitful in pointing out what a “learning environment” and what a “learning situation”

might consist of - structural properties of a community of practice, properties that shape learning, by facilitating certain kinds and by arresting other kinds. Among other things, they bring nuances to the picture of power and learning. They also bring up what we can call “scope of learning.” In other words, they question what constitutes a suitable unit of analysis of learning. Is it the short sequences of actions and operations involved in learning a list of nonsense syllables in a psychological experiment? Is it the curriculum unit that the school provides in an academic subject during a course? Is it the trick of the trade, which is the outcome of long-time learning within a profession? Is it the formation of “modern mentality” as a result of the “immanent pedagogy” of a society over centuries?

What I find problematic with the LPP concept is that it excludes all kind of instruction that is not of the “brutal” type. For example Lave and Wenger claim: “we have focused our attention on the structure of social practice rather than privileging the structure of pedagogy as a source of learning” (p. 113) and also that “very little observable teaching; the more basic phenomenon is learning” (p. 92). Although the LPP concept of learning with delicate nuances is connected to a variety of features, it is freed from instruction. I miss instruction in the community of practice, and then I do not refer to transmission-like instruction (“structure of pedagogy”). What I see as a consequence of this ignorance is that the distinction between learning as activity and learning as “Mit-Lernen” (by-product learning) is lost. It has consequences also for the perspective on the relation between learning and development. Lave and Wenger claim that learning is an aspect of participation in practice - I agree – but learning seems not to be conceived also as a special activity, an activity that can go ahead of “actual development,” an activity that has as its goal the transformation of the activity system itself. Therefore, the community of practice perils to be static.

To be exact, Lave and Wenger address the problem of change: a community of practice is changed by a “continuity-displacement contradiction” represented by old-timers and newcomers (especially pp. 113-116). To me their explanation of change from newcomer to old-timer, or more precisely from peripheral participation into the direction of full participation, make sense. But when they situate the core of development to a mix of the newcomers’ identity and interests conflicting with the old-timers’, and at the same claim that “change is a fundamental property of communities of practice and their activities” (p. 117), I am not able to grasp this as an explanation.

The LPP concept situates people in a community of practice, which has a structure that constitutes learning resources for the person in question. I think it is fair to say the LPP perspective puts the structuring resources of social practice for learning onto the front. By participating participants learn. Although it is now and then suggested that they are agents and active, I cannot escape the impression that their learning is a little passive. Quite obvious is that learning as an activity is totally absent from the LPP concept. And what about teaching? – As we have seen: “very little observable teaching” (p. 92).

Learning as transformation of personal trajectories of participation across contexts of social practice

Critical psychologists in Copenhagen have been developing a concept of learning that deliberately connects to the “legitimate peripheral participation” perspective. However, there are some noticeable differences between their approach and the LPP approach. I will discuss three aspects, which I think can be seen as the Copenhagen group’s further development of the LPP perspective on learning. The further development comprises 1) a sharper focus on the individual person, 2) bringing forward intentional learning in addition to learning as a by-product of participation in social practice, and 3) a broader concept of “social practice” than the “community of practice” concept designates.

Before I go into the differences, and in order not to blow them up - actually the critical psychologist in Denmark have been collaborating with Jean Lave for many years - I will outline the stance the critical psychologists take towards more traditional ideas of learning, a stance which is more or less identical to the stance of LPP. In the “Conclusion” of the Lave and Wenger book the authors summarize their endeavor in a way that I think the critical psychologists fully would endorse. I use the summary to describe the common grounds of the two approaches. Lave and Wenger say (p. 121) that “the practice-theory project (...) insists on participation in the lived-in world as a key unit of analysis in a theory of social practice (which includes learning)” and from a learning perspective it stands for a “longer and broader concept of what it means to learn.”

LPP and the approach of the critical psychologists have in common a critique of the traditional school concept of learning and share an interest to develop “non-scholastic learning” that may be fruitful also within the framework of a school institution. (It ought to be mentioned that they both are part of the network on non-scholastic learning that exists in Denmark; see, e.g. Nielsen & Kvale 1999.)

According to Ole Dreier (1999a), the most well known critical psychologist in Denmark, there are two major shortcomings of the psychologically based research on learning. One shortcoming is that learning is being characterized mainly from the perspective of education and teaching. The other shortcoming is that learning is being conceptualized as if it takes place in a single context, predominantly classrooms of educational departments. Dreier continues:²¹

“School learning works in many ways as a dominating paradigm, which takes fright of other kinds of learning practices, and which comprises a standard of how learning outside the educational institutions ought to be understood. (...) Part of the school learning paradigm is also the tendency to look at learning as the solving of in advance specified tasks. (...) As a consequence, the learning of something new, that which is not known to others, becomes pushed into the background.” (ibid., p. 81)

²¹ The quotations from the Danish originals are in this section translated by B.S.

“Personal learning is uncompleted and impossible to finish. (...) Often there are shifts in the direction of learning, there are modifications and relearning, breaks and expansions of what has earlier been learnt. Because of the tendency of learning research to study learning of singular well-defined tasks, such connections and ruptures of personal learning are insufficiently shed light upon. Concepts about personal trajectories, further education, re-learning and unlearning will find a remedy for that.” (ibid., p. 83)

His conclusion is that there is a need for another kind of theory of learning: “a theory of about personal trajectories of participation in social practice as the general theoretical framework for a theory of learning” (ibid., p. 71). Now to the differences or to the contributions of critical psychology to a theory of learning:

Firstly, sharper focus on the individual person. I think it is fair to say that in comparison to LPP the group in Copenhagen is more directed to the individual person. It is not astonishing since critical psychology, with its academic base in departments of psychology, is a theory of the subject, while LPP leans towards “social theory” (e.g. Bourdieu and Giddens).

Dreier’s ambition is to develop a psychology of learning, which is part of a psychology of personality. In his project a theory of the person is the key (1999b, p. 6). But such a theory, he underlines, must be elaborated “not by looking directly ‘into’ the person, but by looking into the world to grasp the person as a participant in that world” (1999b, p. 30). In a way, Dreier’s concept of learning, “a framework theory,” is derived from his critical-psychology analysis of subjects participating in social practice.

“The framework theory about the person as participant means that the individual person’s knowledge and insight, and therefore learning, must be seen as partial in relation to the practice s/he takes part in. Nobody can everything but learns a particular part of the whole from her/his special point of departure, perspective and position. The individual person’s knowledge and insight therefore get configured in its own personal way.” (1999a, p. 78-79. Translation by B.S.)

In contrast to other approaches which are dealing with action, activity, relation, dialogue, and discourse, he wants to make it a distinctive theoretical feature “to understand of which particular local social practice the person is part.” (1999b, p. 6)

Secondly, the bringing forward of “intentional learning.” In my reading, LPP pays much attention to how a community of practice form the participants, but not so much to how the persons find and form space for their actions, and therefore, actively are forming themselves. Central for critical psychology, as Mørck & Nissen (2001, p. 55) have pointed out, is that “the subject is someone who all the time is formed and is forming herself.” Learning has to do with, in Dreier’s words, “changes and development of personal qualification for participation” and he continues: “Since the person learns, s/he can modify her/his way of participation” (Dreier, 1999a, p. 76).

Thus, what the critical psychologists call attention to, is that the person acts and not only reacts. His/her learning is not only “Mitlernen” but also “intendiertes Lernen” to use the expressions from (Holzkamp 1993) which also the critical psychologists in Denmark use.

Thirdly, broadening the concept of social practice. As a consequence of critical psychology’s focus on the individual person, and the underlining of the agency-capacity of the subject, the “community of practice” framework is too narrow for an analysis of persons who are moving between several “communities of practice” or inhabit several social practices. Therefore, learning is conceptualized like Ole Dreier (e.g. 1999a, b) does, as “transformation of personal trajectories of participation across contexts of social practice.” The critical psychologists usually have been dealing with clients or users as they are defined by social work and psychotherapy, that is, “non-productive people.” In contrast, as a perspective on learning, LPP has been developed closer to productive activity, in the meaning of work activity. Lave and Wenger say that LPP “provides a framework for bringing together theories of situated activity and theories about production and reproduction of the social order” (p. 47). Four out of their five examples of LPP in the book – midwives, tailors, quartermasters, and meat cutters – fit into this framework. (The fifth example of apprenticeship they use as illustration, non-drinking alcoholics, falls out of the picture. Indeed, AA could have been an ideal research object for critical psychology, but in that case – it is my guess – a critical psychologist would have expanded the social context from the AA’s meetings to several other social contexts, at the same time as individual persons more consequently would have been brought into the research focus.)

Critical psychologists give prominence to the fact that “social practice is not homogeneous” (Dreier, 1999b, p. 7). According this being so, “individual subjects configure their participation in these contexts and direct their trajectories across them” (ibid., p. 8). This means that “a theory about subjects in social practice” must take into account the fact that “personal social practice is translocal” (more so nowadays compared to earlier times since places and practices are more interlinked) and, in consequence, what a theory has to conceptualize is “a complex subjectivity in a complex social world” (ibid., p 10). No wonder that Dreier is characterizing the conceptualization he is elaborating as a “cross-contextual framework theory” (1999a, p. 84).

It is the trajectory of the individual person within one community that is accounted for in LPP. Although Dreier (and the other Copenhagen people of critical psychology) adopts the idea of learning as personal trajectory of participation in social practice, they expand the context compared to LPP. Critical psychology, a “science of the subject,” takes into account that a subject participates in different communities and that a person’s trajectory is not only a movement within but also across communities of practice.

LPP is a perspective or an analytical concept of learning. It conceives of learning as taking place through an individual person’s trajectory from the periphery of a

community of practice towards the center, towards full participation. The members are involved in the reproduction cycle of the community and the change that "is a fundamental property of communities of practice and their activities" (Lave and Wenger, p 117). Thus, there are two entities that are undergoing changes, the community and the individual members. Both entities are being dealt with by LPP and by the critical psychologists. In my reading, it is the community that is in focus for the LPP perspective, while the individual person is in focus for Dreier and to some extent also for Nissen and Mørch. However, I am open for that the differences may be a consequence of difference in subjects of research. Dreier has empirically studied psychotherapeutic practice (1993, 1997), Nissen (2000, 2001) and Mørch (2000, 2001) "joint venture" projects (more about that soon) in social work or community work. Lave and Wenger (1991) on the other hand wanted to explain the structuring resources for learning that are available in a community of practice, and what that insight might mean for a perspective on learning, and therefore they had to dwell upon the community of practice.

The kind of research the critical psychologists go for they call *practice research*. It is a kind of action research that Nissen (2000, p. 33) characterizes as "a concept for research of practice." In this practice are included also the researchers that are participating in the research project. It may look self-evident, but I will claim it is not. Taken beyond words, it is a radical methodological position. Nissen has coined a special expression for this, *joint venture*. It is a model for practice research on the basis of "joint venture" between a research project and a development project. One of the "joint venture" projects Nissen is involved in is Gadebørn (Street kids). There, the joint venture is established between "a research endeavor and an endeavor of 'quality development' - between a research project and a developmental project (Nissen 2000, p.35). Another project is called "Wild Learning." It is about young men and women, on the margin of living a societal acceptable life (criminality, drugs, prostitution), and how they are involved in community projects acceptable for them and the municipality of Copenhagen. A focus, so far, has been on how some of them informally and formally are becoming social workers, with one leg in the "gangs" and the other in the community based project. This is a kind of learning project, organized but in a "wild" way. One of the participating researchers, Line Lerch Mørch, claims that "[t]his kind of research" – joint ventures – "is both exciting and challenging, because when the researcher is not the primary person in control you cannot know where it will go." What occurs is not only "Wild learning," but also "the potential wildness of practice research" (Mørch, 2000, p. 82).

Learning and transformation of activity systems

I have been discussing “instruction-and-learning (the given) activity.” It is a kind of learning which emerged with the modern school some hundred years ago, and which mainly has shaped the connotations to the concept of learning. I have also been discussing another concept of learning, or another connotations to the learning concept, learning the new, or more precisely, *instruction-and-learning (the new) activity*.

I will discuss this second kind of instruction-and-learning activity with departure from two approaches that I know of through my own research activity. It is the approach of Michael Cole and his “romantic science” and “utopian methodology” that he tells about in his *Cultural Psychology* from 1996 and that I now and then have referred to and taken examples from in this study. It is also the approach of Developmental Work Research created by Yrjö Engeström and his colleagues in Finland.

From what I have seen in the literature, I can imagine there are other approaches within cultural-historical activity-theoretical and sociocultural studies which can be used to illustrate new ways of promoting learning connected to development of some kind of activity. The reason why I turn to the Cole and the Engeström approaches is not that I think they are the only existing examples of “instruction-and-learning (the new) activity.” Instead, the reason to bring them up is that they are rather well elaborated and that I am familiar with them.²²

Romantic science and utopian methodology

The idea of romantic science and utopian methodology stems from Alexander Luria, who had practiced it as a researcher long before he gave it a characterization in the concluding chapter of his memoirs (Luria 1979). Luria describes “romantic science” as the application of one of the two attitudes scholars may take to science. In contrast to the “classic” scholars, the romantic scholars

“want neither to split living reality into its elementary components nor to represent the wealth of life’s concrete events in abstract models that lose the properties of the phenomena themselves. It is of the utmost importance to romantics to preserve the wealth of living reality, and they aspire to a science that retains this richness.” (1979, p. 174)

“Scientific observation is not merely pure description of separate facts. Its main goal is to view an event from as many perspectives as possible. The eye of science does not probe “a thing,” an event isolated from other things or events. Its real object is to

²² I have been involved in attempts at DWR, which are presented in Sutter and Lindberg (1994), and attempts at development of school-related activities, presented, e.g., in Sutter and Grensjö (1989) and Nilsson and Sutter (2001).

see and understand the way a thing or event relates to other things or events.” (ibid., p. 177)

“The clinical analysis (...) seeks the secondary or ‘systemic’ consequences of these basic underlying factors. Only after these basic factors and their consequences have been identified can the entire picture become clear. The object of observation is thus to ascertain a network of important relations. When done properly, observation accomplishes the classical aim of explaining facts, while not losing sight of the romantic aim of preserving the manifold richness of the subject.” (178)

Luria continues (1979, p. 178) that his “efforts to revive the traditions of romantic science” resulted in two books, “The mind of a mnemonist” (original 1968, in English 1987)) and “The man with shattered world” (1972). Luria wants to grasp the richness of the phenomenon he is studying in his research. As we have seen, this is what he stresses when he tells about his romantic science. But how does he come to a description that makes justice to the richness of the phenomenon in case? Cole has a suggestion: Luria (and here Cole is talking about Oliver Sachs as well as) “attempted to demonstrate through practical amelioration of suffering [of their patients] the truth of the basic premises of their theories” (Cole 1996, p. 346).

In other words, to be able to accomplish many-sided descriptions one has to intervene as a participant, in Luria’s case as a clinical psychologist or a physician. The research move is a double one, aiming at description and at making life better. It is a kind of action research, where action cannot be separated from research. So, what is Luria’s methodology? I think it can be characterized as the *clinical method*, used in order to get rich data for the understanding of the patient and the patient in the culture and in order to develop a fitting cure for the treatment of the patients. This applies to the mnemonist Sherashevsky, the brain-wounded Zazetski, and to some extent also to the uniovular twins Yura and Liosha (a study of whom Luria and Yudovich published in 1956).

Bruner (1987, p. xvii-xix) claims that there “was a compassionate side to Luria, and it shines through the two case books. For Luria was not simply trying to understand these two men, the one with a grossly hypertrophied memory, the other with a penetrating bullet fragment in the left parieto-occipital area of his cranium. He was trying to bring them back to some fullness of life.” In my understanding, the “compassionate side” of the scientist transformed into a research approach is what makes “utopian methodology.” “They cease being ‘cases’ and become human beings again,” is Bruner’s judgement (1987, p. xi).²³

As I see it, Luria’s romantic science concerns the two aspects of research, description of the phenomenon and intervention in (or design of) the activity of which the phenomenon is a part. The aspect of intervention or design makes up his “clinical method” or utopian methodology. To my knowledge Luria has not used the term

²³ In the terminology I have used earlier in this study – they undergo a transformation from “case” to “patient-person” to “person-patient” and finally to become a person.

utopian methodology himself, but the term is pertinent to his way of conducting research.

Michael Cole got the idea of and the phrasing “romantic science” from Luria whom he met in Moscow 1962 and with whom he collaborated until Luria’s death in 1977 (Cole 1979, 1996). But he has also got it from his own experiences. In my view, it comprises a sort of logic of his scientific career and of developments in the research field in which he has played an important role. This is how he has described the rationale of his approach:

“As a rule, CHAT-style investigators take as their object an existing functional system of activity such as a xeroxing room in a large company, the cooperative work program for aiding the process of program writing, or a classroom. They do not pretend to be invisible participants but they are not responsible for the existence of the system they study. By virtue of the fact that it is a “real world” system they are investigating (an important virtue, because it displays the utility/believability of the theory), the activity they study would exist if they were not there to observe it. They are participant observers to various degrees, but the ongoing activity of the observer does not require their participation.

By contrast, my students, colleagues, and I literally create the systems of activity that are the focus of our research. We are participant observers in a quite unique way. In this, I believe we are invoking an idea that has been common to the cultural-historical tradition since the time of Vico, and is one of the mottos of the AI movement: you can best understand something you have made.” (Cole, 1996b).

Michael Cole launched “romantic science” and “utopian methodology” as a research approach after that he and his research colleagues at LCHC had practiced it for a period of time. It is presented in writing from 1995 and onwards (Cole 1995, 1996). I think it is correct to say that Cole has turned it into a research program through the endeavors of the LCHC group (examples of which I have referred now and then in this study) during some decades, and it was brought to a close with the Fifth Dimension model system.

“I consider the methodology of the research in the Fifth Dimension to be an extended example of romantic science, one that applies to the growth of systems of activity as well as to the growth of the children and undergraduates who inhabit them and give them life.” (Cole 1996, p. 347)

In a talk and a paper in 1995 Cole for the first time to my knowledge used the expression “utopian methodology.” In explaining the utopian methodology, Cole refers to Luria’s “way of synthesizing the two psychologies.” There he states the key of the methodology be “to prove the utility of theoretical principles arrived at through the experimental study of groups of people by showing how they are relevant to *understanding and changing the concrete circumstances of the individual beings.*” (p. 3)

Thus, romantic-science description and utopian change go together. Utopian methodology aims at research that gets its results not as a bystander of the studied activity. Improvement is – besides being beneficial to the participants involved – a prerequisite for description in the style of the “romantic” scholar which in Luria’s words (1979, p. 178) is capable of “preserving the manifold richness of the subject.”

An expansive methodology: Developmental work research

Yrjö Engeström has developed a theory of learning (“learning by expanding”) encompassing instruction, learning and development. It is a general theory and methodology for expansive developmental research, and it aims to cover learning and development in all kind of activities (from learning and development of an individual person, to learning at school, in work sites, in organizations, to the development of an activity system or a network of activity systems).

“Expansive developmental research aims at making cycles of expansive transition collectively mastered journeys through zones of proximal developments. In other words, it aims at furnishing people with tertiary and secondary instruments necessary for the mastery of qualitative transformations of their activity systems.” (1987, pp. 336-337)

So far, the methodology has been elaborated primarily in studies of work activities, which at a first glance may look like a troublesome limitation for a paradigm of “expansive developmental research.” If however, as Engeström maintains, DWR ”is an educational research paradigm: (1) it studies learning and development, (2) its methodology relies on educational interventions, and (3) it studies education as work and educational institutions as workplaces” (1996, p. 131), then this limitation goes away.

I agree with Engeström’s radical proposal that “learning activity is an activity-producing activity” (1987, p. 125). The object of learning activity is the span between the current work activity system and a future, given the circumstances, better activity system²⁴. One can describe an activity system according to Engeström’s triangular model comprising the nodes of subject, instrument, object, division of labor, community, and rules. The change of the existing activity system into a future system can be small or large. It can even, apparently, be null. Whatever the case, work has to be done, that is, a changed activity has to be accomplished. The change can be focused on one of the nodes, say, the instrument, and such a change will have repercussions on the other nodes too. The methodological question that comes up is then: How to produce changed activity or how to conduct expansive-learning projects?

²⁴ Better? In developmental work a normative aspect is inevitable. The expression ”given the circumstances” refers to the fact that the future activity system might not always be better in absolute terms, but better, given the circumstances (than giving up the activity or downsizing it, or whatever).

The theoretical ground is laid out in Engeströms dissertation from 1987, “Learning by expanding. An activity-theoretical approach to developmental research,” and there also the “expansive methodology” is given a comprehensive presentation. Before that, it had been developed in theory and practiced by researchers’ interventions in various developmental projects. In 1995 *Forum Kritische Psychologie* published an article by Toikka, Engeström and Norros and an early paper in Finnish by Engeström from 1995 (later translated into Swedish as *Småskrift* No. 4, 1989), both with the title “developmental work research.” With the establishment of the Center for Activity Theory and Developmental Work Research at University of Helsinki 1994, first as a post-graduate research school and later as a Center of excellence, the research group formed its own activity system with the object to produce research and graduated PhD’s.

The principles of developmental work research can be summarized in different ways, while maintaining the key features of the approach. This is how Engeström (1993) presents them in a chapter where he sees developmental studies of work as a test bench of activity theory:

“First, a collective activity system can be taken as the unit of analysis, giving context and meaning to seemingly random individual events. Second, the activity system and its components can be understood historically. Third, inner contradictions of the activity system can be analyzed as the source of disruption, innovation, change, and development of that system, including its individual participants.” (p. 63)

From 1996 the methodology was instantiated as “The Change Laboratory” (Engeström et al. 1996; Virkkunen et al. 1997) or some variants of it (Competence laboratory, Ahonen et al. 2000); Boundary crossing laboratory). The new application of the research methodology means a speeding-up of the interventional change process that earlier could range over several years or more (for example, a janitor project, the Espoo health clinics project, and a national health clinic project). The basic methodological approach is the same, ideally given guidelines from the “methodological cycle of expansive developmental research” (Engeström 1987, p. 323), which minimally includes: a) description and analysis of the activity, b) formation of new instruments for the change process in dialogue between practitioners and researchers, c) trying out of the change instrumentalities, and finally d) evaluation and reporting of the outcome of the activity of intervention. The formalization of the intervention methodology into Change Laboratory or variants of it, has, as far as I can judge, several causes. One is that the methodology has been improved and the skills of the researchers at the Center have been enhanced. Another important cause is that the Center is being recognized as a successful research unit, so successful that it is being invited and asked to participate in different change projects. Consequently, it is easier for the research group to negotiate contracts and to motivate professionals to take part, invest energy and effort in the change project that concerns the work activity in which the professionals themselves are deeply involved. Furthermore, often the Change Laboratory intervention is repeated after a while,

which many times make the factual project span longer than the 10 to 12 weeks that were reserved for the Change Laboratory in the initial planning process. The shortening of the intervention period of time is therefore not so dramatic as it may appear.

The Change Laboratory version of the methodology was presented in writing in 1996. As a practical research methodology it emerged during many years from the beginning of the 1980s in and through the many research projects, which the loosely organized DWR research group or network conducted. With Engeström's dissertation 1987, the methodology got a firm theoretical ground, which it henceforth has kept, although it – in line with its own perspective on transformation– has changed or adopted it substantially in several ways. Among other things “dialogue, multiple perspectives, and networks of interacting activity systems” are brought into the picture (Engeström 1996, p. 133). Furthermore, the ethnography of work as a research method has been developed, and the research group has gone through “‘a discursive turn,’ focusing increasingly on the interplay of talk, external material representations, and physical actions and artifacts in work activity” (Engeström 1996, note 4, p. 140). Also, the understanding of directionality in learning and development has changed. Now expansive leaning is not only conceptualized as a moment forward, but also “a complementary perspective, namely that of horizontal or sideways learning and development” (2001, p. 149) has entered the picture, and by that also the concepts of boundary crossing and knot-working.

Let me sum up the basic ingredients of activity theory and developmental work research. They are:

- ❖ A general model of an activity system (Engeström's triangle model).
- ❖ A methodology: the cycle of expansive developmental research
- ❖ A practical-organizational instantiation of the theoretical and methodological principles: The Change Laboratory

I have already shortly described the first two ingredients, now I want to characterize the Change Laboratory.

The Change Laboratory is a microcosm for change, where a microcosm is to be understood as a miniature “of the community upon which the new form of activity will be based” (Engeström 1987, p. 296). It is a temporary activity system comprising practitioners from the “central activity” (the change of which is put on the agenda) and researchers. One can also say that Change Laboratory is an organizational tool for pursuing developmental work research aiming at two general outcomes: development of the activity in question, and production of research findings.

Emergence of a new research approach to learning and development?

During my studies I have caught sight of something, which I think is an emergent new approach to research on learning and development. I will begin my account of what I am aiming at by presenting Donald Schön's vision of recasting the relationship between research and practice. Let us listen to him:

“Clearly, then, when we reject the traditional view of professional knowledge, recognizing that practitioners may *become* reflective practitioners in situations of uncertainty, instability, uniqueness, and conflict, we have recast the relationship between research and practice. For on this perspective, research is an activity of practitioners. It is triggered by features of the practice situation, undertaken on the spot, and immediately linked to action. There is no question of an ‘exchange’ between research and practice or of the ‘implementation’ of research results, when the frame- and theory-testing experiments of the practitioner at the same time transform the practice situation. Here the exchange between research and practice is immediate, and reflection-in-action is its own implementation.” (Schön 1983, pp. 308-309)

Schön is talking about “reflective practitioners” and in his examples all the practitioners are professionals. Therefore, it is not unlikely (to me) that they, as Schön claims, can conduct their own research and develop the work activities they are involved in. This would imply a new kind of research based upon “epistemology of practice.” The practitioners of coronary clinical work that I have been studying are highly educated professionals, and they have made a substantial contribution to the development of their own work activity. Of course, they are not the only agents to take into account in the conspicuously successful development of the activity that resulted in the new thorax clinic. They obviously “produce development,” but do they also produce research? The answer, I believe, is yes and no. Yes, they have been writing articles and published them in research journals. No, they have not researched development of the work activity, their research have been devoted to more specialized matters. Whether this picture can be generalized or not, I cannot say. The coronary clinical physicians have been involved in a hectic activity of change during a rather short period of time, with a focus on development of the work activity. What will be possible in the future?

Evidently, Schön has a vision of recasting the relationship between research and practice. To what extent this vision can be realized is difficult to have a grounded opinion about. Henceforth in this section I will be more down to earth, but still not forget to fly. I will try to distil what signs there are of a new research approach to learning and development, with departure from the three research approaches I have presented above, “practice research,” “romantic science and utopian methodology” and “developmental work research.” In my presentation I will briefly take up three themes or questions in the discussion: 1) How might “research and development” be

conducted? 2) Who is involved in the activity? and 3) How can the activity in question be sustained?

How might “research and development” be conducted?

All three approaches make clear that the connection between research and practical development is of fundamental importance. In this kind of “research and development” the developmental part is about the activity itself; it is not restricted to the development of a particular product. Without a relation of mutual interest between the “practitioners” and the researchers, the special kind of research-and-development activity that is aimed at would not be possible to attain. Thus, all three approaches stand for some kind of “action research.”

“Practice research” is research of human practice, of which research itself is regarded as “a form of practice, embedded in social practice” (Nissen 2000, p. 34). It is based on the idea that social and humanistic research must keep a double perspective, on the object of research and on itself as reflected practice (ibid.). Practice research has two intended outcomes – development of the activity in question and results of research (description and analysis including reflection on the research practice).

DWR and Romantic science and utopian methodology (for short I will call the approach Utopian Methodology²⁵) address the themes that especially interest me – instruction, learning, and development – and do so in a comprehensive fashion. For practice research in the version of Danish Critical psychology, learning and development are central issues, but instruction is not part of the paradigmatic prerequisite.

In DWR there is a model of the general structure of human activity, and a methodology for developmental research (diagnosing the state of art of the activity and making interventions). Furthermore, there is a corresponding theory of expansive transition (or learning). These three elements have been elaborated already in Engeström’s dissertation from 1987 (pp. 78, 189, 323). For many years the DWR methodology was used in several projects, and it got its shape depending on the circumstances and rhythm of the specific projects. However, as mentioned earlier, after more than ten years of experimentation, a more concise variant of the DWR method was developed, the Change Laboratory. The reason for giving the developmental work research methodology a new form, the Change Laboratory, seems, to state it briefly, to be the need for a more fruitful exchange between work practice and research activity. The main reasons are stated by Engeström et. al (1996, p. 11):

²⁵ Luria’s “romantic science and utopian methodology” is focused on individuals, but Cole includes also “the level of cultural-historical institutions” (Cole 1995, p. 5). As we have seen, romantic science, according to Luria, should aim at a many-sided explanation, and at the same time uphold “the romantic aim of preserving the manifold richness of the subject.” (1979, p. 178). What such a genre might look like Luria has shown. What it might look like at the “level of cultural-historical institutions” is harder (for me) to imagine. Therefore, I call it Utopian methodology.

- ❖ “Bringing work redesign closer to the daily shop floor practice while still keeping it analytical”
- ❖ “Bringing together practice-driven redesign of processes and idea-driven construction of visions for the future”
- ❖ “A new dialectic of long, medium and short cycles of innovations and change”
- ❖ ”Bringing together the tools of daily work and the tools of analysis and design”

If one looks through the presentation of the researchers and their projects that has been published by the Center of Activity Theory and Developmental Work Research, one can get a feeling of the exchanges between work practice and research that have been developed in a broad range of activities by means of the DWR approach. One also gets a glimpse of one of the distinctive features of the Change Laboratory method: “practices observed and changed at site; laboratory located at the workplace” (Virkkunen et al. 1997, p. 163).

Fifth Dimension is an instantiation of Utopian methodology (see Cole 1996, Chapter 11). He says: “I consider the methodology of the research in the Fifth Dimension to be an extended example of romantic science, one that applies to the growth of systems of activity as well as to the growth of the children and undergraduates who inhabit them and give them life” (p. 347). He also describes the Fifth Dimension as “a particularly useful tertiary artifact for thinking about my identity as a developmental psychologist” (ibid.). In addition to the research perspective, which is the historical root of the Fifth Dimension, there is thus a growth-perspective related to the involved children, the undergraduates and the researchers.

Who is involved?

All the three research approaches that I have brought into the discussion here stress that their research is a multi-partnership endeavor.

Utopian methodology as it is embodied in Fifth Dimension has been studied by Nocon (2000) with a focus on who is involved. Her subject of study is an instance of the Fifth Dimension, Magical Dimension in San Diego, an after-school learning environment, and at the same time a “non-traditional community.” Nocon draws attention to an organizational feature that is common for all action research approaches, namely that they constitute “non-traditional communities” of rather short duration, which are formed by a coming together of established activities and organizations – representing research and work, research and social work, research and undergraduate learning and (not yet established) after-school learning. Nocon shows that “infrastructural” activities and artifacts, which are taken for granted in “traditional communities” or established organizations in society, are extensive. In “non-traditional communities,” these infrastructures have to be built up. Therefore, the building of non-traditional communities, to which I want to count “joint ventures” or coalitions between research and practice, has a greater scope and is much more difficult than appears at first sight (a fact which has consequences for sustainability).

The key idea of the form of “action research” that DWR represents has been described by Engeström (1991, p. 80) as “expansive re-mediation.” In DWR practitioners and researchers work together in a certain way. Supported by “the activity system framework,” which the researchers provide, the practitioners “design and implement novel solutions to contradictions they encounter.” The outcome of the collaboration is “new ‘intermediate’ conceptual tools” (p. 79), which are useful for the researchers in their theoretical work and for the practitioners in the development of the work practice. “The task of the researchers is twofold: to facilitate and to document each step in the expansive learning process. This dual task demands that the researchers pay special attention to the documentation and ‘distanced’ analysis of their own roles in the process.” (ibid., p. 80)

Nissen (2000) has developed an idea of “practice research” built on “joint venture.” The joint venture concerns two projects, on the one hand the developmental project, and on the other hand the research project. “The point of the model is that the important angle of approach is neither the researchers’ use of practice as empirical data, nor the practitioners’ use of research as evaluation, *but the collaborative work that develops as a result of the project*” (2000, p. 35; italics by B.S.).

How can the activity be sustained?

Sustainability was a main issue for Cole when he initiated the Fifth Dimension. After having reviewed a large amount of funded pedagogical projects, he wondered: “Why, in short, were proven, effective, programs not sustained?” And his “simple answer” is that “when outside funding dried up, they could not compete successfully for internal resources” (1996, p. 288).

A suggested answer to the question why effective programs were not sustained is, in other words, that the funded research projects were not sufficiently organized as *hybrid activities* (of research and development), that is, as new activities. Instead, they were treated as temporarily research-enhanced, pedagogical activities, which were supposed to continue after they had learned from the research period. The projects were not regarded as new activities, merging research and development and the “old activity,” and *in need of being sustained as new activities*. With such a perspective on the new hybrid activity, it would seem odd to think that the researchers could withdraw after three years (or whatever period of time the project lasted) and the “practitioners” alone could continue with the new hybrid activity on their own. No wonder the outcomes of the educational projects, which Cole reviewed, were the same old activities, perhaps improved in details.

When should the researchers leave? After the project period is ended, this is what all the approaches seem to imply. However, the researchers’ practices are not consistent with this more or less taken-for-granted rule of research. In practice, they switch to similar or adjacent projects and they keep informal contacts with the practice field and eventually these contacts are formalized again in a new project. Experiences from DWR are that Change Lab sessions often are repeated, and not seldom followed by informal contacts between practitioners and researchers. I think many researchers

recognize the situation. It can be interpreted as researchers' persistent fight for a living, but I think there is more to it. My hypothesis is, that the felt need of some kind of persistency is grounded in a societal need to rethink the relation between research and development. The developmental activities in society often need support from research, and vice versa, research (in many fields) is in need of being challenged by complex "real-life" problems. There is an ongoing process of connecting people and things in a societal scale ("Vergesellschaftung," "communalization", globalization) to which research activity and the university as an institution has something to contribute. So, when should the researcher leave? That projects will be continued without ending is not realistic, but would it be possible, as suggested by the research practice of the three approaches, to have some kind of low-intensive continuation between research and practice as a base, followed by sporadic more intensive joint-ventures when there are need for them²⁶? My conclusion is that there seems to be a research practice which is contradicting the official research agenda, and which is not analyzed and posed as a problem to overcome.²⁷

A summing up

Two common ways of understanding learning are prevalent today. One is that learning is an individual act. The other is that have come to challenge both these ideas. At the same time, I do not want to ignore instruction, as current approaches to "environmental learning" are inclined to do. Instead, my attitude to instruction is to regard instruction as co-coaching, as mutual supporting of each other, and, accordingly, to regard learning as a collaborative endeavor.

Probably school-learning and school-instruction have formed our conception of learning and instruction. The historical achievement of the school during the last two centuries was that learning was organized as a specific activity, as learning of a general attitude to society and to knowledge. School-learning was also organized outside of work practice, isolated from other activities in society. After usage of chalk and blackboard, artifacts that encouraged a communicative approach to knowledge

²⁶ Perhaps something like Nocon's (2000, p. 319) "attentive presence" between the partners could be developed as a low-intensive form of collaboration.

²⁷ I expressed a slight uncertainty about Schön's idea that practitioners could do their own research, and have in the section discussed the fruitfulness of some kind of collaboration between researchers and "practitioners." Schön also takes up this way of embodying epistemology of practice. "To the extent that such partnerships" – partnerships between researchers and practitioners – "grow in importance and begin to occupy an important place in the research enterprises of the professional schools, universities and practice institutions will enter into new relationships. University faculty will become interested in professional practice, not only as a source of problems for study or internships for students, but also as a source of access to reflective practice. As a consequence, a new meaning will be given to activities usually considered peripheral to the conduct of the research university. Field work, consultation, and continuing education, often considered as second-class activities or as necessary evils, will rise to first-class status as vehicles for research, the main business of the university." (1983, p. 324)

building (Fichtner²⁸), the school practice came to focus on almost exclusively on one instrument of knowledge, the textbook. Today we can see that one-sidedness of tool use and the isolation from society as a whole have turned school-learning into a problematic activity.

My approach has been to study learning and instruction outside of school, in and as part of work activity. The specific work activity I have been studying is coronary clinical work, which contains certain appealing characteristics. It is organized as a highly collaborative activity, in which there is use of a great variety of artifacts – this makes it ideal for a study of uses of artifacts. The main participants are professionals working on a collegial basis – this facilitates the mutual supportive interactions that I believe are a prerequisite for the phenomenon of co-coaching I want to explore.

Furthermore, the professionals of coronary clinical work have had a decisive role in the development of their work activity. In fact, the work practice I have been studying has undergone a spectacular transformation within a few years, resulting in the establishment of the Thorax Clinic at the Blekinge Hospital in Karlskrona. The development of work activity and its connection to learning is the final main theme of my study.

More specifically, my dissertation is an attempt to provide answers to three questions: 1) How is the collaborative nature of learning established and sustained? 2) Can artifacts be instructive, and if so, in what ways? 3) How is learning connected to development? In this section I will sum up my findings.

How is the collaborative nature of learning established and sustained?

My point of departure, which I have from cultural-historical activity theory, is that instruction and learning go hand-i-hand.

Among researchers on learning during the last decade or so (Lave and Wenger's book from 1991 is seminal here), the importance of learning as a consequence of participation in social practice has been stressed and elaborated on. I think this is an important insight. The importance lies in the fact that *learning is put in context of the activity as a whole*. This means that learning takes place as participation in practice. This is the key idea of Lave and Wenger as we have seen. However, now their idea is in danger of turning almost into fashion, allegedly implying that people learn best when left alone. In my opinion, the conception is in need of further development, more precisely by addressing how participation in social practice may relate to instruction in a broad sense and to learning as a specific activity. My starting point for such an endeavor is to get guidance from activity-theoretical and related approaches and from empirical studies of coronary clinical work. What I have found empirically is something I have come to call "co-coaching," mutual instruction in and as part of

²⁸ Oral presentation at "International symposium: New challenges to research on learning," Helsinki 21-22 March 2001 (organized by the Center for Activity Theory and Developmental Work Research)

the work activity, in the accomplishment, sustaining, and development of the work activity.

In order to explain the point of the concept of co-coaching, I will relate it to some basic ideas of instruction and learning, and I will do that by highlighting some structural features, which have emerged earlier in my presentation.

As just mentioned, there are two influential “figures of thought” related to instruction and learning. One is “school-instruction,” as a metaphor for transmission of knowledge. The other is that one learns by making experiences in the environment.²⁹ LPP-learning is a sophisticated version of this “figure of thought.”

	Instruction	Learning
Specific activity	Figure of thought: “School-instruction”	
Embedded in other activities		Figure of thought: “Learning environment”

Figure 12. Two influential “figures of thought” about learning and instruction.

The activity-theoretical classification of instruction and learning on the level of activities and on the level of actions/operations shown in Figure 12, displays that the two common figures of thought of learning and instruction ignore important aspects. What about learning as a specific activity? What about instruction when it takes place as instruction embedded in other activities?

My concept of co-coaching is an attempt to grasp the phenomena of instruction and learning in a comprehensive way.

Co-coaching is an instruction-concept, that is, it takes an instruction-perspective on instruction-and-learning. If it should be placed into Figure 12, it definitely has a place in the instruction-column. As I have claimed above, co-coaching takes place on an action-level as well as on an activity-level. However, co-coaching is about mutual coaching of each other, and therefore there is a “recipient”-aspect, a learning aspect, implied by the concept. Consequently, it should be placed also in the learning-column. One can say that from the point of view of co-coaching, the classification of learning and instruction into two categories (columns) is not a good idea; it is better to talk about instruction-and-learning.

The concept of co-coaching is connected to learning and development of activities, that is, learning and development of that which is societally new. It is a way of approaching Engeström’s concept of “learning by expanding” from the perspective of mutual instruction, and from the perspective of “in-house” development³⁰. Co-

²⁹ Perhaps also a third figure of thought can be discerned: learning as a specific activity represented by the alone Auguste Rodin-thinker or the alone reader.

³⁰ See section “Instruction and learning – two distinctions.”

coaching as a concept restricted to understanding learning of the “given new” would make no point.

The alternative figure of thought of learning that I have outlined is that learning and instruction go together, that we assist each other as a part of ongoing activities, that learning is connected to development of activities, and that individual and subjective learning is a secondary phenomenon to the collaborative development-learning activity.

To the picture of the collaborative nature of learning I want to add the very fundamental phenomenon that ethnomethodology has underlined: human interaction is instructional. When interacting one has to make something stand out to the co-actors, one has to “make instructably observable” (Garfinkel 1996) of what is at stake. This basic kind of instruction, I believe, has a corresponding recipient-aspect of learning. Learning to see a point is established in the same act as the point is made “instructably observable.”

Can artifacts be instructive, and if so, in what ways?

My arguments about the instructiveness of artifacts are developed in two steps. First, I argue that artifacts are instructive because they are made instructive, because artifacts are designed to influence future behavior. This is especially true for representative artifacts (“secondary” in Wartofsky’s vocabulary). The second step is to make a distinction between the potential instructiveness of artifacts and the instructiveness in use.

Artifacts are made by humans, and they are designed to give assistance – in different ways, for different people, and in different circumstances. Artifacts are purposefully designed, and the intentionality in their making makes them imbued with meaning. Initially, this is valid for the designer. Usage of the artifact means that the meaning of the artifact also will be discovered/constructed by the users. Put in another way: artifacts are instructive, but not by themselves. Through work by designers and by users artifacts mediate meaning. There are many kinds of artifacts – anything can represent anything else, as Wartofsky has pointed out (1979, p. xx). In my studies, I have found it especially fruitful to discriminate four kinds of artifacts – practical-material, organizational, linguistic, and graphic – and I will briefly present how they are used in the coronary clinical work activity I have studied.

Use of material-practical artifacts.

Primary artifacts, artifacts used in production, are trivial. The use of material things is so fundamentally basic and self-evident that we often forget about its importance. Let me briefly summarize basic use of material-practical artifacts by using the front cover picture of the study. On the picture one sees three persons. Two are sitting in the room (closest to the camera the cardiologist, and behind him the radiologist) and one appears on a screen (the surgeon). Let me also point out some of the important material-practical artifacts they are using in the situation. All three physicians have the paper-based patient journal at hand. Still, in the age of the computer, paper-based

artifacts are of utmost importance. An essential feature is that they make annotations possible. The surgeon and the cardiologist are using their pencils or have them ready for use. The paper journal is a “carrier” of representational artifacts (text and graphic), which in turn “carry meaning,” and in that sense are more essential. The paper artifact is nevertheless important. The text and the graphics could be represented in another media, for example, in electronic form, but then the work would have to be arranged in a different way, and still, e.g., making annotation possible and keeping the text and graphics close to hand. Such a rearrangement of the work activity is not easy to accomplish. The radiologist is the person who presents the angio video in the heart conference. At his disposal he has two devices to manage this. One is used as a remote control for the video (play, stop, forward, rewind, pause/still), and the other is used to control the arrow-cursor, which the radiologist uses to pinpoint details of interest on the video display. One of the devices is placed on top of the patient journal on his lap, and the other is placed on a bench in front of him.

I think it is reasonable to say that the central artifact in the heart conference is the angio video. It is shown on a screen, both in the conference room at the Karlskrona hospital (visible in the picture) and in the corresponding conference room used by the team in Lund. Its central feature is that it can display film pictures of the coronary arteries, which can be seen and discussed simultaneously in real time in Karlskrona and Lund. This material-practical technology is what makes the video-mediated heart conferencing possible in the first place.

The last material-practical artifacts I will mention here (practically, there is no end of them of course) are the complete patient journals that are kept in the shopping trolley within reach of the cardiologist. In several of the cases presented in this study, we have seen them in use. (See, particularly, Paper VI.)

In sum, these are some of the primary artifacts used “in production” (Wartofsky) of coronary clinical diagnoses. They are basic, because they determine the space-body-time-artifacts arrangement of the work activity. They are also carriers of the secondary artifacts, the representational artifacts, which are so central for all complex activities.

Use of organizational artifacts.

An organization is an institutionalized form of classification (Bowker and Star 1999). In the case of the heart conference, the patients are let in there (after a screening which is not very restrictive: in principle all patients that are referred to the angio investigation will be let in) and classified according to what treatment procedures that are appropriate. An established activity has an organizational form that scaffolds the activity, its division of labor, its rules and ethics, its community. In their work the physicians, in addition to the hospital organization, also make use of local ways of organizing work. These are organizations that probably will not show up in managements’ flowcharts of the whole organization, but they are organizations of ultimate importance for getting the work done.

I will give three examples, with the first two examples from Paper IV. Paper IV is about the activity in the Angio Lab, and I did my second period of fieldwork there when the thorax clinic had been run for almost four years. The heart conference still remained as an organizational structure for collegial discussions and decision, although it now was as an internal part of the thorax clinic, and the heart conference meeting took place every morning. However, in addition to the ordinary heart conference, they had organized two minor ones. One of them was an afternoon heart conference organized in the Angio Lab, where one of the surgeons came down at a specified time (around 3 pm). At this afternoon conference, patients that had got PTCA and were expected not to be in need of surgery were discussed. If this expectation was confirmed in the meeting with the surgeon and one of the radiologists and one of the cardiologists, the patient could leave the same day. The other example of a local organization is a kind of mini heart-conference that was delegated to the operating cardiologist-radiologist duo responsible for the PTCA. The rationale for this “mini heart-conference” is that if it is found that a patient, who has had a PTCA investigation, preferably would have also PTCA treatment (balloon dilatation), the cardiologist and the radiologist are delegated to decide that immediately. This means that, while the patient who just had had a PTCA investigation is still on the “operation table” in the inner part of the Angio Lab, the physicians could discuss the patient case using the videos of the coronary artery that just had been shoot. If they agreed upon that this was a clear case for balloon dilatation, they decided to ask the patient of approval, and if they got that the patient directly had a PTCA treatment.

Thus, the organizational “logic” of the heart conference is that the ordinary heart conference is the basic organizational unit. By reason of efficiency or convenience for the patient, clear cases could be “processed” during the way so to say, on delegation. But in case of uncertainty, the ordinary heart conference is always to be used.

The third example of use of an organizational artifact comes from Paper V. It concerns an improvised queue of patient organized in such a way that patients who were judged as possible candidates for PTCA treatment were placed in the beginning.³¹ The reason is practical. When PTCA patients are discussed, a radiologist and sometimes also a cardiologist from Lund are expected to participate in the heart conference, so when PTCA-candidates have been discussed, they could leave the heart conference. It is a highly improvisational way of organizing work, a kind of “articulation work” (Strauss et al., 1997) of a collective kind.

The first two examples of usage of organizational artifacts show a sustained way of organizing the work activity, while the third example shows a more provisional way of organizing work. All three examples, however, are about from-below initiated ways of organizing local work.

³¹ On some occasions, when the radiologist, plus eventually a cardiologist, in Lund was delayed, the group of PTCA- candidate patients were moved and discussed later when the delayed physicians turned up in the conference site at Lund.

The use of linguistic artifacts.

Linguistic artifacts are, like graphic artifacts, representational. I will give an example of how they are used in coronary diagnostic work. The example I pick out is a “coding scheme,” that is a “systematic practice used to transform the world into categories and events that are relevant to the work of the profession” (Goodwin 1994, p, 608). I call it the “coding scheme Fifty Percent,” and it has been presented in (mainly) Paper III. As Goodwin says, a coding scheme is a “systematic practice.” It is also a plan, a linguistic artifact related to the systematic practice. The coding scheme Fifty Percent states that when 50% or more of the diameter of a blood vessel is blocked, the vessel is to be regarded as significantly sick and measures should be taken accordingly.

The observations show that the coding scheme Fifty Percent is an important conceptual artifact, which the physicians regularly relate to. Is the blockage 50%, less or more, is one thing to decide. Another is how to measure (by means of a computer-supported method that is used, or bare-handed estimations, which also are used) and if the estimated values should be regarded as valid or not. A patient case, the “Almost Fifty Percent Case,” is discussed in Paper III, and it shows that practice is containing subtle distinctions. (For details, see Paper III.)

The “systematic practice” of the coding scheme Fifty Percent is varied. As a linguistic artifact the coding scheme is a rule-based direction or a guideline or a plan for how to behave, but the clinical practice relates to the guidelines with discretion.

The use of graphic artifacts.

In Paper IV I have studied the design and redesign of the central artifact in the heart conference, the angio graphic. My main conclusion is that artifacts, at least angio graphics, are designed to be instructive. Here I will recapitulate one of the patient cases, Case 3.

The Case 3 patient had had an angio investigation, which indicated that treatment was necessary. But which one – by-pass surgery or PTCA? Thus, the case was not a clear PTCA case that could be decided by the radiologist-cardiologists pair “at the spot” (as discussed above in connection to the “mini heart-conference”). Therefore, an angio report was written and was included as a part of the patient journal used in the heart conference. At the heart conference, the Case 3 patient was recommended balloon dilatation.

This much of the clinical work with the Case 3 patient happened about one week before I had the opportunity to observe the further clinical work with the patient in the angio lab. Therefore, I do not know the very details in this phase of the clinical work, but enough (from how similar cases are handled) to give a description of how the graphic artifacts were designed and used. This pattern is always distinguishable (for more details, see Paper IV): The x-ray filming of the heart displays digital graphics of the coronary arteries; this angio graphics are sent to a Picture Archive

Communication System (PACS), sometimes after a light editing; at the PACS computers, editing of the angio graphics are made and summarized in the “Angio Report” where significantly important features are highlighted in order to inform colleagues who will use the Angio Report as one source of information when discussing the patient case in connection to the presentation of the angio film.

The angio film pictures the coronary arteries (a picturing which is designed under specific conditions of course and therefore not unproblematic), and it comprises the “raw” material instance of this important index. If there are controversies or questions, this version is the ultimate source, which eventually is used.

The next phase of the Case 3 patient, a phase from which I have first-hand observations, is when the patient comes back to the Angio Lab in order to get PTCA treatment. PTCA treatment is always preceded by an angio investigation which is directly turned into balloon dilatation. In the actual Case 3, the balloon dilatation procedure was complicated - five dilatations were made, which took almost 80 minutes; it ought to have been surgery, was the comments from the radiologist. This matter of fact gave rise to an elaborated presentation of the treatment. The “Angio Report PTCA” contains a series of graphics displaying the repair of the coronary arteries, with texts and pinpointing arrows.

What we see here is design and redesign of angio graphics, with different aiming and addressees. The “raw” angio film for intern, basic, and detailed uses; the edited angio film and the Angio Report as basis for collegial decision in the heart conference; the Angio Report PTCA with a highly pedagogical aiming addressed to the cardiologist who has referred the patient to the All in all, my conclusion is that the angio graphic artifacts are made instructive.

As a summing up this section on what it means to say that artifacts are instructive, I will connect to a footnote in Paper II, where I commented on a recent discussion that Lucy Suchman and Kjeld Schmidt have initiated.

In her influential book on plans and situated actions Lucy Suchman (1987) discussed the problem of “human-machine communication.” She criticized the AI concept and elaborated the concept of “situated actions” as unique for human beings and as having the essential property of being open until they happen. Before long, situated actions became a popular concept in CSCW circles. It appealed to many people, among other things probably because the concept entailed close studies of work practice, including use of technology. This was the case for me and the research group in which I am working. It gave impulses to close studies of activities as they really took place (“near-sighted”). However, from a CHAT perspective the situated-actions approach had an obvious limitation: it was restricted to actions and operations – the activity perspective was missing.

Recently, shortcomings of the situated-actions perspective have been discussed by people who also have used the perspective, among others by Suchman herself (www) and by Kjeld Schmidt (1997). Roughly, their critical comments concern that artifacts, like plans and scripts, have influences on human activity (actions) that cannot be explained by the situated-action concept alone. In her www-article Suchman wants to reconsider “the question of nonhuman – particularly machine – agency” (p. 1) and “to understand our differences differently” (p. 4) compared to what she did in her 1987 book. In this endeavor, she is inclined to see that there is “a durable asymmetry among human and human actors” (p. 6).

Schmidt suggests that plans play a role and that “situated actions” cannot adequately account for what is happening, and he makes it plausible with an illustration of a production system of cabinets regulated by a “kanban” system (card, protocol). He also proposes a distinction between formal organizational constructs (“plans”) functioning as maps (i.e. having a weak determining role) or as scripts (with a strong determining role). Schmidt’s conclusion is that there is need for more empirical research on the issue: “we need to investigate (...) the actual use of formal constructs and the artifacts in which they are objectified” (1997, p. 146).

My suggested contribution to the discussion about artifacts and agency comprises two arguments. The first is a distinction between “crystallized instruction (artifact-bound representations of human activity)” and “situated or ‘live’ instructions (actions embedded in work activity)” (Table 2 in Paper II). This means that artifacts are imbued with intentionality, because they are designed to be instructive. To me this matter of fact seems to be a possible opening to an understanding of the influence of past activities inherited in plans, scripts and other kinds of artifacts. My second argument is that artifacts are instructive, but only potentially instructive. The potentiality has to be realized in the use of the artifacts as part of an activity. In the vocabulary of Ilyenkov (1977), one can say there is a dual transformative dialectic between activity and objects, a dialectic that can be illustrated in the following manner:

Activity/object →	Object/activity →	Activity/object
Making artifacts instructive by design	Artifacts as potentially instructive	Artifacts as instructive in use, by being used in an activity

Figure 13. Two opposing metamorphoses of production and use of artifacts. (An attempt after Ilyenkov 1977)

Artifacts are ideal objects, and the ideality of the object comes from activity. Another way to put it is to say that artifacts as such are inert, but they are offsprings of activity and they are being used in activity.

I will end the summing up human-artifact-interaction by giving space to Sartre. From an artifact-perspective, the situation, the practical field that a person encounter, is a “hodological space” where ways and routes are mapped. This practical field corresponds to what Sartre (1939/1971, p. 62) calls “the pragmatic intuition of the

determinism of the world.” The “given” aspect of the produced world of artifacts offers invitations, recommendations, directions, and suggestions: “Do this!” or “Do something! These are the alternatives!” In Sartre’s words: “The means themselves appear to us as potentialities that lay claim to existence.” (ibid.) However, for Sartre, this given-aspect of the practical field is only one aspect, which is the point of departure for the human project, the transcendence of the given circumstance. The distinction Sartre makes between the hodological space of the given and the transcending project corresponds to my distinction between artifacts as only potentially instructive and artifacts which are instructive when used as part of an activity. The point is that artifacts have structural properties, which make them potentially instructive, but the potentialities are realized only when incorporated in human activity. In that way, it makes sense to say that artifacts are instructive.

How is learning connected to development?

I find it fruitful to distinguish two perspectives on how learning is associated with development. One concerns learning and individual development, and the other concerns learning in connection to development of an activity. Vygotsky’s conception of the former is paradigmatic for CHAT. It says that only learning in the lead of development earns to be called learning. In other words, instruction-learning in the zone of proximal development makes a contribution to development. This kind of learning and development has its focus on an individual person’s learning of what is societally given but what is new to the person (“learning of the given new”).

The other perspective on learning and development is learning as participation of development of a new activity. This perspective has mainly been used in the present study (“learning of the societally new”).

In both of the perspectives on learning and development, one has to take into account that there is always a learner-contribution to the outcome. In the second case, learning as a consequence of participation in development of a new activity, this is obvious. But it is also true in the former case.³² The learner is not passive. There is never just passive reception, passive internalization.³³ There is no simple transmission of content in the instruction-learning activity.

The construction zone (or zone of proximal development) is not a zone in the child, it is an interactional concept. The trick of the teaching trade is to establish an activity structure and invite newcomers to participate in the activity, little by little through encounter of challenges. In this instruction-and-learning activity there is “no time out” (Garfinkel). The newcomers “internalize” the activity in which they are participating, not only the part the teacher wants to teach (the tasks, the curriculum), but also the

³² See, e.g., Adelswärd et al. (1997).

³³ The critique of Vygotsky’s concept of “internalization” – e.g., Lave and Wenger 1991, p. 48-49; Rogoff 1995, p. 157; Säljö 2000, p. 106-107 – often misses Vygotsky’s permanent insistence of the fact that a transition from one plane of thinking and speech to another plane always means a transformation, implying that there are always active moves from the “internalizing” person.

attitude and stance of the teacher. (And conversely, the oldtimers also internalize the activity.)

Yrjö Engeström's wonderful reconceptualization of learning - learning activity is an activity-producing or activity-transforming activity – means a shift in interest and focus: from learning/development to development/learning. Several scholars (e.g., Fichtner, Säljö) agree that the development of the activity is central also in learning of the given, but often this is forgotten: learning the given new is by that confined to learning only that which is given.

Engeström's conceptualization of learning is fundamental for the conception of my study. It implies a break with traditional school-learning as paradigmatic for the conception of learning and development. Although all societies have to organize handing over of basic knowledge ("the given new") to the children, this handing over must not necessarily be isolated from "learning of the societal new." Learning in a (modern or future) school might open up to the society as a whole and combine "learning of the given" and "learning of the new." Or to put it in the words of Vygotsky's (1926/1997, p. 182) vision of a productive school: "not only is labor introduced into the school, but the school is introduced into labor."

There is a kind of guidance on learning and development which is provided by the object of the activity. I have made an attempt to show how it works in coronary clinical work (Paper VI). As I see it, an activity is layered in that it encompasses activity/object, present and past in the same moment. In addition, it encompasses intentions about the future. Thus, activity is a weaving together of objects and of past, present and future. The purpose of Paper VI was to describe in detail how this "interweavingness" might look like in a specific case. One can say that, the object orchestrates people's actions, and it coordinates people's use of artifacts. This means that the "corrections", the tinkering, the adjustment, the coordination, and the articulation of work actions are guided, not by a fixed lighthouse, but by a moving "instruction," which is created in the tension between the given and the possible of the object of work, and in consideration of the many interests involved. In my conception, this is the way the object of work can be said to give guidance to the participants.

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Paper I

Berthel Sutter (1999). Instruction and learning in the development of telemediated coronary diagnostic work. *Researching Work and Learning*. Conference Proceedings. University of Leeds, UK, 10-12 September 1999

Instruction and learning in the development of telemediated coronary diagnostic work

Abstract: In the paper I address specific changes regarding work practice in clinical heart conferences. The conferences were telemediated between a team of surgeons and radiologists at the University Clinic of Lund and a team of cardiologists and radiologists at the county hospital of Karlskrona. This telemedicine practice was part of routine work for more than three years, 1993-1996. The focus of the paper is on the intertwined process of the teams' development of diagnostic work and learning how to perform the new activity. My approach is (1) to give a historical account of the coronary diagnostic work in the special setting I am studying, and (2) to make a rather detailed analysis of a single case in terms of instruction, learning and development.

Introduction

During a few years in the mid 1990's, particular kinds of clinical heart conferences were held in the south of Sweden. These conferences were special because they were distributed between two clinical teams, one team of surgeons and radiologists at the University Clinic of Lund and another team of cardiologists and radiologists at the regional hospital of Karlskrona, 200 kilometers away. At these clinical conferences coronary diagnoses were made. These special kinds of clinical meetings were rendered possible by teleconferencing facilities, including high capacity transmission channels and a piece of equipment enabling shared display of video taped coronar angiographies at the two studios. (Kehler et al. 1996, 1997)

The context for the emergence of this telemediated clinical heart conference is the profound change in the relation between the regional hospitals (like the university hospital of Lund) and smaller county hospitals (like the one in Karlskrona) concerning health care hierarchies based on distinctions of knowledge and status. Up until the 1980's, the traditional pattern prevailed. In other words, the regional hospital had the responsibility for all health care in the region. "The professors at the regional hospital had the say of which health care should be provided where," a chief physician at the hospital of Karlskrona explained (Utbulst 1994, p. 90). A new agreement between the hospitals in the region, an agreement propelled by new ideas of health care economy, implying buy-and-sell relations, marked a significant change in the established order of health care and medicine. With the new agreement, the payment and the deliveries were regulated according to more exact requirements. Thus, over a period of time the regional hospital had turned into a contractor through so called "diagnosis related groups." The county hospitals eventually found that it

could be economically beneficial to “take home” some of the health care services that the regional hospital had provided so far.

Thoughts like these existed in management circles at the Karlskrona hospital when in 1990 a cardiologist from Lund was employed with the mission to prepare the “taking home” of coronary angiography investigations from Lund to Karlskrona. One of the initial steps also involved recruiting an experienced radiologist from Lund. The “taking home” of coronary angiographies was a fact when the new Angio Lab started its activity in February 1993. In hindsight, this was probably the first step on the road to the thorax clinic that was established in December 1996 at the Karlskrona hospital. The second step was the establishment of a new form of clinical conference made possible by the deployment of technical means. If the first step was driven mainly by economical considerations, the second step was mainly driven by technological deployments.

Because Karlskrona Hospital had no heart surgeons of their own, their coronary staff had to go to Lund to attend the clinical heart conference. Once a week, after having made the coronary angiographies on their patients and the neighborhood county patients, the physicians from Karlskrona traveled to partake in the clinical heart conference with the Lund surgeons. This clinical heart conference in Lund was a meeting exclusively designed to discuss the patients from the county of Blekinge and the neighboring county Kronoberg.

However, within a short amount of time this arrangement, with traditional clinical heart conferences in Lund, was recognized as a waste of resources. The new possibilities that the modern telemedicine techniques offered made the physicians in Karlskrona envision a new practice. It was a practice in the form of a *distributed* clinical heart conference between Karlskrona and Lund. Already in autumn 1993, it started as part of a more comprehensive experiment in telemedicine at the hospital in Karlskrona.

In short, this is the background to the emergence of the *distributed clinical heart conference as a new activity system*. Two rather independent developmental projects, one economical and one technical, merged, and “hooked into” the main work activity of coronary diagnostics. During the following three years, the new practice of this distributed clinical heart conference was refined and turned into a routine of everyday work. In the period 1994-96 more than 500 angios were accomplished annually in Karlskrona. (Kehler et al., 1996, 1997). As a routine of daily work practice, this telemediated coronary diagnostic work seems to have been a unique endeavor worldwide.

During 1995-96 a colleague and I studied these conferences (Sutter and Helgeson, 1995, 1997). By using three highly interconnected concepts, instruction, learning, and development, the aim of this paper is to understand the transformation of the coronary diagnostic work that took place at the hospitals in Karlskrona and Lund.

Learning the given and learning the new

In educational settings such as the school, it is obvious that the students are expected to learn the core knowledge of what is culturally given. However, it does not appear equally obvious and recognized that the students are also learning to cope with what is unexpected and new. Generally speaking, it seems that in school and other educational settings, priority is on “transmission” of the culturally given, and that the creation of the new is underestimated or ignored. On the other hand, in work places, the priority is reversed. Production, the construction of the new, is what counts, and, with the exception of shorter periods of training, the appropriation of the culturally given does not hold the same importance as it does in educational settings.

From an activity-theoretical point of view, this is not an acceptable account of learning. The objective of learning activity is the development of activity systems, be it work, education or some other activity (Engeström 1987, 1994). Therefore, if this is true, *development is an aspect of learning*. The idea thus is that a system learns and develops, and not only the individuals which are part of that system.

Learning at work is often discussed in terms of apprenticeship, as in the seminal work of Jean Lave and Etienne Wenger, *Situated learning: Legitimate Peripheral Participation* (1991). Their “analytical perspective” (LPP) is that the basic phenomenon is practice and the participation in a community of practice. Out of that, learning and identity emerge. In their work, learning is connected to development, but they almost exclusively address development as the development of the individual person, the learner, the newcomer. It means that the kind of development they deal with is learning of the “given new,” that which is “given” or “old” for the newcomers but new for the newcomer. Development of the societally new is not what a story of apprenticeship normally will address, and this is also the case with LPP.

I will use two concepts from Berndt Fichtner (1988, 1996) to analyze learning and development. According to Fichtner, there are two core aspects of learning, namely “Begründung” and “Entwicklung.” In his 1988 paper translated into English, “Begründung” is translated as “substantiation” and “foundation.” The meaning is that one asks for grounds helpful in understanding the conditions and emergence of the expressed knowledge. It is a way of grasping “the fundamentally mediated nature” of knowledge (Fichtner, 1988, p. 45). “Entwicklung” means development of knowledge; but I will also let it include development in a broader sense; deployment of a technological artifact, development of an activity, building a community, in short, constructing an *oeuvre* (Bruner 1996) which can be inspected, discussed and shared.

Thus, learning activity can be regarded as having two poles, a pole of Begründung, and a pole of Development. These poles are connected through active transformations. On the one hand, Begründung is not a passive activity. On the contrary, one needs to develop new methods and new perspectives to analyze and substantiate a phenomenon. On the other hand, development should not be a change for the sake of change, it needs to be moderated by already gained cultural insights.

Learning as an activity is oriented at two directions: the past and the future. On the one hand, there is a societally given culture, aspects and parts of which must be shared with the younger generation. On the other hand, there is a necessity for learning to deal with what has not been revealed, but which is there as expectations and proactive constructions of the future. Therefore, for understanding of learning activity, recognition of this historical dimension is essential.

The close connection between learning and development is appropriated into a research program by an activity-theoretical approach, namely Developmental Work Research. A central issue here is “expansive learning”, a phenomenon explained in the following way by Yrjö Engeström (1996, p. 135). (The background is that an activity system has faced acute internal contradictions, which demand a reorganization of the activity.)

“When an activity system – a workplace, for example – goes through such a reorganization and constructs a historically new mode of practice for itself, it learns something that was not there at the outset, something that no authority was able to transmit and teach. This is collective learning in which internalization and externalization, appropriation and creation, routinization and innovation, take place as parallel and intertwined processes. *It is a type of learning that is systematically neglected in standard learning theories*”. (italics added)

This kind of learning is what the Developmental Work Research approach tries to promote. The method for achieving this is “educational interventions” or “instructional interventions,” which may take diverse forms. However, whatever the form, instruction is involved.

Expansive learning is also the focus of my paper, although I am not reporting on a research interventionist study, but on a change process initiated and performed by the practitioners themselves.

The role of instruction

Regarding instruction, my point of departure is a distinction between instruction as an activity and instruction as instructional actions. Instructional actions are embedded in all kinds of activity, e.g. work, instruction, learning, and play. (The reader familiar with activity theory will see that I have taken Leontyev’s basic idea of the structure of activity and actions/operations (1981) and applied it to instruction.)

Furthermore, I will take as a point of departure that learning is assisted, in one way or another. At the level of activity, learning is assisted by instruction. On the level of action/operation, actions are assisted by instructional actions in a variety of forms, e.g. artifact affordances, instructions, indications, directions, information, orders and briefings. In sum, learning is mediated by interactions between people and artifacts. In

Figure 1, which is an attempt to account for relation between instruction and learning, this aspect of interaction is illustrated. At the same time, my classification tries to incorporate the distinction between the given new and the societal new.

	LEARNING THE GIVEN NEW	LEARNING THE SOCIETAL NEW
Instruction as an independent Activity	Well articulated tasks or well established practice	Sketchy, suggesting, “in principle”-tasks
Instructional Actions and Operations	Embedded in every activity	Embedded in every activity

Figure 1. An activity-theoretical classification of instruction and learning.

In learning the given new, apprenticeship and other kinds of workplace learning perspectives accentuate learning as embedded in the overall activity. In my terminology, such explanations restrict themselves to instructions as actions/operations and forget or underestimate the importance of instruction as an activity. As a reaction against theories of instruction of the transmission-type, the “situated learning” perspectives are understandable. They oppose ignoring the embeddedness of learning in everyday activity, and the attitude that the content-transmission focus of the activity is the only thing that counts, as if the teachers were situated outside the whole educational activity.

In learning the societal new, it speaks for itself that instruction cannot be explicit, well articulated or representing a well established practice. In this case, instruction can only concern the frame of what is going to be developed. A salient feature of this creation of the new, therefore, must be the mutual support the participants give each other, by showing, telling and in other ways influencing the co-participants through instructional actions while doing the job.

In the following I will test these conjectural ideas of learning, instruction and development in a detailed analysis of a single patient case in a clinical heart conference.

Instruction, learning and development of work – the case of telemediated coronary diagnostics

Approach

The basic idea of my approach is simple. First, I use a full patient case as an empirical unit of analysis. The rationale is that a patient, i.e. a pre-diagnosed person in the “care line,” is the object of the coronary work I am studying. Focusing on the “processing of the object of work” may display what is essential in the actual work practice. Second, with regard to the important historical dimension of the work activity, I attempt to encircle it by giving an account of the origin and change of the work practice. In short, this is my approach to analyzing telemediated coronary diagnostic work as an activity system.

As I am interested in instruction, learning and development as part of the ongoing activity of the coronary diagnostics, I have chosen interaction analysis of video logged work as my main method. Learning as a live process cannot be observed. Instead I rely on the instructional part of the interconnected activity of instruction and learning. In this way, instruction, displayed as actions and operations can be directly accounted for, and indirectly, also learning can be described.

The kind of development I am interested in is the development of work activity. Like individual learning, development of work activity occurs over time. In this paper, my account of the developmental side of the coronary diagnostic work is accounted for against a grounding of kept statistics that are showing changes in work practice.

During a few decades, a new tool for diagnosis and treatment of coronary sickness has been deployed and applied. In the beginning it was used mainly as a diagnostic tool for radiological investigations of the heart, “coronary angiography.” But more and more it was also deployed as a treatment method, by which blocked coronary vessels could be expanded, PTCA (Percutan Transluminal Coronar Angiography) or balloon dilatation.

Within a couple of decades the amount of coronary operations and balloon dilatations have increased substantially in Sweden (as in most Western countries). Almost a 20-fold increase can be seen during 15 years (Figure 1).

	Coronary operation	Balloon dilatation (PTCA)	Total
1980	503	0	503
1985	1970	165	2135
1990	4359	1098	5427
1995	6029	3582	9611

Table 1. Number of coronary operations and balloon dilatations in Sweden.
(Source: BLT 970417)

From Table 1 it is apparent that the proportion of PTCA has increased as a coronary treatment technology. From a modest beginning in 1985, when PTCA did not reach even 10 percent of the coronary operations (C-OP), five years later the proportion has raised to almost 20 percent, and 5 years later it increased to almost 60 percent. In proportion, of the two treatment methods used, PTCA comprised 8%, 20% and 37% percent for the years 1985, 1990 respectively 1995.

The picture for the Karlskrona hospital, for the years of 1997 and 1998 (the first two years after the establishment of the Thorax clinic), is summarized in Table 2.

	Coronary operation	Balloon dilatation (PTCA)	Proportion PTCA
1997	369	210	36%
1998	361	260	42%

Table 2. Balloon dilatation (PTCA) and Coronary Operations at the Thorax clinic, Karlskrona hospital 1997 and 1998. (Thorax clinic, local database statistics.)

For the first two years of its existence, the Thorax clinic at Karlskrona had a PTCA-quotient just below the average in Sweden, around 40%. “I wouldn’t mind a little more, 50 percent. Abroad, 70 percent is not unusual,” said the chief radiologist at the Thorax clinic. (Personal communication, 990602.)

I have not been able to get exact local figures of C-Op and PTCA for the period of telemediated coronary diagnostics, 1993-1996, but a guess is that they roughly follow the national trend. Interesting for my discussion is the fact that in coronary diagnostic and treatment work, the two mentioned methods or technologies, i.e. coronary angiography and PTCA, have dramatically changed the work practice during the last decade. (Although, others methods and technologies add to the outcome, they seem not to be as important to the current issue). What the statistic figures are showing, can also, at a more detailed level, be seen in the collaborative work in the distributed clinical heart conferences I have studied.

Appropriating the given

School and apprenticeship learning are the traditional forms used to trade the culture’s “given.” In the medical setting I have studied, there is an informal apprenticeship applied, and also a more formal one, in the education to become a physician. It is the informal apprenticeship that interests us here.

We can take the example of a becoming radiologist who is working at the Karlskrona hospital. It is an example of apprenticeship or LPP that took place in what is called the angio lab. In this lab, the coronary angiography is conducted and an x-ray video of the patient’s working heart is made and used later in the heart conference.

“Peter (the apprentice radiologist) is prepared to start with the angio. He is redressed (sterile and lead-coated) in the angio lab./.../ He goes to the door opening between angio lab and pre-lab and asks Sven, the cardiologist who now is back; ‘Shall we start with left chamber or the arteries?’ Sven: ‘Take the chamber!’ Lennart, the experienced radiologist also present, says the same thing.

In the pre-lab we can see how Peter tries to get the catheter in position so that he can inject contrast liquid. He has a problem getting the catheter in place. He tentatively searches, but bounces repeatedly on the walls of the blood vessels or the stenoses. ‘Do you want to try?’ he asks Lennart. Lennart redresses rapidly and within short time he has got the catheter in the right place. ‘Beginner’s luck,’ Sven jokes. Peter takes over again, injects the contrast and after that completes the examination of the coronaries. /.../

Peter commented to Lennart and me when he had finished the angio: ‘It was 14 days since last time. I felt unpracticed, you need more continuity.’”

(Fieldnote 951026; the names are changed)

Obviously, this can be called informal apprenticeship or Legitimate Peripheral Participation, LPP (Lave and Wenger, 1991). It is legitimate because only physicians in training or experienced physicians are allowed to take part in the activity. The partaking is peripheral in the sense that the newcomer starts by looking or assisting in easier tasks. According to LPP, learning comes to being through participation in the practical activity. This is the only way to learn how to use the artifacts and the concepts with discretion, tune the sensibilities, and find an appropriate stand.

The episode above is from a fieldnote describing a radiologist who is conducting the angio examination and did not succeed in accomplishing the examination. As a result, the more experienced radiologist took over. Formally, the situation had the character of apprenticeship. There is a rule of thumb stating that you need to do about 500 coronary angio investigations as an apprentice in order to develop a skill that is acceptable. This means that the apprentice radiologists perform their examinations supervised by the master-radiologists. The unsuccessful radiologist in our episode was such an apprentice. This relationship was evident when he was working, and the master was “in the background.”

In this apprentice situation, the commitment to get the work done is more salient than the commitment to train the apprentice. The situation is this: The team finds itself in trouble. The “apprentice”-radiologist was not able to insert the catheter into the heart and the “master,” the more experienced radiologist, took over. No specific instruction can be seen in the actions of the master-radiologist. He did not say anything similar to, “you should do it this way.” One can say, however, that the situation was “educationally loaded.” Although the apprentice-radiologist did several attempts and tried hard, a disruption in the standard work was not mastered by the executing

radiologist. He had to give up and ask the Master to do the work. When the Master did the coronary angiography in the OP room, the apprentice stood outside in the angio lab. He was watching the Master through the windows and the open door, where he also could watch the monitors showing the catheter, where the vessels and the heart appeared as live X-ray pictures.

A patient at a clinical heart conference

The case I now will present is in form of a log from a videotape recording of “Patient 3” of a heart conference held in June 1996. It is a “normal” case in that:

- ❖ it is one case out of 14 cases processed during about an hour of a weekly clinical heart conference
- ❖ it took about four minutes to accomplish
- ❖ it is displaying the structure: A) Background presentation by a cardiologist (Karlskrona) 1-2 minutes; B) The real meeting where a radiologist (Karlskrona) is showing the angio-video, commenting on it orally and using a pointer at the film as a deixis device, and where the surgeon in Lund asks questions or provides comments himself, and where there is a dialogue; C) The surgeon makes a decision, eventually after having summed up what has been agreed upon in the sub-diagnoses.

In another respect, the case is not normal, and that is the reason why I have selected it. The case is unusual in that it clearly displays a tension between what can be referred to as a balloon dilation-perspective and an operation-perspective. In a way these perspectives are embodied in the division of labor between the team of cardiologist(s) and radiologist(s) in Karlskrona and the team of surgeons in Lund. There is a tendency that can be verified empirically that suggests the Karlskrona team “favoring” PTCA-decisions, and the Lund team “favoring” OP-decisions.

As I have mentioned, the global structure of the case is like the structure of other cases. However, a more fine-grained structure can also be discerned. In my logged version, the case comprises 64 “turns.” (In short, a turn is counted when a new person is speaking, or when a person continues to speak but bring up a new topic, for example, refers to a specific sequence of the angiovideo.) These 64 turns can be divided into 15 phases, as can be seen in Figure 2.

Participants in this clinical conference include one cardiologist and radiologist in Karlskrona, and one surgeon in Lund. This is the minimal staff possible, often more physicians participate. The background proceeding the phases presented in Figure 2 is that the cardiologist had done an oral presentation of the patient history, using a paper record that all clinicians have at hand at the meeting. Among other things, the presentation highlights that the patient had had a PTCA a year ago.

Phase	Turns	Main agent(s)	Description
I	1-3	R	Non-contested comments of angio
II	4	R	Side-track: comments about the technical quality of the angio
III	5-8	R-S	Dialogue: question-answer
IV	9	R	Non-contested comments of angio
V	10-11	R	Meta-comment connected to the patient's former PTCA
VI	12-18	R-S	Dialogue: question-answer
VII	19-25	R-C	Side-track: the Karlskrona-studio duo discusses
VIII	26	R	Non-contested comments of angio
IX	27-38	R-S	Dialogue: investigation and innovative solution
X	39	R	Suggestion of sub-diagnosis
XI	40	R	A start for continuing comments of the angio
XII	41-44	R-S	Dialogue: S is contesting the sub-diagnosis R just has suggested (in turn 39), then S agrees
XIII	45-61	R-S-C	Dialogue about the overall diagnosis and the decision-in-the-air, eventually S confirms the decision
XIV	62-63	S-C	Dialogue. A friendly power struggle. S reframes the decision, C reinterprets S's reframing
XV	64	All three	Laughter indicating the recognition of the friendly fight

Figure 2. Phases in the Patient 3 case (following the background presentation). (R= radiologist, S= surgeon, C= cardiologist)

In my further presentation of the case, I will give a rather detailed analysis of the phases III and IX-XV, containing 42 out of the 64 turns that comprise the whole case. But before I do that, let me give an idea of what is happening in the phases I do not discuss in detail. In phase I and phase IV, the radiologist, having started the video, comments verbally on what he thinks there is to see, and at the same time he uses the pointer to show to what directs his comments. Nobody else makes comments. I call these phases “non-contested comments on angio.” Phase II and phase VII are side-tracks; in the former the radiologist is commenting on the technical quality of the X-ray, in the latter, he and the cardiologist form an “ensemble” discussing internally

with low voices for a while. Finally, phase VI displays a question-answer dialogue between the radiologist and the surgeon.

Now, more details. Let us start with phase III, where the surgeon contests by questioning the interpretation of the radiologist.

- 5 (R) sick just at the departure of the diagonal branch
6 (S) is it D1 is it only
7 (R) it is D1 yes
8 (S) mm (1.0) I buy that

What we can see here is that the radiologist is pointing out in words that D1 (a diagonal vessel of the left coronary artery) is “sick.” At the same time he handles a pointer with which he marks the corresponding area seen on the video. In the paper records that the clinicians have at hand, the radiologist has drawn a sketch of the coronary artery. He has indicated by a pencil mark which of the vessels he thinks are “sick.” On the video, this “sickness” can be seen as an “indentation.” On the paper, it is seen as a pencil mark with an added figure indicating the amount of indentation.

I think it makes sense to say that the radiologist is instructing the surgeon (and the other physicians that are part of the meeting but for the moment not involved in talking) on how to see what there is to see, namely “sickness” “at the departure of the marginal branch.” However, instruction and learning are not the main issues here for the professionals. The main issue is work. The instructional/learning actions of the physicians are actions embedded in collaborative work activity.

A little later the heart conference continues in the following manner (phases IX-XII):

- 27 (R) and this is also (0.5) sick
28 but it's 'little
29 he has written “over fifty”
30 it yeah it may depend on what to compare with
31 (S) they are large-sized the vessels
32 (R) they are large-sized the vessels
33 thus you have
34 (S) [at the catheter it doesn't look stenotic
35 (R) exactly because you have about one decimal one decimal seven
36 at the catheter
37 so the width is rather good
38 (S) hmm
39 (R) so it (0.5) perhaps one ought to PTCA this one too
40 and then here at the end then comes
41 (S) but that will be many to do
42 you have to do LAD, the diagonal, the marginal and
43 (R) no yes those 3
44 (S) yeah
45 [(1.0) shall we do that then?

In turns 27-30 the radiologist states that the blood vessel they are inspecting is sick. He then softens his claim by saying about the indentation, that “it’s little.” Then he refers to another person, “he” (a colleague who has accomplished the angio investigation and written the report). What his colleague has written is “over fifty.” Meaning that over fifty percent of the vessel is indented. Fifty percent indentation is the criterion for judging an indentation as significant, or one that is “sick.” In turn 30, the radiologist opens the discussion for a reinterpretation of this potential “sickness”-diagnosis: “It may depend on what to compare with.”

The surgeon responds to the “invitation” of the radiologist by saying that the vessels are large-seized. The meaning is that even if a stenosis is over fifty percent, this defect may be compensated for by vessels that are so wide that enough blood can pass through anyway. In turns 34-38 the radiologist and the surgeon agree that the case is not that severe: the surgeon suggests that judging from what you can see on the video, “it doesn’t look stenotic,” and the radiologist affirms, “exactly.” In response, the radiologist informs them that the exact measure of the width is “one decimal seven.” The surgeon answers “hmm,” the meaning of which is difficult to interpret (“I hear what you say,” “I agree,” or something else).

In turn 39 the radiologist suggests the possibility of making a balloon dilatation (“PTCA”) on this vessel too. The surgeon raises an objection: there will be many balloon dilatations to do, and then he summarizes which specific part of the coronary artery ought to be accomplished: “LAD, the diagonal, the marginal, and...” Here the radiologist “stops” him: it is only those three. The surgeon approves, “yeah” and asks back: “Shall we do that then?”

This second part of the interaction analysis shows, like the previous one, that the radiologist instructs the surgeon on what evidence should be taken into account. But in the latter sequence, instructions also came from the surgeon: “they are large-sized the vessels” (turn 31), “it doesn’t look stenotic” (turn 34).

Phase XIII has a special character. It can be called the decision phase, and for the first time all three participants are actively involved in the discussion.

- 45 (S) shall we do that then?
- 46 (C) yeah it’s up to you
- 47 (S) (laughter) or you
- 48 (C) no no yes I think
- 49 no but
- 50 the patient ought to have the last word
- 51 actually I have discussed this already with the patient
- 52 and he is thus (1.0) he would (1.0) be happy for PTCA yes
- 53 he thinks it was a very good way to
- 54(S) [yes
- 55 the stenoses fit well for that

56 so I think that it
57 (R) exactly
58(C) he was satisfied with the last treatment
59 he wants to try it again
60 you may listen
61 (S) [okay

In the phases before, the diagnostic work was related to sub-diagnoses of parts of the coronary artery. The order of the work was regulated by the order of the x-ray sequences of the angiography. That phase ended with an approval from the surgeon on the suggestion from the radiologist that the vessel under discussion could be treated with PTCA. In phase XIII, an overall diagnosis is at stake. Now it must be decided which outcome there will be: by-pass operation or balloon dilatation. During the process of the heart conference, it had been agreed that the coronary vessels, one at a time, could have a PTCA treatment. At the time, the vessels equaled three, and at that time a multi-vessel problem was not a typical PTCA case. Therefore, they had to re-think the whole case. The surgeon starts: "Shall we do that then?" (i.e. make a three-vessel PTCA). The Karlskrona sub-team seems prepared and adds a new argument: the patient had already had a PTCA a year ago, and he would prefer to have it once again. The surgeon seems to weigh the only possible argument against PTCA, namely that there are some medical indications pointing in another directions. He refuses this possible objection himself and states: "The stenoses fit well for that (PTCA)." Thus, the decision can be made explicit: The surgeon's turn (61): "okay."

The formal part of the Patient 3 case is over, but there is a closing that I, and obviously also the other participants, interpret as a principle of norm setting. The surgeon says:

62 (S)] you got a new try then
63 (C) (laughs) before the definite cure (short laugh)
64 (Common laughter)

The meaning of the laughter is not easy to interpret, but what I hear is an indication of the contradictions between the PTCA-perspective and the operation-perspective. The participants are acknowledging that they are aware of a tension between their perspectives. It is as if the cardiologist (in line 63) is saying: we know that for you surgeons, the PTCA is a temporary move and the surgery the definite cure.

Discussion

In this study I attempt to find out how learning at work may happen. In this study I have used an ethnographically informed case study as empirical base. My perspective on learning at work is delineated by the concepts of learning (the given new and the societally new), instruction and development. More precisely, I suggest there is a connection between the concepts, a connection that is summarized in Figure 1 above. I think that a free interpretation of the figure can be read like this:

In contrast to school learning that can be characterized as oriented to the past, and predominantly supported by verbal instructional activity, learning at work displays another pattern. It recognizes that the activity of instruction is not restricted to only verbal instruction, but also includes instruction built into artifact affordances and institutional procedures (Jonsson et al., 1991). Work is oriented to the future. The instructional activity that supports work is built into artifacts and institutional procedures used in the work activity. Furthermore, the mutual interactional support the participants are giving when doing the job is salient.

In the discussion, I will connect to Figure 1 and discuss three questions related to my case study. What may learning the given mean, when learning at work? What is the relation between learning the given and learning the new? How to understand the development of the new?

Apprenticeship – learning to contribute to the work production of the given.

Learning together means learning in a community. It includes learning to share a view, learning to adopt a certain point of view in seeing things (Adelswärd et al. 1997). This community point of view is shaped by, e.g., a shared work practice background. All the physicians involved in the clinical heart conference have worked at the University clinic in Lund. The members stress this fact as important. In the manuscript to the *Acta Radiologica* article (Kehler et al. 1997), they wrote in a paragraph that later was cut down to include only the first sentence. "...the quality of the examination at the receiving end has been sufficiently high to enable a decision to be made in almost all cases. The fact that both the cardiologist and the radiologist had just left the university hospital after more than ten years collaboration with the surgeons may have made the acceptance more easy"(p. 339).

Probably, another fact is more important than the shared educational and work practice background. The distributed clinical heart conference comprises an institutional setting with specialized uses of artifacts and procedures. For example, at the conference, there are inscriptions available in form of highly structured patient journals and preprinted schematic drawings of the coronary artery on which the radiologist has marked the sick vessels. Another example is the frequent and regular contacts between the sub-teams. It can be in the form of telephone contacts between

the responsible cardiologist in Karlskrona and one of the surgeons in Lund. So was the case in the preparation of the heart conference regarding Patient 3. The following happened at this heart conference according to my fieldnote: “Cardiologist: ‘I skip NN. I have talked with [surgeon] about him. He will get PTCA.’” Obviously, the clinical conference has a lot of institutional back up, before and during the meeting. It is institutional support which makes the clinical heart conference condensed.

In the article “Formulating the past. Remembering in the police interrogation” (Jonsson et al. 1991), there is a suggestive idea about how an institutional setting comprises a kind of “schema” through which an activity is performed. The term “schema” is from Bartlett, the famous psychologist, who used it as a mental schema in accounting for remembering. However, the authors stress that the schema is not only an individual, mental schema. It is also a schema that is interactionally shared in the institutional setting, and it is a schema that produces practical actions. When a police officer interrogates a suspect, not everything counts as relevant for the protocol, only aspects that may have juridical relevance.

Such a perspective makes sense also in analyses of the coronary diagnostic work. For example, in the patient background that is presented for each case, age, gender, weight, and hereditary predisposition are always reported, as well as if the person smokes, is unemployed, or has had PTCA or has been operated on earlier. This belongs to the coronary- “schema” that shapes the actions of the physicians, at the same time as this coronary-schema is molded by their actions.

Everyday work (routine) and the unexpected

In a longitudinal study of workers within the process industry (pulp mill and oil refinery), Perby (1995) came to the conclusion that there is a very close connection between everyday, routine work and the unexpected. Therefore, a chapter in her dissertation is devoted to “the encounter with the unforeseen.” The reason is that this is a central issue in the work practice of process controllers. She writes: “From the point of view of process controllers there is no separation between ‘the ordinary every day situation’ and ‘the unexpected’ (this compared to a generally diffused conception of such a separation). On the contrary, ‘the every day situation’ and ‘the unexpected’ are *inextricably linked* in the process of the controllers’ skill and inextricably intertwined when they are performing their job.” (Dissertation summary).

Although the work of the process controllers and the work of the physicians in the clinical heart conference differ, I think Perby’s finding can be brought to the point also for the work of the latter. The unexpected that happens in the work of the process controllers just occurs, and forces them to a kind of problem solving according to the “given new.” They have to react to the disturbance in the machinery and be innovative in re-establish the normal order. Similar unexpected things may happen also in the heart conference, e.g. when the equipment in the heart conference studios fail. Actually, this happened in the conference of which my patient 3-case was part. When they started with the first patient, the surgeon in Lund asked for a higher

volume on the sound. The radiologist tried to settle that, but he was only able to change the sound in the Karlskrona studio. The surgeon then said that he would do it “from here.” I realize that the comparison is limping, the error detection in the sound volume case is simple compared to the examples Perby is talking about. The error detection was part of the process controllers’ object of work, but for the physician it was not.

By contrast, development of the new in the heart conference is related to the physicians’ object of work, the patient and his/her problems. Can Perby’s insight of the inextricable linkedness between everyday (routine) work and the unexpected or the significant new, throw light on coronary diagnostic work? I think so. Most of the work in the conference is routine. It does not mean that the work is easy in an absolute way. It might be easy, but only for skilled people, people “fully participating” in the community of practice: Also routine work has to be produced. This can only be done in an institutional setting where a “coronary-scheme” is applicable. In that way, most of the 14 patients discussed and diagnosed at the heart conference I deal with here, were routine cases. Patient 3 was not. As can be seen from Figure 2 and the turns I have presented above, some innovative actions can be discerned, innovations that summed up to an innovative diagnosis. It is first established without questioning that two vessels are sick, the diagonal (phase I) and the marginal (phase VI). That PTCA is possible here seems to be understood by implication. After that, the important coronary vessel, LAD, is discussed. By standard measurement, the indentation is “over fifty” percent, and, therefore, the coronary significantly sick. At this moment, the radiologist is trying another way of arguing. First, he says that the indentation is “little” (turn 28). Then, he suggests that even if the “over fifty” is correct, something he perhaps doubts (“he has written ‘over fifty’”, turn 29), this must not be decisive. As the vessel is wide, it can be taken into account. Finally, he gets assistance from the surgeon who proposes a more relative assessment: The vessels are large-seized. (The implication is that even if they have an indentation “over fifty”, there is still room for enough blood to pass through.) The radiologist endorses the assistance and adds a quantity to the measurement: the width of the blood vessel is “one decimal seven.” Eventually, he proposes: “perhaps one ought to PTCA this one too.”

Now the team faces a dilemma. PTCA on three important vessels was not that usual at the time. An obvious hesitation can be discerned in the clinical conference. The cardiologist shows the way out of the dilemma by suggesting that the patient might have the last word. And, actually, he has already discussed with the patient. The patient knows what he is talking about. He had had a PTCA about a year ago, and he would like to have it once again. With the innovation to clearly bring the patient’s voice into the discussion, the case approaches an end. But the final decision is still to be taken.

Gunnar Bergendal has in several publications (e.g. Bergendal 1990) underlined the importance of “responsible action.” Familiarity with normal cases and with

exceptional cases is the basis for acquiring a skill. The normal is seen in the light of the exceptional, and vice versa.

In phase XIII (Figure 2) the surgeon takes the lead in rethinking the decision that is “waiting.” Two strong reasons for PTCA are articulated, that the stenoses fit well to PTCA treatment, and that the patient wants it, and his soundness of judgement can be expected to be particularly good as he already has experienced a PTCA. The surgeon does not find any medical or surgical reason against, therefore, he approves.

I said earlier that there is a contradiction between a PTCA-perspective and an OP-perspective in the coronary diagnostic work. The new that is generated in the innovative actions developing PTCA treatment is something that is a societal “potential-new.”. Many things contribute to this potentiality, like economic benefit (it is cheaper), deployed supplement technology like more flexible catheters and stent-strengthening of the expanded balloons, or that is more indulgent to the patient, and so on. In other words, the societal new is “in the air” as a potentiality, that may be realized in situated actions which are always open. It is my interpretation that this is what happened in the patient 3-case.

Without difficulty I can think of a quite different process: no suggestion from the radiologist that PTCA might be applicable on LAD too (because it was “over fifty”); no good interactions between the surgeon and the physicians in Karlskrona; no bringing in of the patient’s voice, and so on; and no decision of PTCA, but operation.

The change is not a change without alternatives, it is a change against the background of a working work practice. The new and the given are coupled through “responsible action.”

Co-coaching and collaborative mastering of the new.

Donald Schön’s recipe for education the reflective practitioner is: “Combining telling/listening and demonstrating/imitating” (1987, p. 111). His ideas of coaching are interesting, because his concept of coaching is oriented to the object of work. In coaching, the actions are oriented at the Thing, both for the coach and for the student. By making moves, listening to the talk back of the situation, and reframing the situation, learning and coaching continue and develop.

What I miss in Schön’s picture is the profound back-talk from the student. Here Adelswärd et al. (1997) and their concept “communicative apprenticeship” is helpful. They study how children “learn about the appropriate forms of discourse as well as about the modes in which the content of the stories should be organized so as to be relevant for the activity in which the communication takes place”(p. 116). The children are young, six and eleven year old, and the storytelling is very much “dominated” by the adults. Notwithstanding, “the child is able to offer cultural novelties and innovations that potentially move the stories in new directions and offer

new interpretations” (p. 117). In essence, the child is co-authoring, co-communicating, co-coaching in the practice of storytelling.

The concept of “coaching” is related to a more knowledgeable person and a less knowledgeable person. However, it is easy to change the idea a little, and regard ability as belonging to the situation, rather than to the person. Who is knowledgeable is an open question, it shifts; expertise is demonstrated by different persons in turn as the situation unfolds. A fitting concept for this, may be “co-coaching.” If co-coaching can apply to adult-child in educational setting, it may even better suit for adult-adult relationship in the activity of work.

In the patient 3-case, I think it is appropriate to talk about co-coaching. In one moment, the radiologist is telling and showing what are the relevant topics and the relevant comments about these topics. In next moment, the surgeon invites a reframing of the situation by regarding the more than fifty percent stenotic vessel in a more relative way. In a later moment, the cardiologist strongly brings in the patient-perspective and interest, and so on. They support each other, and find innovations which could not be created and realized outside the team and the institutional setting.

Learning the new is still a mystery, but maybe some ideas about how the new may emerge have been suggested in this paper. Basic to my account is that the generating of the new is possible when it exists as a potential in the old, in culture. A lot of, e.g. technological and economical innovations contributed to the potentiality of PTCA as a common treatment technology. Between PTCA and operation, there are contradictions, conflicts and complements. They emerge as situated actions, not least in the clinical heart conference that I have studied, and they constitute a base for innovations.

If learning activity is two-way as I have suggested, i.e. oriented to the past and to the future, there is an asymmetrical pattern regarding these orientations. For learning the given (or “the given new”), priority is given to the past. For learning the new (or “the societal new”), there is a prioritized orientation to the future. Therefore, one may make a distinction between “learning for understanding” on the one hand and “learning for development” on the other hand. However, these concepts are not to be understood as a sharp dichotomy. Learning for understanding (*Begründung*) also includes understanding of possible future practices (*Entwicklung*). Learning for development also includes learning to know the preconditions of development.

During the period of my observations, one year and a half, the coronary diagnostic activity did change substantially. Something new was being learned. The participants were learning on their own, but they were also learning as a collective. Thus, there was no teaching as deliberate activity. But there was instruction in the form of implicitly understood aims, institutional routines and socially loaded material artifacts. There were also instructions in the form of actions embedded in the work activity, instructions which each of the participants got and gave while doing the job.

Basic to my account is thus a collective mastering of the new, a developmental process of work.

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Paper II

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Instructions at work: A case of coronary diagnostics

Abstract: The aim of this paper is to explore the role of instruction as an integrated part of work activity. The perspective I take is an activity-theoretical conception of instruction integrated with three fundamental professional work practices, namely highlighting, use of coding schemes, and articulation of graphic representations. The empirical part of the paper consists of a patient case from a clinical heart conference that is studied in detail. The main outcome of the study is an analytical distinction between instruction as ("crystallized") artifact-bound representations and "live" or situated instructions. It is argued that all instructions are situated, and that situatedness is doubly situated: both in the artifact-mediated tradition of the profession and in the ongoing interactions at work.

Introduction

The current understanding among researchers of learning and collaborative work in complex real-world settings is likely to have been substantially influenced by two seminal books: *Plans and situated actions* (Suchman, 1987) and *Situated learning: Legitimate Peripheral Participation* (Lave and Wenger, 1991). Both books stress the fundamental nature of situatedness of human practice and actions. As one of those who appreciate these books for their profound theoretical analyses of situated action and learning, and for their contribution to detailed work practice studies or studies of long term learning processes in communities of practice, however, I have lately come to believe that they, in different ways, underscore the important role that instruction, in diverse forms, plays in collaborative work and learning. In this paper I study the use of instructional resources in collaborative diagnostic work. The empirical example I analyze is taken from a patient case in one of the telemediated clinical heart conferences that were arranged during 1993-96 as part of a ongoing collaboration between two distributed teams of clinicians at two hospitals in the south of Sweden.

How do learning and instruction come about in complex real-world settings? A study on telemediated coronary diagnostics gave me the opportunity to attempt to answer this question. My focus is on instruction (and I take for granted that learning and instruction go together). In the analysis of how instructional resources are used in coronary diagnostic work, I take an activity-theory perspective on instructions at work. In this perspective I have incorporated a structuring of work used by Goodwin (1994). It is a structuring that differs from, but is compatible with, Leontiev's (1978) famous structuring of work activity into activity, actions/operations, where activity is object-oriented and more global, and actions are the goal-directed ingredients of the activity, and, finally, operations are the ways actions are enacted depending on the specific circumstances. The consequence of Leontiev's distinction for instruction is that you have to take into account *instruction as a special activity*, and also *instructional actions* that can be part of any activity, e.g. play, learning, and work. In the coronary diagnostic work I am studying, it is possible to discern diverse

instructional actions that are embedded within the work activity. These instructional actions are the focus of my analysis.

Instructional actions at work are of many kinds. In the paper I utilize a classification of practices that Goodwin has used when discussing “professional vision,” e.g. professional work, namely *highlighting*, the *use of coding schemes*, and the *production and articulation of graphic (material) representations*. In this paper I attempt to show how these ingredients of professional work are related to instruction.

Highlighting according to Goodwin is making “specific phenomena in a complex perceptual field salient by marking them in some fashion” (p. 606). From the instructional perspective I take, highlighting may be regarded as an action that in itself is instructional. By displaying a figure against a background, you instruct, i.e. you are highlighting a figure against a ground. Thus, highlighting means making topical: “Let’s talk about this!”

The use of a *coding scheme* is a “systematic practice used to transform the world into the categories and events that are relevant to the work of the profession” (Goodwin 1994:608). The use of coding schemes, therefore, implies commenting on a topic that has been highlighted or that stands out “spontaneously” for competent members in a certain situation.

Activity-theory characterizes work as an activity that is oriented towards its object, and that is accomplished by goal-directed actions (Leontiev 1988). From such a view, it is understandable that the object of work has a “directing” or “guiding” function on ongoing work practice. (Imagined future influencing the present.) Also past actions crystallized in artifacts are “marked” by this goal-directedness. Therefore, the situated actions that are performed to get the work done, are shaped doubly. They are shaped by the object-orientation and goal-directedness of past work and embodied in the produced artifacts, when using these artifacts. They are also shaped by the object-orientation and goal-directedness of the present work. This is the reason why the object-orientedness of work activity has an instructional character: a direction in which to go is pointed out. Or, in the words of Wartofsky (1979, p. xv): “The cognitive artifacts we create are models: representations to ourselves of what we do, of what we want, and of what we hope for.”

The third kind of action that Goodwin mentions as part of professional work is *production and articulation of graphic representations*. – A central artifact in the heart conference is the so-called *angio video*, an X-rayed film of the working coronary artery. Another central mediating artifact in the heart conference is a *graphic representation* included in the patient journal. It is a sketchy picture of the heart displaying the three main coronary vessels. To this picture, the radiologist adds the results of the coronary angiography by drawing and by writing numbers, which indicate location and amount of stenosis (indentation). How articulation of graphic representations connects to instruction, will be discussed below.

A case study

At a clinical heart conference about ten patients are discussed during one hour. There are two parts in every case: patient history (about two minutes) and showing, discussion and decision (3-4 minutes). From a case, (patient 9, late May 1996) I will discuss the beginning of the second part (12 turns out of 50). The results with regard to highlighting, use of coding schemes, and articulation of graphic representations to organize perception, are shown in Figure 1. My way of categorizing the actions of the participants in the heart conference can be inferred from the comments in Figure 1. However, I will say a few words about it.

The main highlighting method at the clinical heart conference is the presentation of the angio video. It is a technology displaying sequences of the x-rayed coronary in action that are shot from different standard angles. This means that the video successively highlights one critical part of the coronary after the other. In that sense highlighting is going on during the presentation of the angio film. The video at the heart conference is thus a highlighting procedure. This kind of highlighting is, however, rough and unfocused, and therefore, the participants focus by additional highlighting when they feel this is necessary. A common way of doing this is the running commentary that the presenting radiologist often lets accompany the angio film sequences. But even this way of highlighting has a routine character, thus being a “weak highlighting” (in Figure 1 I call it “voicing/highlighting”). Strong highlighting is accomplished by means of deixis or (professional) concept designation.

The coding scheme that is used in the case in point is the coding scheme “Fifty Percent.” It is a standard procedure that says that if the diameter of the dubious vein is at least 50% indented compared to the adjacent vein, then the indentation should be regarded as significantly sick. By articulating the graphic coronary representation in the patient journal that the participants have at hand, the suspected parts of the coronary artery are pinpointed. Thus, articulating means transforming what is “said” in the graphic picture into the oral mode of the meeting and at the same time re-highlighting what has already been highlighted in the graphic picture.

Now, let us look at Figure 1. The angio video is a tool that can be used for highlighting, although as mentioned, its way of highlighting is often blunt. The video shows sequences of the coronaries in action, and this is more like an overview. To pick up a word that the radiologist uses, the picture only shows an area: “Yes ... this is the area of ... PTCA” (line 1). This kind of highlighting is ubiquitous in the heart conferences.

For the conference system used in the heart conferences, a “highlighting device” is deployed, a cursor, which can be regulated by means of a special kind of joy-stick. With the aid of this device, the radiologist who is showing the angio video, can use the cursor to highlight what he wants to comment on in the angio film. In the sequence I present in the paper, however, the cursor is not used by the radiologist.

	SPEAKER	TALK	COMMENTS
1	Radiologist, Karlskrona	Yes ... this is the area of ... PTCA	The angio video is a series of x-ray representations. Here it is running and showing a picture of the left coronary artery. - The radiologist is voicing what is seen on the angio. It is a way of highlighting by means of lay or professional concepts. - "This" = highlighting by deixis.
2		Yes, it is not possible to stop the tape but	The technology at the heart conferences usually enables the radiologist who runs the angio video to voluntarily freeze the picture, but for some reason it does not work here.
3		It really looks like it did	- Voicing/highlighting of angio film representation
4		Thus we can measure it to quite close to 50%	The radiologist is looking down at the patient journal with its graphic representation used by the participants in the heart conference. - Articulation of graphic representation. - Use of coding scheme Fifty Percent
5		But the eyes really say, I think, that it is less	- Voicing/highlighting of angio-film representations - Indirect use of the coding scheme Fifty Percent, and contesting of the concrete measure of the coding scheme Fifty Percent
6		And actually it looks like it did immediately after PTCA July -93	- Voicing/highlighting of angio-film representations - Indirect use of the coding scheme Fifty Percent, and contesting of the concrete measure of the coding scheme Fifty Percent
7		In any case, there is no sure progress	- Voicing/highlighting of angio film representations - Indirect use of the coding scheme Fifty Percent, and contesting of the concrete measure of the coding scheme Fifty Percent
8	Lund	Does she have the area of dilatation exactly <u>there</u> at the s-curve?	- Highlighting by deixis
9	Radiologist, Karlskrona	<u>There</u> yes exactly	- Highlighting by deixis
10	Lund	Yes	
11	Radiologist, Karlskrona	Sorry, I didn't point correctly, Anders, I pointed at the circumflex (laugh)	See commentary in text.
12	Lund	Well well, but the s-curve at the LAD?	- Retrospective highlighting by means of concepts (lay and professional)

Figure 1. Instructional resources used in a clinical heart conference. Legend: "Radiologist Karlskrona" is the one who presents the angio video. "Lund" is the surgeon or the radiologist in the other sub-team at the University Clinic in Lund.

Another function of the video system that can be used for highlighting is the “still”/“freezing”: the film is stopped and the picture is “frozen” for inspection. In this specific case, the film cannot be stopped for some reason (line 2). At line 4 the radiologist glances in the patient journal and uses the graphic representation of the coronary artery and its marked points that indicate possible significant stenosis (indentation of 50% or more).

Other tools for highlighting are linguistic expressions used in connection with the video. This can be accomplished in different ways. At line 1, there is highlighting through deixis: “Yes... this is the area of ... PTCA.” As the picture on the screen is not focusing, what “this” refers to may be unclear. A more focused way of highlighting through deixis can be seen later in the displayed sequence: “Does she have the area of dilatation exactly there at the s-curve?” (line 8), and the response of the radiologist: “There yes exactly” (line 9). At this point the coronary is shown on the screen. By describing a characteristic part of what is shown (the s-curve), the Lund-radiologist focuses what was already highlighted by the angio film.

At line 12 one of the clinicians in Lund is using words to highlight in retrospect what is not still on the screen, but was there some seconds ago: “well well, but the s-curve at the LAD”.

Yet other tools for highlighting are written records, or the graphic representation of the coronaries. On one occasion in the start sequence the radiologist who is showing the video looks down at the patient journal (line 4) and articulates orally what it says: “Thus, we can measure it to quite close to 50%.”

An interesting detail in the start sequence of the angio shows that the actors have a potential variety of tools for highlighting, and if some of them “fail” or turn out to be non-effective, others are used instead. In the actual sequence, the cursor is not used by the radiologist, it is laying passively in the upper part of the video display. The working highlighting-device here is the angio video, which successively shows topics that are commented. But, as mentioned, the angio video is not very focused as a highlighting device, it displays too much of the coronary artery at once to always be very informative. It is not “positioning for perception” to use Goodwin’s expression (1997, p. 126). Instead of using the designed highlighter, the cursor, the radiologist in Karlskrona highlights by using professional concepts (e.g. “circumflex”). But abruptly, the video shooting is finished and the angio picture disappears, the screen turns black with the exception that the white pointer now can be seen very clearly, it really stands out. At that moment it is evident that the cursor has been laying passively in the upper right corner of the screen. The radiologist finds it necessary to repair what may have caused a misunderstanding, so he corrects himself: “Sorry, I didn’t point correctly, Anders, I pointed at the circumflex” (line 11). But obviously, the colleague in Lund was not misled by the passive cursor and he highlights orally what he has paid attention to: “well well, but the s-curve at the LAD” (line 12).

At line 4, the radiologist uses the coding scheme Fifty Percent. Also at lines 3, 5, 6, and 7 references are made to that coding scheme, albeit not explicitly. Thus, at least three kinds of work practices can be seen in Figure 1: highlighting, use of the coding scheme 50%, and articulation of a graphic representation.

Discussion

In my investigation, an activity-theory instructional perspective blended with three work-practice concepts from Goodwin was confronted with an empirical case. The results that came out of this encounter are summarized in Figure 2.

The columns in Figure 2 stand for a distinction between “crystallized instruction” on one hand, and situated instruction or “live” praxis on the other. Crystallized instruction can have the form of linguistic representations, for example, plans for future actions or accounts of past actions. It can also have the form of “externally embodied representations” (Wartofsky 1979, p. 202), either as material artifact-built-in representations or as graphic representations.

Three kinds of crystallized instruction are displayed in Figure 2: physical-artifact representations, linguistic representations, and graphic representations. I think it makes sense to say that an instruction frame is involved in the practice of articulating material, linguistic, and graphic representations: you articulate something in order to organize perception (for yourself and for your colleagues). This means that there is an “educational program” disguised as a standard procedure. However, a graphic, linguistic or material representation is not an instruction prescribing actions in detail. No instruction can in detail prescribe what actions to perform. Every action is open until it has been accomplished, as we have learnt from the situated-actions perspective. An instruction is rather a specification intended as a resource for acting with discretion according to the circumstances. Thus, for example, by articulating a graphic representation, this artifact is brought to life in a certain situation.

The second column of Figure 2 shows the “live” or situated instructions that this study claims to be important. These instructional actions are embedded within the activity of work: highlighting, use of coding schemes, and articulation of graphic representations.

The work the clinicians accomplish in the heart conference that the columns in Figure 2 attempt to illustrate does not stand for two main ways of instructing, a “crystallized way” and a “situated way.” The separation corresponding to the columns is only an analytical distinction. In reality actions and activities are intertwined. The only actions that exist are situated actions, but my point is that situatedness is also contingent on the artifacts used in the situation. For example, at line 4 the radiologist orally articulates a graphic representation in the patient journal. The graphic representation

consists of a sketch of the heart displaying the three main coronaries. To the sketch are added lines and numbers as a result of the outcome of a coronary angiography. The radiologist’s oral articulation is thus not only articulated by him alone, it is a collective product, bridging past and present actions, and mediated by artifacts.³⁴

CRYSTALLIZED INSTRUCTION (Artifact-bound representations of human activity)	SITUATED or “LIVE” INSTRUCTIONS (Actions embedded in work activity)
<ul style="list-style-type: none"> - Physical-artifact (material representations) (e.g. angio video) - Linguistic representations (e.g. coding scheme Fifty Percent; curriculum; plans and accounts) - Graphic representations (e.g. sketch of coronary artery in patient journal) 	<ul style="list-style-type: none"> - Highlighting (lines 1, 8, 9 12) - Use and contesting of coding schemes (lines 3, 4, 5, 6, 7) - Articulation of graphical representation (line 4)

Figure 2. Instructional resources in coronary diagnostic work.

As I have suggested above, coding schemes are of special importance for work activities. They are connected to objects of work, they summarize past professional competency, and their uses display the discretion and the responsible action of contemporary working. They encode what to do, and thus encompass a sort of work-related instruction.

The focus of the analysis of this paper is instructional actions. *A first conclusion* is that among the inter-actions that constitute human interactions at work, instructional actions play a very important role. Working together means instructing each other while doing the job. Instruction may be given in different ways, and in this study two ways of instructing can be discerned, highlighting and the use of “representations of human activity” in the form of “crystallized” instruction. These two kinds of instructional actions are, as all situated actions, *situated* and *mediated* by artifacts. The character of these two instructional actions is different, however. Highlighting is special in that it is very flexible and highly dependent on the actual situation. It is accomplished by “barehanded man’s” use of gestures and voice, and sometimes underlined, as we have seen, by use of lay or professional concepts and special devices such as the angio video and the cursor. Highlighting implies an invitation

³⁴ This is, I believe, what Suchman (forthcoming) and e.g. Schmidt (1997) are struggling with in their reconsideration of Human/Machine and of the relation between situated actions and plans. My way of tackling this problem is to search for connections between the two entities as various kinds of instructions. What is summarized in the figure can be regarded as my tentative attempt to contribute to the task that Lucy Suchman formulated in her draft paper Human/Machine Reconsidered: “to develop a discourse that recognizes the deep mutual constitution of humans and artifacts without loosing their particularities.”

("Let's talk about this!") and concerns what topic to put on "the agenda" for discussion. The other kind of instructional actions, the use of artifact-bound representations ("crystallized" instruction), concerns what is already on the agenda by means of highlighting (plus the participants' agreement on that). Of special importance in the empirical example presented here are coding schemes, representing linguistic pointers towards the objects of work, and articulation of graphic representations. This use of artifact-bound representations means reuse of resources that in the past have been used in human activity and "stored" in artifacts. The use of those artifacts thus brings to life "experiences", "recommendations", and "advice." The use takes place as situated actions, so how the advice or recommendations from the past are used depends on circumstances in the situation. The instructions from the past may at any moment be contested, fully or in part, but in the long run one cannot avoid using the resources of one's own culture. Inevitably, there will be "instruction from the past."

My second conclusion is that instruction takes place at, at least, four levels. Two of those levels have been discussed in this paper, highlighting and use of artifact-bound representations. The former is more basic in that it accomplishes the construction of a topic, a topic that in the next step, by use of artifact-bound representations, is commented upon and discussed by the participants. If I am right about the four levels of instruction, there are two levels left to explain. Even more basic than highlighting, I think, is the influencing of each other that goes on "automatically" in interaction with other people. It is the stuff that ethnomethodologists are studying, the producing of social order, as when walking in a crowded street or finishing a telephone conversation. The fourth level of instruction is instruction as a specific activity, instructing as part of an educational program, be it as apprenticeship learning, vocational training, polytechnic education or whatever. (In the coronary work setting described in this paper, there is an instructional plan, a curriculum for apprenticeship learning, that I am not going to explain here. See Sutter 1999: 408-9, for some details.)

I am sure that the reader, now, if not before, will raise objections. So much instruction! Isn't that exaggerated? My answer is that in a time when learning is often discussed as if learning goes on without instruction (as activity or instructional actions), I think it is more to the point to reverse the presupposition and counter with a question: Is there, ever, learning without instruction?

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Paper III

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Co-coaching at work. Instruction and collaboration in coronary diagnostics

Abstract. This paper explores the role of instruction in collaborative work. I argue that instruction is an essential part of working together, and I test that argument with a detailed empirical case. The case study I present is based on a telemediated heart conference between two geographically distributed sub-teams of clinicians who collaborate in making a coronary diagnosis. Within the framework of an activity-theoretical perspective on instruction, work practices important for every work activity were studied. These include highlighting, the use of coding schemes, and articulation of material representations. Three conclusions emerge from the study. First, a distinction should be made between instruction as artifact-bound advice and instruction as “live” instructions. Second, artifact-bound advice takes diverse forms including written language, graphic presentations, or thing-mediated representations. Third, instructions are doubly situated – in inter-personal interactions and in the use of artifacts (that carry the “advice” of the tradition of professional work).

Introduction

Several perspectives on work acknowledge that work, to a large extent, consists of mutually provided assistance, e.g., Anselm Strauss’s concept “articulation work” (Strauss et al. 1985) and Shoshana Zuboff’s (1988) “acting-with.” However, the idea that different kinds of instruction play a substantial role in assistance at work seldom is underlined, even in theories of cooperative work (e.g., Schmidt and Bannon 1992, and Bannon and Schmidt 1991). Researchers within, or influenced by, the tradition of activity theory, a tradition in which instruction and learning generally are regarded as processes that go hand in hand, often take the role of instruction/learning for granted, but, to my knowledge, they do not explore in any depth how instruction may function and what role it may have in the activity of work.³⁵ My point of departure is that instruction, both as a special activity and in the form of instructional actions, is a central resource for cooperative activity. How instructional resources are used in cooperative work, more precisely in coronary diagnostic work, is the topic of my paper.

I believe that learning and instruction go together and that instructions at work are instructions for “professional vision”, to use a term from Charles Goodwin (1994). I will use categories of work practice suggested by Goodwin in order to investigate the work activity of coronary diagnosticians.

The setting of the coronary diagnostic work that I studied was geographically distributed, but the work of the sub-teams involved was synchronous. Once a week two sub-teams of physicians, one at a hospital in Karlskrona and the other at a

³⁵ Exceptions, to a certain degree, are Engeström, Y. (1994).and Schmidt, K. (1997).

university clinic in Lund (200 kilometers away), held a telemediated clinical heart conference. The activity was transitory, in that the teleconferences went on only during the years 1993-1996, ending with the establishment of a thorax clinic at the hospital in Karlskrona. The main work to be done at the clinical heart conferences was coronary diagnostic work. At the clinical heart conference meetings decisions were made about what treatment the patients would receive. The diagnoses were used to inform interventions by means of surgery or balloon dilation. In case of surgery or balloon dilation, the treatment was performed in Lund. In case of so called “conservative treatment,” i.e., adopting a wait-and-see policy including, for example, a change in medical treatment, the local cardiologist did the job.

Besides the teleconferencing equipment that enabled this kind of distributed diagnostic work activity, two other artifacts were central in getting the work done. These artifacts are also central in my study of instruction at work. One artifact was a videotaped angiography accomplished at a special “angio lab” in Karlskrona and showing the X-rayed heart in action. By using a joystick, the radiologist in the Karlskrona studio directed a pointer that was displayed on the video screen. The angio video and the pointer could be seen at both conference studios simultaneously. The other central artifact was paper-based: the patient journal, including a drawing of the coronary arteries with markings indicating sick vessels. (For more details on the setting, see Kehler, Bengtsson et al. 1996, Kehler, Bengtsson et al. 1997; Sutter and Helgeson 1995)

In the sections that follow, I first introduce key concepts that are fundamental to the analyses I do of instruction and collaborative work. After that I present a patient case in some detail (the “Almost Fifty Percent Case”) and discuss it using the key concepts. Finally, I sum up what I have found concerning instruction and instructional actions in collaborative diagnostic work, and propose the concept of co-coaching at work.

Instructions and learning at work

Donald Schön (1987) has some ideas about instruction and learning that I find fruitful, though they are not explicitly about collaboration and instruction at work. Schön describes a coach or a studio master who is educating a student in a form of design apprenticeship. Some basic characteristics of his theoretical framework of design apprenticeship may easily be applied to activities of work. These include 1) the dialogic character of the interaction between coach and student, 2) the interwoven process of instruction and learning, and 3) the orientation towards the object of work.

Two quotations from Schön further illustrate what I take to be his core conceptions:

“Their dialogue has three essential features: it takes place in the context of the student’s attempt to design; it makes use of actions as well as words; and it depends on reciprocal reflection-in-action” (*Schön 1987*), p. 101).

...”the coach’s showing and telling are interwoven, as are the student’s listening and imitating. Through their combination, students can learn what they cannot learn by imitation or following instructions alone. Each process can help to fill communication gaps inherent in the other.” (ibid., p. 111)

If we apply Schön’s conceptions to work instead of coaching between a master and a student in an explicit educational setting, we can think of people working together, oriented at their object of work, and mutually supporting each other in diverse ways. Then we have something like “mutual coaching” or *co-coaching* as I will call it.

Goodwin (1994) claims that learning through work practice is connected to the ways interactions are enacted. However, the two examples of learning and instruction he uses in his text – a senior archaeologist instructing a student how to measure, draw and write for an archaeological chart, and a police expert instructing the court members how to interpret a video sequence – have a special character. Both examples show how experts or old-timers are teaching newcomers or laymen. What happens here, in Donald Schön’s terms, is Coaching. There are at the same time and in the same setting “demonstrating/imitating” and “telling/listening.” In the work activity I am exploring, the conditions are different. In the clinical heart conference all the participants are experts, and they mutually instruct or advise each other in the course of their work activity. In this case, I believe it is more appropriate to talk about “co-coaching” as the kind of instruction/learning that is taking place in the course of the work activity.

As noted above, this kind of co-coaching, learning and instructional interactions when working together, is the focus of my study. A basic premise in Goodwin’s paper is that ways of interaction at work shape learning. A basic premise of mine is similar, but emerges from a different perspective: instructions shape learning. This perspective is taken deliberately in order to reexamine and further explore what “instructing” is about and how it can be understood as an integrative part of human interaction. My hypothesis is that instructional actions and instruction as activity are important ways of interacting at work. Thus, in contrast to Goodwin, and in contrast to the currently prevailing ideas of apprenticeship learning or of legitimate peripheral participation (LPP, e.g. (Lave 1991), I stress *the instructional ways of interaction as resources for learning at work*.

Before moving on to a discussion of instruction in work activity, it is useful to define work activity more concretely. One way is to do what Charles Goodwin has done in his 1994 article, to look at professional work as the accomplishment of professional vision. Goodwin does this by scrutinizing some practices of professional vision, namely highlighting, the use of coding schemes, and the production and articulation of material representations.

In work activity, people use artifacts and interact with each other, and as a consequence they learn. But what is learning at work? People learn differently depending on the “alternative ways that interaction was structured” (Goodwin 1994, p. 628). In short, this is Goodwin’s answer to the question of what learning at work is.

In this paper, my way of studying work and learning at work is to focus on co-coaching or instructional actions, and I claim that instructional actions, embedded in work activity, are important aspects of interactions at work, of collaboration, and of use of artifacts.

Some general patterns of work practices

Instructions at work are of many kinds, and they may be enacted at several levels and by different agents. As already mentioned, in this paper I will follow Goodwin's example and discuss instructions in connection with three kinds of practices directed at developing "professional vision," that is, highlighting, the use of coding schemes, and production and articulation of graphic (material) representations.

Highlighting according to Goodwin is making "specific phenomena in a complex perceptual field salient by marking them in some fashion" (Goodwin 1994, p. 606). It is a way to make patterns in the perceptual field stand out "in a work-relevant way" (p. 611). What you do then is to point something out by some means. In the coronary diagnostic work activity a special highlighting practice is PTCA (Perkutan Transluminal Coronar-Angioplastic). This consists of x-raying the heart by means of angiography and documenting it on a monitor. The result is that the arteries "stand out". They are highlighted.

After the PTCA, the angiography film is used to get measures of the amount of arterial blockage. It is done by measuring the width of blocked coronary artery relative to the width of the vessel close to the occluded part. This is accomplished with the help of a computer program. First, the occluded part is brought into focus and magnified. Second, the contours of the vessel are marked (i.e. highlighted) automatically. If the clinician does not agree with the computerized highlighting of the contours, he can correct the drawing. In the next step, the amount of blockage is calculated by the computer program, and from that the graphic representation of the blocked coronary artery is transformed into a numeral, e.g., 60%, thereby highlighting the same phenomenon in a different mode.

The *use of a coding scheme* is a "systematic practice used to transform the world into the categories and events that are relevant to the work of the profession" (Goodwin 1994 p. 608). In the community of coronary diagnostic work that I am studying, there is a coding scheme in use that is central to assessing cardiovascular diseases. As mentioned above, it is the measure of the width of the blocked coronary artery relative to the width of the vessel close to the occluded part. A fifty percent blockage means a reduction of the cross-section area to 25% (provided that the vessel is circular in cross-section), with consequences for the blood flow. From experience it is known that a blockage of 50% or more turns out to be critical. Therefore, a coding scheme is established saying that 50% (or more) blockage is significant and, consequently, that action should be taken. It is a coding scheme that I will call Fifty Percent.

Other important coding schemes are a work capacity test measuring (in Watts) the patient's physical effort ability, and Tallium and Scint measures showing how the blood gets access to the heart muscles, thereby indicating which parts of the tissue are healthy and which are not.

The third kind of practice that Goodwin mentions is *production and articulation of material (particularly graphic) representations*. The work activity at the clinical heart conference is restricted, for the most part, to *articulation* of graphic representations. However, the *production* of graphic representations is an embedded core activity in coronary diagnostics at the heart conferences. The heart conference is contextualized by work focused on the production of graphic representations. One part of this production is the video documentation of the x-rayed coronary arteries, which is done in the Angio Lab as a preparation for the heart conference. Another part of the production of graphic representation is the transformation of the angio video by editing it, e.g., by taking away uninformative parts of the tape. A third part is to transform the angio video into a graphic figure on paper, which is included in the patient journal that all the participants have at hand at the heart conference. Thus, the work at the clinical heart conference does not produce any immediate joint graphic representation, although some of the clinicians individually take notes and make drawings. The production of graphic representations is done in the Angio Lab as a preparation for the heart conference, or after the heart conference, when the responsible cardiologist sums up the outcome of the decisions made at the heart conference.

In my reading, highlighting and the use of coding schemes are basic practices inherent in all human activities. Professional activity or "professional vision" is special in that certain elaborated coding schemes are used. In situations where professionally established categories and coding schemes are contested, however, methods are used to accomplish new "speaking terms" for the members, methods that make ongoing discussions possible despite differences of opinion. The result would then be, at minimum, that members can share that "this we agree upon" and "here we have different opinions" (Johansson 1975 and 1989). One of the methods used in order to get the members on "speaking terms" is, I believe, the "producing and articulating of material representations" (Goodwin 1994), p. 606, *material* representations that may take the form of *graphic* representations.

Instruction and objects of work

From an activity-theoretical point of view, the object of work in a sense determines the activity of work. This is because the goal-directedness of the actions is framed by the object-relatedness of the work activity. Let me give an example. In car production the countless actions that comprise the car production activity are not arbitrary. They are determined, although not at all in detail, by the activity of which they are part. The

determination more resembles scaffolding: Diverse actions have to be enacted, and in the long run these actions are coordinated to form a whole, the production of cars. Thus, work activity has a direction, and the directedness is determined by the object toward which the work activity is directed. Alexej Leontiev (1978, p. 62) has put it this way:

“The main thing that distinguishes one activity from another (...) is the difference of their objects. It is exactly the object of an activity that gives it a determined direction. According to the terminology I have proposed, the object of an activity is its true motive. It is understood that the motive may be either material or ideal, either present in perception or existing only in imagination or in thought.”

However, it is not easy to determine exactly what constitutes the object of work. Yrjö Engeström who has wrestled with the problem in several empirical analyses, says, after stating the fact that Activity Theory is based on the notion of object-relatedness of human activity:

“It is relatively easy to envision the objects of basic material activities such as manual labor. However, a closer look at such an activity as scientific research or product design reveals the slippery and multifaceted character of its objects. Yet, it is clear that those activities are oriented towards something and driven by something larger and more durable than just the specific goals of particular actions and individuals. This something – the object – is constantly in transition and under construction, and it manifests itself in different forms for different participants and at different moments of the activity.” (Hasu and Engeström 2000, p. 64)

He also claims that “the object refers to the ‘raw material’ or ‘problem space’ at which the activity is directed and which is molded or transformed into outcomes”(Hasu and Engeström 2000, p. 63) and on another paper occasion that “the object is something given and something anticipated, projected, transformed, and achieved.” (Engeström 1990, p. 181)

It is evident that the object of work evolves. On any one occasion it brings about one or several work actions and is through that process changed into a new object. This new object is then worked on and transformed into still another object of work, and so on.

Yrjö Engeström (1990) has given an account of how objects of work are accomplished in a medical setting. He describes how a general practitioner at a health center successively construes his objects of work through consultations with patients. His analysis is summarized in Figure 1 (which is a somewhat simplified version of his own Figures 8:3-6 and Table 8:2).As can be seen from this analysis, the general practitioner makes the diagnosis with the help of a number of tools, specifically three kinds of artifacts, a classification that stems from the philosopher Marx Wartofsky. The general practitioner forms the diagnosis in several (in the present case, four)

steps. The point of departure is that the practitioner, in some way, has got an object of work with which to start (“patient’s external features”), an object of work which is rough or superficial. With the help of artifacts, for example “expectations concerning the patient; algorithms and routines of computer use; initial computer data on patient,” the clinician works on the object, and the outcome of his or her work is a re-formation of the object of work into a “first impression.” This is the first step in the diagnostic work of the general practitioner. The work then proceeds in three further steps or “cycles” (described in Figure 1, steps 2 to 4). In each cycle of the clinician’s work there are mediating artifacts with the help of which he or she transforms the given object of work. The outcome of the transformation is a new object of work that can be used as a point of departure for the next move. The object of work is both the focus of the work and, in a later step, an instrument of work. Engeström’s analysis is based on a generalization drawn from the work of several general practitioners. In a later paper Engeström (1995) makes a similar analysis based on a single case.

Besides the distinct focus on the topic “objects of work,” the merit of Engeström’s analyses is that they take into account the changing character of the object of work. Additionally, the stepwise reconstruction of the object during the work process is described in some detail.

	STEP 1	STEP 2	STEP 3	STEP 4
Object of work	Patient’s external features	First impression	Meaningful pattern	Patient’s problem-as-diagnosed
‘Why’ artifacts	Expectations concerning the patient	Explanatory model of illness	Hypothesis	Meaningful pattern
‘How’ artifacts	Algorithms and routines of computer use	Method of history taking	Procedures for examinations and tests	Instructions and algorithms for specific therapies
‘What’ artifacts	Initial computer data on the patient	Patient’s accounts, records and documents	Examination and test findings	Medication, sick leave, or other therapy
Outcome	First impression	Meaningful pattern	Diagnoses and treatment plan	Altered state of health

Figure 1. Objects of work of a general practitioner and their transformations.
(According to Engeström, 1990)

My point in discussing the “object of work” is to stress the connection between the “object of work” and “instruction.” Remember Leontiev’s assertion that “the object of the activity is its real motive.” If he is on the right track, a consequence will be that

the object of work will have a motivational character, that it will constitute a propelling force giving direction to the workers' actions. The direction may not be precise but it is a projection into the future. In other words, there is an instructional aspect of the object of work: it gives a hint of what to do and where to go.

So far I have introduced the concepts that constitute the basis for my analysis of instruction and collaborative work: co-coaching, highlighting, the use of coding schemes, articulation of graphic representations, and finally, objects of work.

On methodology

Scholars interested in learning at work face the problem that learning cannot be easily observed. My way of managing this problem is to investigate instruction and instructional actions, and, as has already been mentioned, take for granted that instruction and learning are intertwined processes or two aspects of a twin process.

The empirical case I present in this paper, the "Almost Fifty Percent Case," is characterized by an explicit and abundant use of the coding scheme "Fifty Percent," a scheme that is standardized and regularly used in the coronary diagnostic work I have studied.

The unit of analysis in my study is the coronary team's diagnostic work on individual patients. Therefore, I use the patient case as my practical unit of analysis. This means that I present the full case to the reader, and I do that in the form of a comment log. This also means that I regard the work of the physicians as being directed essentially towards the patient's characteristics. This does not mean, however, that the context of the diagnostic activity, e.g., the other patients treated at the same conference, will be ignored. It only means that the context (i.e. what is associated with and relevant to the case, here the coronary diagnostics at the heart conference, but that is not part of the case as such) will be taken into account only when the members of the diagnostic team themselves bring it in, in ways that can be observed by others present.³⁶

³⁶ Here I attempt to follow Schegloff (1992) (and take context to be related to "relevance" and "procedural consequentiality." In short, that means: "It is not for us to *know* what about context is crucial, but to *discover* it, and discover *new sorts* of such things." (p. 128)

The “Almost Fifty Percent” case

At the clinical heart conference the patient cases are presented, discussed and a decision is made with consequences for the further treatment. Each of the cases takes about five minutes and consists of two parts. The first part is a presentation of the patient history by the cardiologist. The second part comprises the showing and discussion of the angio video, which displays X-rayed pictures of the coronary arteries in action. This part ends with the summing up of the decision for future treatment of the patient. My presentation of the case will be structured according to these two parts. However, I will add another part comprised of the articulation of a central graphic representation at the clinical heart conference, and I will start with that part.

Production and articulation of graphic representations for and during the clinical heart conference

The patient journal, as a paper artifact that all participants have available, constitutes input into the clinical heart conference. The patient journals are created for the occasion, and are ordered in the same way as the patients to be processed during the meeting. In the conference, the “whole picture” of the patient is to be inspected, by use of all available means: words, numbers, graphics, and so on. By orally presenting the case at the heart conference, the cardiologist brings the case to life, outlining the premises for the diagnostic work that immediately will follow. Included in the oral presentation of the patient medical history are the indices that the cardiologist mentions which may be relevant to the coronary diagnostic work at the heart conference. These indices, e.g., Tallium and Scint measures, are coding schemes used in the specific professional activity. As will be seen below, some of these institutionalized coding schemes will be used explicitly in the “negotiations” of exactly which coronary diagnosis is to be made.

A central mediating artifact in the heart conference besides the angio video, is a *graphic representation* included in the patient journal. The graphic sketchily pictures the three main blood vessels of the heart. To this picture the radiologist adds the results of the coronary angiography by drawing and by writing numbers. An example is given in Figure 2, where four numbers indicate locations and amount of blockage (in per cent of the diameter of the vessel).

Figure 2 consists of a form that is used in the coronary diagnostic work. On that form, the radiologist has made some markings based on what he (and often also his colleagues) believes are “patient topics” that they should put on the agenda of the heart conference. In Figure 2 four blockages are marked with numerals (60, 100, ~50, and 40). Furthermore, there are two serpent-like arrows indicating alternative ways of blood provision to the blocked arteries. [Note that Figure 2 does not show the form belonging to the Patient 9-case I am discussing.]

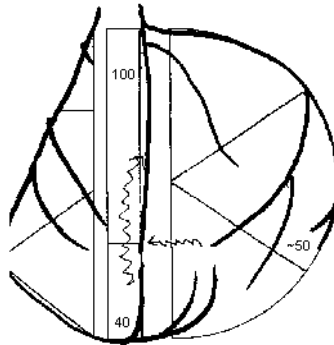


Figure 2. A graphic representation used at a clinical heart conference

The coronary diagnostic work accomplished in the clinical heart conference can be specified in the following way. For each patient the diagnostic outcomes of the coronary angiography, presented as a graphic representation in the patient journal and as a guided angio video presentation at the conference, are used as mediating artifacts in making a new collective diagnosis. The new diagnosis may in its parts confirm or correct the preliminary part-diagnoses from the Angio Lab. As a summing up for each patient, a conclusive diagnosis is formed that is the basis for the recommendation of future treatment.

The cardiologist's presentation of the case "Almost Fifty Percent"

The case in point, the Almost Fifty Percent-case or, as I alternatively will call it, the patient 9-case, was discussed at a heart conference in May 1996. The presentation by the cardiologist took 2 minutes and 10 seconds, and brought up the following characteristics of the patient "problem":

"Then we turn the page and go to NN. She was born in -28, 67 years of age. Early retirement, i.e. early, because of general chest pain. In July -91 she had a subio-cardinell infarct and after that an angina pectoris. PTCA was done, and it should probably not be in -93 but 921020, in Lund, on an elongated 75% LAD-stenosis. After that she was free from symptoms during two months, but then new symptoms again emerged. An angio was made in June -93 and displayed a 90% stenosis in the same area, and after two dilations, it was assessed to be of normal width in June -93. However, the patient did not get rid of her symptoms.

During -95 she has been given health care service five times because of chest pains, which at least I think are rather atypical. A myocard scint was made in January -96 and it shows (...) probably a smaller ischemia part within a limited area ante-lateral. But because of the expressed problems the patient had, she is now coming for a new angio.

Thus, she has something that possibly can be characterized as exertion-related chest pain or she has chest pain, but she also has other episodes with elongated pain episodes that sustained for some days.

Let's see. On Status she has varices in her right leg, but the left leg is without remark. The Tallium in Karlskrona indicates a rather good work capacity, she works 90 Watts, with an enhanced heart frequency from 65 to 124; feels tired in her legs, no chest pain, no significant ECG changes; and I have already commented on the Scint.³⁷

And then we have the angio.”

As can be seen, the presentation of the patient by the cardiologist means, in addition to a short summing up of the patient history, that the cardiologist gives word to “factors” and indices that may have relevance for the coronary diagnostic work at the heart conference. In the actual case, the results of Tallium, ECG, and Scint tests are pointed out. In addition, the status of varices (varicose veins) is mentioned. This is important because if there are varices, the veins cannot be used as replacement veins in case of by-pass surgery.

In order to “qualify” for having a coronary angiography (“angio” for short), other instances of the medical apparatus have been involved and other tests have been taken, which indicate that coronary disease may be a possibility. An institutionalized distributed and cumulative diagnostic procedure is at work here, and it is recapitulated and expanded upon in the heart conference.

The use of the “Angio video” artifact

A standard way of working with the cases that the clinicians apply in the heart conference, after the presentation of the patient history, is first to go through the angio video and comment on the findings there, and after that end with an overall discussion of the “whole picture” of the patient problem. It is an institutionalized practice that is used also on this occasion. If it is at all possible to draw a clear demarcation between these two parts, I will suggest that the video-paced inspection (inspection that is temporally controlled by the pace at which the angio video plays) of the coronary vessels covers the first half of the log, lines 2-37, and the overall diagnostic discussion the rest of the lines, 38-52.

My analysis of the case focuses on 1) instructing by highlighting, 2) use of coding schemes, and 3) objects of coronary work. The first two foci that I have chosen occur in the video-paced inspection, and my third focus occurs in the last part. My presentation of the case will therefore be divided into three parts corresponding to different foci:

³⁷ Some of the terms used here may need a translation. Stenosis means blockage of the artery. An angina pectoris may result in myocardial ischemia, which is indicating insufficient delivery of oxygen to the heart muscles. A diagnostic method for identification of that symptom is Tallium-201 scintigraphy, which shows blood provision to the muscular tissue of the heart by picturing distribution of radioactivity.

Lines 2-14	focus on highlighting
Lines 15-37	focus on use of the Fifty Percent coding scheme
Lines 38-52	focus on object of coronary diagnostic work

When I explicitly state that in lines 38-52 the focus is on the object of coronary diagnostic work, this is not to say that the work logged in lines 2-37 is work without an object. From an activity-theoretical point of view, that would be absurd, because there is no work activity without an object. However, it is reasonable to speak about a difference in focus. In the earlier parts, where highlighting and use of the coding scheme Fifty Percent are dominating, the object of work was in the background. In these parts the focus is the sub-activities or ensembles of actions that constitute and mold the overall activity of coronary diagnostic work.

Highlighting

As noted above, in the first part of the case (lines 2-14 in the log) I will comment primarily on the work practice of highlighting. The angio video is a tool that is used for highlighting, albeit highlighting that is not very focused. The video shows sequences of the coronary vessels in action, similar to what can be seen in Figure 2, and this is more like an overview. To use the words of the radiologist, the picture is only showing an *area*: “Yes ... this is the area of ... PTCA” (line 3)³⁸.

A special “highlighting device” has been deployed for usage in the heart conferences. It is a pointer, which can be regulated by means of a joystick.

The radiologist, who is presenting the angio video, can use the pointer to highlight what he wants to comment about on the angio film. In the starting sequence of the case in point, however, the pointer is not used by the radiologist.

Another function of the video system that can be used for highlighting is the “pause/still”-button: the film is stopped and the picture is “frozen” for inspection. But this time, the film cannot be stopped for some reason (line 4).

Other tools for highlighting in addition to the pointer are linguistic expressions in connection with the video. Their use can be accomplished in different ways. In line 3, there is highlighting through deixis: “Yes... this is the area of ... PTCA.” What “this” refers to may be unclear, as the picture on the screen is not focusing but showing the artery as a whole. But talk may help in focusing as can be seen in line 10: “Does she have the area of dilatation exactly there at the s-curve?” and the response of the radiologist: “There yes exactly” (line 11). At that moment one of the coronary arteries is displayed on the screen. By describing a characteristic part of what is shown on the angio film (“the s-curve”), the Lund-radiologist in talk elaborates the phenomena

³⁸ PTCA as a technology for x-raying the heart’s vessels is a diagnostic procedure. PTCA also has come to mean treatment by means of the same technology, i.e. balloon dilatation.

highlighted on the screen. What is to be seen is in that way articulated through the mutual elaboration of multiple representations.

In line 14 the Lund-radiologist is using words to highlight what is no longer on the screen, but was there some seconds ago: “well well, but the s-curve at the LAD.”

Further tools for highlighting are written records or the graphic representation of the blood vessels (like the one depicted in Figure 2). On one occasion in the initial sequence the radiologist who is showing the video looks down at the patient journal (line 6) and articulates orally what it says: “Thus, we can measure it to quite close to 50%.”

An interesting detail in the starting sequence of the angio shows that the actors have a variety of potential tools for highlighting, and if one of the tools “fails” or turns out to non-effective, others are used instead. In the actual sequence, the pointer device is not used by the radiologist; it is laying passively in the upper part of the video display. The working highlighting device here is the angio video, which is showing successively the topics that generate comments. The angio video, however, is not very focused as a highlighting device; it displays parts of the heart too large and therefore insufficiently detailed to be very informative. It is not “positioning for perception” to use Goodwin’s expression (Goodwin 1997 p. 126). Instead of using the designed highlighter, the pointer, the radiologist in Karlskrona is highlighting by using professional concepts (e.g., LAD, circumflex). In that moment suddenly a video sequence is finished, and the angio picture disappears, showing a screen that has turned black for a short period of time. The white pointer now can be seen very clearly. It really stands out. In that moment it is evident that the pointer during the presentation has been placed passively in the upper right corner of the screen. The radiologist finds it necessary to correct what may have caused a misunderstanding, and therefore he corrects himself: “Sorry, I didn’t point correctly, Anders, I pointed at the circumflex” (line 13). But obviously, the colleague in Lund has not been misled by the passive pointer and he highlights orally what he has paid attention to: “well well, but the s-curve at the LAD” (line 14).

In the rest of the case, lines 15-52, the phenomenon of “highlighting” can also be seen, although not at all so frequently as in the beginning, where there are several potential topics to be discussed, of which some are brought to the forefront by means of the practice of highlighting.

2	Radiol	Normally functioning left chamber	The angio is running and on the display can be seen a picture of the contracting chamber
3		Yes ... this is the area of ... PTCA	The angio is running and showing the coronary arteries
4		Yes, it is not possible to stop the tape but	The technology at the heart conferences usually enables the radiologist who runs the angio video to voluntarily freeze the picture, but it does not work here.
5		It really looks like it did	
6		Thus we can measure it to quite close to 50%	The radiologist is looking down at the special patient journal used by the participants in the heart conference.
7		But the eyes really say, I think, that it is less	
8		And actually it looks like it did immediately after PTCA July -93	
9		In any case, there is no sure progress	
10	Surgeon	Does she have the area of dilatation exactly there at the s-curve	
11	Radiol	There yes exactly	
12	Surgeon	Yes	
13	Radiol	Sorry, I didn't point correctly, Anders, I pointed at the circumflex (laugh)	Circumflex is one of the big arteries of the left coronary
14		Well well, but the s-curve at the LAD?	LAD is one of the arteries of the left coronary (usually the most important one)

Figure 3. The first part of the video-paced inspection of the coronary angio.

The use of the Fifty Percent coding scheme

The beginning of the Patient 9-case log shows that the scheme Fifty Percent coding scheme plays a central role in the coronary diagnostic work. Applying the Fifty Percent coding scheme is a standard procedure of the coronary work activity. In the case in point, the use of the coding scheme does not easily pay off in a diagnosis. The case is somewhat “reluctant,” forcing the diagnosticians to examine it more thoroughly. In the first phase of the inspection of the angio video, the explicit use of the Fifty Percent coding scheme is clear:

- (line 5) It really looks like it did
- (line 6) Quite close to 50%
- (line 7) But the eyes really say, I think, that it is less
- (line 8) and actually it looks like it did directly after PTCA July 1993
- (line 9) in any case, there is no sure progress

This first phase is, as I said earlier, more focused on highlighting, that is, putting on the table what to discuss as the main topics. The second phase starts with one of these topics—the doubtful adequacy of the Fifty Percent coding scheme for the present case. Now the question is: What is it and what to do with it? For the Patient 9-case, the discussion goes as is documented in Figure 4.

In order to follow the discussions here, it is important to bear in mind that the patient had a balloon dilatation, in June 1993. This is what is referred to in line 8, and this is also pointed out by the cardiologist when presenting the case at the heart conference (see above, p. 11). What is discussed in Figure 4 is first and foremost the coronary artery called LAD that was treated in 1993 by means of balloon dilatation (or PTCA).

- (line 16) But I, I ... wanted to say that it is thus between 40 and 50
- (line 17) When we measure

Applying the Fifty Percent coding scheme on the LAD vein, the Karlskrona sub-team has found that the blocked part is close to significance. This is what they get when they measure it by means of the computer-based measurement system in use. This is one thing to take into account in the diagnosis.

As the patient already had a balloon dilatation (PTCA) of the LAD three years ago, the team has another means for diagnosis available in addition to using the Fifty Percent coding scheme. They can assess how the LAD blockage has changed over the three-year period. That is what they do in line 18 and 20, where the radiologist is arguing that no change at all can be seen:

- (line 18) but also it isn't changed compared to the angio
- (line 20) We really are in the situation Björn was when he had finished the dilatation

15	Radiol	Yes, exactly exactly
16		But I, I ... wanted to say that it is thus between 40 and 50
17		When we measure
18		But also it isn't changed compared to the angio
19	Surgeon	We accept that
20	Radiol	We really are in the situation Björn was when he had finished the
21	Surgeon	But ... mm
22	Radiol	I think we perhaps overrate the LAD blockage
23	Lund	Yes
24	Radiol	I don't think it is close to 50
25		As we measure it
26	Surgeon	No
27		The circumflex is anything there?
28	Radiol	Yes, one can see
29		There ... there is there between 40 and 50, proximal
30		That is how we measure it, anyhow
31	Lund	45?
32	Radiol	Yes, it is there
33		Perhaps in the 40 area in any case
34		But it is as I said unchanged compared to
35	Lund	There is nothing, yeah, there is nothing

Figure 4. The second part of the video-paced inspection of the coronary angio.

And he keeps to this line of argumentation:

- (line 22) I think we perhaps overrate the LAD stenosis
- (line 24) I don't think it is close to 50
- (line 25) As we measure it

In the patient journal there is another dubious artery that is highlighted in the graphic picture of the coronary vessels. One of the Lund physicians asks how to judge the marked artery, i.e. the circumflex (line 27). The Karlskrona radiologist answers that -

(line 29) It ... it is there between 40 and 50, proximal

(line 30) That is how we measure it, anyhow

The Lund radiologist wants a more precise measurement and asks if it should be interpreted as a 45% occlusion (line 31). Not that much, is what the radiologist in Karlskrona answers.

(line 33) perhaps in the 40 area in any case

And then he adds the same argument that he used on the blood vessel that was discussed first, the LAD, namely that the blockage has not worsened since the treatment done in 1993, and at that occasion it was assessed as being not significantly occluded.

(line 34) but it is as said unchanged compared to ...

(line 36) Thus she looks like when Björn left her

The team at Lund accepts the evidence that the Karlskrona radiologist has presented: "There is nothing, yeah, there is nothing" (line 35).

As can be seen, there are two problems at stake in the first parts of the angio video-paced discussion, the parts that deal primarily with highlighting and the use of the Fifty Percent coding scheme. One problem is whether the vessel that was treated by balloon dilation in 1993 has deteriorated. The answer the clinicians give is that it has not, even if their way of arriving at the answer is not short and straightforward. The second problem that is put on the agenda is whether the patient has got some other significant coronary blockages. As can be concluded from the discussion – "The circumflex, is anything there?" (line 27) - one possible candidate, the circumflex coronary, is already highlighted in the patient journal. This time also the answer is negative.

A coding scheme points out what is relevant according to the tradition of the profession. In this case, the coding scheme functions as a rule of thumb stating that if the blockage is 50% or more some medical measures have to be taken. The Patient 9-case is a borderline case from the perspective of the Fifty Percent coding scheme: maybe medical measures should be taken in the form of surgery or balloon dilation, maybe not.

Earlier at the same heart conference as the Patient 9-case, another patient case (Patient 3) also displayed abundant use of Fifty Percent coding scheme. In the Patient 3 case, the difficulties lay not in assessing if the blockages met the Fifty Percent criterion –

they did – but rather in deciding what measures to take: surgery or balloon dilatation. Let us look at this Patient 3-case a little closer, before we return to our main case.

The Patient 3 case:³⁹

41	Surgeon	But that will be many to do
42		You have to do LAD, the diagonal, the marginal, and
43	Radiologist	No, yes those three
44	Surgeon	Yeah
45		Shall we do that then?
46	Cardiologist	yeah it's up to you
47	Surgeon	(laughter) or <u>you</u>
48	Cardiologist	no no yes I think
49		no but
50		the patient ought to have the last word
51		actually I have discussed this already with the patient
52		and he is thus (1.0) he would (1.0) be happy for PTCA yes
53		he thinks it was a very good way to
54	Surgeon	yes
55		the stenoses fit well for that
56		so I think that it
57	Radiologist	exactly
58	Cardiologist	he was satisfied with the last treatment
59		he wants to try it again
60		you may listen
61	Surgeon	okay

For Patient 3, it had been agreed during the process of the heart conference that the coronary vessels, one at a time, could have a PTCA (or balloon dilatation) treatment. At the time, there were three vessels, and in those days a multi-vessel problem was not a typical PTCA case. Therefore, the diagnostic team had to reconsider the case as a whole. The surgeon starts: “Shall we do that then?” (i.e., make a three-vessel PTCA). The Karlskrona sub-team seems prepared to suggest that, and they add a new argument in favor: the patient has already had a PTCA a year ago, and he would prefer to have it once again. The surgeon seems to consider the only possible

³⁹ I have used this log excerpt in another paper - Sutter 1999 - but then in order to highlight and discuss instruction and learning related to the emergent developmental aspects of everyday work.

argument against PTCA, namely that there are some medical indications pointing in other directions. He refuses this possible objection himself and states: “The blockages fit well for that (PTCA).” Thus, the decision can be made explicit: “okay” (turn 61).

36	Radiol	So she looks like when Björn left her
37	Lund	Hmm
38	Lund	Eeh, I think, as it is seen on this tape,
39		One has to be satisfied, clearly satisfied with this result
40	Lund	Hmm
41	Lund	And ... it is sort of she has an atypical angina also
42		and a Scint which doesn't ... which probably displays a small area [inaudible]
43		but the LAD then, I would never approach it
44	Radiol	Mm
45	Surgeon	Thus ... (two short coughs)
46	Cardiol	We are very satisfied with this decision
47	?	(Laughter of several people)
48	Lund	That is around what you were hoping for, maybe
49	Cardiol	Well well (laughter) I think, I think
50	Lund	One must give it a peace, absolutely
51		Because it is surely ... it surely is other things that bother her
52	Cardiol	I have also that impression, yeah
53		Then we continue with (name of the next patient)

Figure 5. The final part of the discussion of Patient 9 at the heart conference.

Thus for Patient 3, the use of the coding Scheme Fifty Percent resulted in a clear recommendation: Three vessels are significantly stenotic – take measures! However, what measures to take were not part of the recommendation derived from the usage of the Fifty Percent coding scheme. In order to find out what to do, the clinical team has to argue and find good reasons by means of references to current practice. They found that recent experiences had shown that three-vessel PTCA would be a fitting alternative for this kind of problem pattern.

Now we leave the Patient 3 case and return to our main case, the Patient 9-case. Here too, a two-step procedure was applied. First the problematic points were discussed,

one at a time, in a discussion mainly paced by the sequences of the angio video. The assessment in this step can be summarized as: “Almost fifty percent, but there is no deterioration compared to the balloon dilation that was performed three years before.” Then, in the next step, an overall diagnosis has to be made. What the team is saying in this overall diagnosis is that even if the blockages are significant, the occluded parts of the coronary vessels are not the main problem for the patient. Looking at the problem patterns in general, the coronary stenoses are subordinated to other problems that the patient is suffering.

Focus of coronary diagnostic work

As mentioned in the introduction to this paper, the object of work is the activity theoretical expression for the content/motive of work, its focus. The object of work essentially determines the activity of work. What then is the object of coronary diagnostic work? Before I start to discuss that, one thing can be stated. Although the object of work determines how the work should be accomplished, it does that far from completely.

Therefore, the object of work is often contested, and more so in times of great changes. In the remaining part of the Patient 9 log, we can see how this is done in the Almost Fifty Percent-case.

The main arguments in the sequences in Figure 5 are:

- (line 41) And ... it is sort of she has an atypical angina also
- (line 42) And a Scint which doesn't ... which probably displays a small area [inaudible]
- (line 43) But the LAD then, I would never approach it
- (line 51) Because it is surely ... it is surely other things that bother her

What is the context here, the context as the members themselves display it in their talk and actions? In other words, what do they find relevant and what do they bring into the discussion by suggesting procedural consequences, even if they do not explicitly use the Fifty Percent coding scheme?

One aspect of coronary skill and professional vision is to know how to apply the Fifty Percent coding scheme. Applying the coding scheme mechanically is no big issue. The use of a coding scheme can be a means to control and regulate the actions of the users. As we have seen, coding schemes belong to a culture's knowledge, and from that point of view, the control aspect can be regarded as fair because it is up to the users' discretion how to use the coding scheme in a specific situation. However, if the control is a way to regulate the actions of one's subordinates, it is more problematic. By imposing coding schemes you are able to control other people's work. It can be

done in a way that Goodwin (1994, p. 609) illustrates by means of an example: “Forms, with their coding schemes, allow a senior investigator to inscribe his or her perceptual distinctions into the work practices of the technicians who code the data.” This kind of control must be kept within reasonable bounds, otherwise the professionals will be deprived of the discretion that they, and only they, can enact when doing the job.

What the professionals do in this part of the case, is work with just such discretion. First they attempt to apply the Fifty Percent coding scheme at the dubious and marked vessels, and upon doing that they claim that two of the vessels are still dubious. Based on the fact that they have not deteriorated since after the last balloon dilation, however, the “Almost Fifty Percent” measures for both vessels are interpreted as not significant. The sub-teams also take into account the measures from the Tallium scint and the fact that the symptoms of the patient’s angina pectoris are assessed as “atypical.” Therefore, their conclusion is that “it surely is other things that bother her” (line 51).

Discussion

This paper deals with the question in what ways instruction is part of collaborative work in the heart conferences. In this section I will attempt to answer the question in three steps by discussing instructional actions, artifact-bound “advice”, and objects of coronary diagnostic work.

Instructional actions in coronary diagnostic work

In activity theory a distinction is made between actions/operations and activity. This holds true also for instruction. On the one hand there is the activity of instruction or teaching or training, on the other hand there are instructional actions (and operations).

From an activity theoretical point of view, actions and operations are happenings on an individual level. However, actions and operations are part of an activity that is collective in nature. Thus, individual actions/operations do not exist outside an activity. The reverse is also true. An activity is comprised of individual actions/operations. The consequence is that individual actions and collective activity are inseparably intertwined.

In this section of the paper I focus on instructional actions and operations that are embedded in work activity as diverse actions, e.g. gestures, deixis, pointing, video-paced displaying, and orally expressed concepts.

If we look once again at the first part of the Patient 9 case, we can specify certain of the instructional actions that are enacted (the lines referred to here correspond to Figure 3):

Highlighting by deixis (line 3, 10, and 11), by means of articulation of the angiogram (line 2, 3, 5, 7, 8, and 9), and paper graphic representation (line 6). Also retrospective highlighting by means of lay and professional concepts (line 10, 13, and 14).

Explicit *use of the coding scheme Fifty Percent* (line 6, and 7; implicit use in line 8 and 9).

Articulation of a graphic representation (line 6).

Sometimes actions go together, and therefore certain patterns of actions may be discerned. These small scale actions that go together in larger chunks or clusters of actions, I call “ensembles of actions.” In the paper I have introduced three concepts from Charles Goodwin, concepts that may be regarded as ensembles of actions: highlighting, the use of coding schemes, and the articulation of graphic representations, and I have applied them to coronary diagnostic work. My presentation is designed to illustrate how these work practices all share an instructional character. My arguments are summarized in Figure 6.

Highlighting is the practice of marking something in order to make it stand out. As I see it, highlighting is a set of actions or a practice that in itself has an instructional flavor. You instruct by showing or finding or constructing a figure against a background, i.e. by highlighting a figure against a ground. In that way perception and discourse start to be structured. Thus, highlighting means making topical: “Let’s talk about this, it is important!”

Ensembles of actions	Instructional characteristics
Highlighting	By some means constituting a figure against a background in order to use it as a topic for further discussion. (“Let’s talk about this!”)
Use of coding scheme (e.g. Fifty Percent coding scheme)	A coding scheme is the tradition’s advice (instruction, recommendation, invitation) how to act in certain situations. Using a coding scheme means to play a recommended language game (with room for contestation)
Articulation of graphic representations	Bringing to life what already has been assessed as important by predecessors and “saved” as a graphic artifact.

Figure 6. Instructional characteristics of certain “ensembles of actions”

Use of the Fifty Percent coding scheme. The use of coding schemes implies commenting on a topic that has been highlighted or stands out “spontaneously” for competent members in a certain situation. A coding scheme may be regarded as a professional categorization that the tradition offers (recommends, requires, advises) professionals to use. Coding schemes are part of crystallized past expert experience. It is as if the tradition demands through dead men’s imperatives that their collective experience should be used: “Thou shalt!” And what else can you do, if you not will renounce all claims on the cultural estate?

Articulating graphic representations. There is an instruction frame involved in production and articulation of graphic representations. What is happening is that one produces and articulates something in order to organize perception for one’s self and for one’s colleagues. That means, there is an “educational program” launched with the help of the graphic representation. One may speak about a graphic or material instruction. It is not an instruction prescribing actions in detail – no instruction can – but rather a specification aimed at serving as a resource for acting with discretion. An articulation of the graphic representation brings it to life in a certain situation, as for example when the Karlskrona radiologist glanced down at the patient journal and read out what there was to see in the graphic representation (Figure 3, turn 6). When the graphic representation is brought to life it can be dealt with in different ways, by

being approved, contested, changed, and so on. (As always, situated actions are agile and open until they have been enacted.)

The actions (or ensembles of actions) that are in focus in Figure 6 are “highlighting,” “use,” and “articulation.” The first of these actions, highlighting, I claim to be instructional as such. Independent of what is highlighted, highlighting means instructing. This is not the case with “use” or “articulation.” Instead they are constructed as instructional in connection with what is used and what is articulated, that is, a coding scheme and a graphic representation respectively. The Fifty Percent coding scheme and the graphic representation that can be seen in Figure 2 are, what I call, “artifact-bound advice.” When they are used and articulated, they are transformed from an artifact state to an interactive state, or from an “inert” to a “live” state.

Highlighting and use of artifact-bound representations (including articulations of graphic representations) are, I suggest, basic ingredients in all activity. They are similar to what is expressed as figure – ground (as Goodwin notices), and to the basic duality expressed in language structure as *topic* and *comment*.

Artifact-bound “advice” or representational-artifact instruction

In my account of instruction as an activity depicted in Figure 7, there are two main aspects, one aspect is instruction that is bound to artifacts, the other aspect is instruction as situated instructions in live interactions. The relation between the two aspects is of course that they cannot be separated except for analytical purposes.

The first distinction expressed in Figure 7 is corresponds to the distinction Lucy Suchman captures in her metaphor “Plans and situated actions.” I use the term “artifact-bound advice” as a general concept of which plans are examples. In using this term I want to express two things, one is the artifact-boundedness of instruction, that instruction is part of a culture and “has a past tense.” The other is that the artifacts have an instructional character, they “give advice.” In instructions there are inherent contradictions between past and present, between something already structured and something open.

The contradiction between the two aspects of instruction – instruction as artifact-bound and instructions as actions - is well formulated by Mike Robinson (Robinson 1993, p 3) when he discusses the nature of work. It is from Robinson that I borrow the term “advice,” which I think in an appropriate way underlines the instructional character of representational artifacts.

“None of this means that organizational procedures, structures, roles, workplans, objectives, and so on, are without value. (...) It is simply that no procedure, no anticipated sequence of events, will ever match the rich, concrete detail of an actual situation. Procedures are more like advice than algorithms.” (*Underlining by B.S.*)

Now, let us discuss the two aspects of instruction as activity, one at a time. I start with the artifact-boundedness of instruction.

Artifacts as representations of human activity. Artifacts are produced by humans, and they are, if not “monuments,” the public archives of human activity. “Read” by a skillful interpreter, these artifacts have a lot to tell about human practice.

Marx Wartofsky is one skillful interpreter who has developed a theory of “fossilized human activity.” His “historical epistemology” encompasses a theory of artifacts. Artifacts that function as “secondary artifacts” do what they do by representing human activity. In Wartofsky’s (1979) words:

“The production of such artifacts for use, I argued, was at the same time the production of representations, in that such artifacts not only have a use, but also are understood as representing the mode of activity in which they are used, or the mode of their production. Thus, spears and axes are not only made for the sake of hunting and cutting, but at the same time represent both the method of their manufacture and the activities of hunting animals or chopping wood.” (pp. xiii-xiv)

(...) “such representations, as ‘secondary artifacts’, are not in the mind’, as mental entities. (...) They are externally embodied representations.” (p. 202)

In Figure 7, I have made three sub-categories of artifact-bound instruction: linguistic, graphic, and physical or thing-mediated representations. They are all examples of “secondary artifacts.” The Fifty Percent coding scheme is one example of a linguistic representation. In Figure 7 I also mention “plans” and “accounts.” The reason I include them, notwithstanding that I have not used these terms elsewhere in my study, is that they are central to the research context in which my paper is written. It is a context in which Lucy Suchman’s book *Plans and situated actions* (1987) plays an important role, and therefore, indirectly, also the concepts of “plans” and “accounts.”

Physical artifacts are things, but they are also thing-mediated *representations*. Thing-mediated representations in the form of physical artifacts are used in production and are often easily associated with productive activity, and because of that they are intelligible. This is the reason why physical artifacts are at once used in production, and at the same time thing-mediated representations of human activity. They are the stuff that archeologists study - like the spears and the axes Wartofsky mentioned in the quotation above – in order to acquire knowledge about earlier forms of human activity. Physical artifacts are also the stuff we all use as means to get to know the past, the present, and possible future of human activities.

INGREDIENTS OF INSTRUCTION AS ACTIVITY

ARTIFACT-BOUND “ADVICE” (Representations of human activity)	“LIVE” INSTRUCTIONS (Instructional actions embedded in work activity)
<p style="text-align: center;">Linguistic representations (e.g. coding schemes, plans, accounts)</p> <p style="text-align: center;">Graphic representations</p> <p style="text-align: center;">Physical-artifact representations</p>	<p style="text-align: center;">Highlighting</p> <p style="text-align: center;">Use of linguistic artifacts (e.g., coding schemes, plans, accounts)</p> <p style="text-align: center;">Articulation of graphic and artifact-bound instruction, by turning them into live instructions</p>

Figure 7. Instruction as activity composed of two components, one “inert” and artifact-bound, the other “live” and comprising situated actions.

An example of a *graphic representation* is shown in Figure 2. It is part of a form that is included in the patient journal used at the heart conference. The form summarizes the outcome of the angio by means of figures and graphic descriptions. Such a form is what the radiologist in the Almost Fifty Percent-case uses as a source of information when he glances down in line 6 (Figure 3).

Instruction as activity has according to Figure 7 two aspects: artifact-bound advice and live instructions. Artifact-bound advice consists of representations of human activity and as representations, artifacts are instructional. They suggest how to understand and what to do. Wartofsky again suggests:

“The cognitive artifacts we create are models: representations to ourselves of what we do, of what we want, and of what we hope for.” (ibid., p. xv)

He continues:

“The model is not, therefore, simply a reflection or a copy of some state of affairs, but beyond this, a putative mode of action, a representation of prospective practice, or of acquired modes of action.” (ibid.)

“It is in the use of such representations that a characteristic mode of praxis is preserved, and comes to be transmitted; and in this lies the germ of cultural evolution.” (ibid., 205).

In a nutshell this is the background to Wartofsky’s cultural-historical credo: “the *artifact* is to cultural evolution what the *gene* is to biological evolution” (ibid., p. 205).

Instructional actions embedded in work activity. The other aspect of instruction is its “live” character. That means that it is constituted by instructional actions embedded in work activity. When people collaborate they do a lot of coordination, adjustment, and orchestrating. They “fiddle” and do “articulation work” (Strauss, Fagerhaugh et al. 1985); (Gerson and Star 1986). I claim that part of the reciprocal influencing that is going on in all work activity is that people mutually advise each other. In other words, they are performing mutual coaching, co-coaching.

Note the mutual contingency of actions both as artifact-mediated (and therefore also getting instruction from the past), and as “open” to the future (and therefore using whatever resource available to get the work done). Accordingly, actions are doubly situated: by artifact-mediated instruction and by face-to-face interactive actions.

Objects of coronary diagnostic work

During the 1990’s, the clinical coronary work described in this paper has undergone significant changes as a consequence of technical changes (heart angiography, catheters, stents⁴⁰), improved balloon dilation skills of the teams, more effective medicines, new perspectives (balloon dilation as an everyday activity of coronary work), and organizational renewal (the establishment of the thorax clinic at Karlskrona hospital).

Thus, new tools and a more experienced and skilled clinical team have led to a partially new object of work. Balloon dilation can now be applied in a multitude of blocked and occluded arteries that some years ago were not within the horizon of possibilities. Consequently, PTCA can serve as a partial substitute for by-pass surgery. The advantages for the patient are that PTCA treatment is a modest and less dramatic intervention compared to by-pass surgery, and it sometimes can be done as an continuation of the PTCA investigation (the coronary angiography) when the patient is still in the PTCA Lab bed.⁴¹

It is no exaggeration to say that a profound transformation has been taking place in the area of diagnosis and treatment of heart disease during the last years. If one describes the change of coronary diagnostic work by means of the triangular model that Yrjö Engeström (1997) has developed, one has to state that all components have changed – the collective subject, the instruments, the community, the rules, the division of labor, and that there is a development of the work activity as a whole. As a

⁴⁰ A stent is a wire or plastic mesh tube that is expanded with an angioplasty balloon. The aim is to strengthen the artery wall in order to prevent restenosis.

⁴¹ The coronary angiography is made at the Angio lab. A catheter is inserted, normally through a vein in the groin, and contrast liquid is squirted into the coronary making possible x-ray filming of the heart. The video film inspection is one of the main artifacts used in the heart conference. When there is no doubt that balloon dilation will be the cure, the dilatation can be made as a direct continuation of the angiography investigation. The only thing that has to be added is to insert a new catheter with an attached balloon, get it through to the indented part of the coronary and expand the balloon.

consequence the object of coronary diagnostic work has also changed: you can do, and you should do, what wasn't possible before.

It is important to realize that the object of work is both real and ideal. In the case of coronary diagnostics and treatment, the clinicians work with, for example, catheters, x-ray cameras, video tapes, written documents – real stuff. But they also work with ideas, concepts, theories and models – more elusive entities that cannot be pointed to or inspected by the senses directly, entities that only can be established as collective interactional patterns.

In addition to being real and ideal the object of work is both something given and something at which to aim. It is something that is “in transition and under construction” and “something given and something anticipated, projected, transformed, and achieved” to once again use Yrjö Engeström's words. Let us take the patient 3-case above as an illustration. In that case, it was stated that three of the patient's coronary blood vessels were blocked. In that moment, the team decided – given the new technologies, the new cultural standards of what interventions were possible, and given the improved skill of the team – that a three vessel PTCA would be made. Thus, the team's object of work was at the same time given as a real disease pattern (three blockages), and a possibility of its treatment that still had to be realized (three-vessel PTCA).

In doing their jobs, the clinicians are applying “the same everyday procedures” on changing circumstances, including events and instances that do not fit so well into the standard procedures. In that way they jointly produce “the same work activity”. This “creative routine work” also implies development of the work activity. Most often this development is “nothing special”, just slow changes of work practices. Sometimes the disturbances, ruptures or dilemmas (Engeström 1992) add up, so that the contradictions of the work activity cannot be mastered without innovative breaks from everyday procedures. Then the change in routine is counted as “special.”⁴² In co-coaching people instruct or advise each other, and they do so as part of their everyday work activity. In doing this they also develop the work activity, and the result is a “collective mastering of the new” (Engeström 1987).

The object of coronary work is changing, and the change is accomplished by clinical teams in the process of doing the job. They act, and they reflect-in-action (Schön 1983) as can be seen in the two cases I have presented. In the “Almost Fifty Percent” case (Patient 9), measures of the coronary blockages pushed in a direction of “doing something,” i.e., PTCA or surgery. But, the team's conclusive overall assessment resulted in a different picture: this is nothing that will be cured by PTCA or surgery, “it surely is other things that bother her.”

⁴² A feature of work activity is the bridging of the “same” and the new (Bergendal, 1992; Perby, 1995; Middleton, 1997). I am interested in what role instruction plays in this bridging.

In the Patient 3-case, the coronary inspection resulted in an unusual proposal for a solution – a three-way PTCA. Reconsidering the case as a whole – there seemed to be no medical contra-indications, and the vessels looked fitting for balloon dilation. Therefore, the team decided to go with the proposed solution. What can clearly be seen in these cases is that routine work and innovative solutions are tightly interwoven.

What is at the center of the work activity – its object - is not always obvious even for the practitioners themselves:

“Isn’t it strange how some people can live with that many blockages, while others die with one?!” (Field note from a heart conference, November 1994)

Sometimes there is a clear contradiction between the rather precise standard procedures that are part of the work (like measurement of degree of blockage, or video inspection of the x-rayed coronary vessels) and the mystery of the vascular diseases. I have a field note from an occasion at the Angio Lab when there was a short informal discussion about this paradoxical state of the art, and a radiologist finished with: “We are talking, here, about a whole person, not plumbing!”

Talk like this is not uncommon. “War stories” (Orr 1996) can be heard on the theme as if the clinicians want to encircle a “disease space” by talking of extreme and not easily intelligible cases and render them parts of ordinary work. What is real and what is possible? How does the horizon of possibilities look? What is the object of work, and how may it be developed? It seems that a zone of proximal development⁴³ exists between the reality of tradition and routine work on the one side, and a possible new work activity inherent as contradictions in the current activity system on the other side—something that the practitioners carefully consider through reflection-in-action and through reflection-on-action (Schön, 1983).

⁴³ I refer to the expanded Vygotskian concept of the “zone of proximal development” that Engeström (1987) has generated.

Conclusions

The main conclusion I draw from this study is that learning at work presupposes instruction. This conclusion is to all appearances in contrast to the now prevalent apprenticeship or LPP approaches to learning.

The main advantage of the apprenticeship or LPP approaches to learning is, in my opinion, their underlining and exploration of the basic participatory aspect of all kinds of learning. Learning takes place in a community of practice and this is a situatedness that cannot be escaped in practice, and that must be acknowledged in theory. You cannot learn without being involved and engaged. I think this insight, that especially the LPP approach has stressed, is a fundamental contribution to learning theory. However, when it comes to understanding how this learning takes place, there is a need for a better explanation than the apprenticeship explanations have provided so far. What is missing is an account of the phenomenon of instruction as an essential aspect of learning, be it in the form of apprenticeship, LPP or something else. The kind of instruction that I refer to is a different kind of instruction than the apprenticeship model implies. It is an instruction that, in addition to teaching, includes both instructional actions embedded in any kind of activity and instruction in the form of artifact-bound “advice.”

The second conclusion I will draw is that these forms of instruction may be characterized as “co-coaching.” The reason for this is that in accomplishing practices such as highlighting, the use of a coding scheme, and the articulation of a graphic representation as part of collaborative work, the members’ interactions also take the form of the members’ mutual instruction of each other. This kind of instruction takes place as instructional actions or as work practices within the activity of work. In other words, the members are co-coaching each other in doing the job. For this reason, it is appropriate to say that collaborative work comprises co-coaching.

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Paper IV

Berthel Sutter (2001). Artifacts are made instructive. Constructing and reconstructing “angio” Graphics in Coronary diagnostic work. Unpublished manuscript.

Artifacts are made instructive

Constructing and reconstructing the “angio” graphics in coronary diagnostic work

Abstract. The aim of the paper is to give an account of the construction and uses of a representational artifact at coronary diagnostic work. The artifact is the angiography (“angio”), an x-ray based visualization of the coronaries after injection of a radiopaque substance. The angiography has turned out to be a central artifact in current coronary diagnostics, not the least in the heart conferences, where patient cases are discussed, diagnoses are made, and treatment decided. My research methodology is to focus on a few angio cases, and record their history and transformations. My observations concern the whole cycle of the patient angiography, from its production and uses until the patient, at least temporary, is considered to have got a fair (final) diagnosis and recommended treatment. The study shows that the graphic artifact is not just constructed once and for all. It is first constructed as a digital computer-based representation, but is then reconstructed, added on, transformed into paper format, used as a shared representation, and also used as a representation for individual use. The patient angio is constructed in the angio-lab, being prepared for and is used in the heart conference as a tool for diagnoses and as an object of work to investigate and transform. Further, it is used as a guide for the treatment, and is finally used as a summing up documentation of the history of the angio patient. I end the paper by giving a preliminary answer to the question if and how the angio graphic can be instructive.

Introduction

More and more artifacts are used in human activity. It seems as if artifacts proliferate. A characteristic of our time can be said to be that artifacts are involved with humans into larger and larger networks (e.g. Castells, 1996, and Latour, 1993). As a consequence the use and design of artifacts, and, not the least, particularly of information and communication technology (ICT), have turned into a substantial part of many research fields like CSCW (Computer Supported Cooperative Work) and HCI (Human-Computer Interaction), and of research and development activities in many companies. There are even suggestions of forming the “sciences of the artificial” (Simon, 1969) or establishing an “artificial science” (Dahlbom, 1999).

For my own part, particularly through a study of instruction at work, I have come to be interested in how artifacts - physical, linguistic, and graphic artifacts - are used in collaborative work (Goodwin, 1994; Sutter, 2000a, b). In the present paper I am studying a graphic artifact at work. The background to the study is that in the coronary diagnostic work a lot of indices are used by clinicians to get to know the condition of the patient’s heart. Since two decades a more and more important diagnostic artifact in coronary artery work has been angiocardiology and now it

may be regarded as the central one.⁴⁴ Among the practitioners it is called “angio” for short. The expression “angio” has come to refer to both the angiocardigraphic investigation and the video of the coronary. In the work process the artifact representing the coronary artery undergoes a variety of transformations. This artifact and its transformations are the focus in the paper

Perspective and aim of the study

In the paper I am studying how a central graphic artifact is produced and used in coronary diagnostic work. The aim is to see in what ways, if any, graphic artifacts can be said to be instructive.

I do not believe that artifacts are agents (see Tap & Sutter, 2000), an idea that is ascribed to Actor Network Theory (see e.g. *Mind, Culture, and Activity*, No. 4 1996, and Miettinen, 1999). However, I think you have to acknowledge that scholars of Actor Network Theory, together with upholders of activity theory and Artificial Intelligence, have to have credit for putting on the research agenda the need of rethinking artifacts and our uses of them. If artifacts, man-made products, are not agents, they nevertheless have some properties that make them different from nature, non man-made objects. Although it may be difficult to characterize what constitutes this difference, it is even harder to deny its existence. Many have tried to get a grip on what matters here. For example, Sartre (1976/1960) talks about “the practico-enert field” (matter in which past praxis is embodied), Popper (1972) about a “World 3” of objective knowledge, Ilyenkov (1977) about “ideal objects”, Wartofsky (1979) about “representational artifacts,” Norman (1988, 1993) about “affordances,” Wenger (1998) about “participation” and “reification”, and Petroski (1999) about “the engineering method” possible to find out through archeology of artifacts.

Some artifacts seem to play a special role in learning. They are what Wartofsky calls “representational artifacts.” According to him, they represent actions, actions that have been accomplished, and actions that are proffered for the future. This is the “loading” of “representational artifacts.” According to Wartofsky, the range of representational ability of the artifacts is wide. All artifacts, even material artifacts that are used in production as concrete tools (“primary artifacts” in his terminology), have a representational potential – they re-present human activity. However, some artifacts are constructed just to have a maximal representational power. They are “secondary artifacts” or “representational artifacts.” Models and theories are examples of such artifacts. They are summing up human experiences, and because of that they are powerful in instruction and learning. By using them in a community of practice, that is, as part of an activity, together with other artifacts and other participants in the activity system, you get access to knowledge. In short, you learn.

⁴⁴ “Coronary angiography is currently the ‘gold standard’ for evaluation coronary artery disease. A catheter is advanced through a peripheral artery to the root of the aorta; radiopaque dye is then injected into the coronary artery, and x-rays are taken to provide a picture of obstructed areas.” (*Medical and Health Annual*, 1992, p. 333)

The angio graphic artifacts I have studied belong to the category Wartofsky calls representational artifacts.

Graphic artifacts are special because they can join abstract and concrete properties of diverse kind. They are rough and robust representations. They are close to “primary artifacts”, because they picture concrete tools and objects, as well as they are abstractions and “theoretically” are summing up experiences. Furthermore, they may embody thoughts about alternative states of affairs. With an expression from Susan Leigh Star (1989) you can say they can function as “boundary objects,” which lot of people can understand and contribute to with different kinds of additions – drawings, diagrams, written words, photos, etceteras.

Graphic artifacts are “drawing things together”

In *Laboratory Life*, published in 1979, Bruno Latour and Steve Wolgar introduced the theme of “inscription” as an essential part of scientific work, and since then Latour has continuously developed on the theme. How come inscriptions⁴⁵ are so important in science? Latour’s answer is that their primary influence originates from “the unique advantage they give in the rhetorical or polemical situation. ‘You doubt what I say? I’ll show you.’ ” (Latour, 1988, p. 36)⁴⁶ His arguments are that natural scientists that have made discoveries can be said to have been visiting alien worlds. When they want to tell about those worlds, want to persuade themselves and their colleagues and the public opinion, they need to bring some evidence, some “things.” The things they bring need to be stable, they should not change during the transportation, be ruined or destroyed. Furthermore, they should be presentable and make sense when being demonstrated. They preferably have to fit well with other kinds of evidence or “knowledge objects.” Or as Latour glosses it in his article titled “Drawing things together”: “In sum, you have to invent objects which have the properties of being *mobile* but *also immutable, presentable, readable* and *combinable* with one another.” (ibid., p. 26) Inscriptions, and graphic artifacts among them, are such things.

⁴⁵ “Inscription: A general term that refers to all types of transformations through which an entity becomes materialized into a sign, an archive, a document, a piece of paper, a trace. Usually but not always inscriptions are two-dimensional, super imposable, and combinable. They are always mobile, that is, they allow new translations and articulations while keeping some type of relations intact.” (Latour, 1999, Glossary, p. 306-7)

⁴⁶ Perhaps this is a too Machiavellian explanation. On the other hand, this is what science has been about. “You present absent things,” as Latour says (aa, p 27), and this means that you have to turn to vision and exclude the more “local” senses. In such a game Luria’s famous peasant from a “remote Kashgar village” (Luria, 1976, p. 108-109) is lost as when he refuses to answer a syllogism (and logic is primarily built on text and vision) – “In the Far North, where there is snow, all bears are white. Novaya Zemlya is in the Far North and there is always snow there, what colors are the bears there?” – for the simple reason that he could not know, because he had not been there. He did not know that logic and the rigorous parts of science are enacted within the discourse itself. “How things are” is ignored, until a new discourse is fabricated which may take new facts into account.

Tools and objects of work in coronary diagnostics

In this paper the angiographic artifacts are in focus. However, it should be clear that the “angio” is a tool, certainly an important tool, but nonetheless just a tool⁴⁷. It is a tool for diagnosing the patient. The patient is the object of work for the physicians, and what the physicians do is motivated by and oriented at the patient’s problem. The tools they are using are subordinated to the motive of the activity. Consequently, it will be seen that the physicians, before the production and use of the angio graphics, have other tools available for diagnoses of the heart and the artery coronary. They do not let their work rely exclusively on the angio tools, but acquire access to a kit of tools and procedures developed as part of the activity over a long period of time. Moreover, even when the angio graphics have come to be reliable and dominant in the diagnostic process, other tools are used as well, as alternatives, complements and verifications.

The object of clinical medical work is the patient. But when is a patient a patient? Not every person visiting a hospital is a patient, you have to “qualify” to be one. You need to pass some screening before being accepted as a patient. Only in rare cases of obvious physical damages, the screening is done by visual inspection of the person. Most often the screening is a test or a series of tests, and in those cases you cannot, by just looking at a person, see if he or she is also a patient. The transformation of a person into a patient is made on the basis of documentation of tests. And the transformation of a patient of a certain kind to a patient of another kind is also based on tests and documentation. One may paraphrase Latour and say that physicians start seeing a patient once they stopped looking at the person and look exclusively and obsessively at prints and flat inscriptions.⁴⁸ Therefore, the object of medical work, the patient, is not an easily grasped phenomenon. It is an agile, changing, and evasive object, which, with few exceptions, is possible to grasp only on the basis of documentation and inscription.

Method

My method in this paper is to study the production and use of a central graphic artifact in clinical coronary work. Like the clinicians I am interested in the object of work, the patient, the person with his or her diagnosed problems, and like the clinicians I am not able to observe the patient problem without help of some supporting artifacts. The artifact that I focus on in this study is the artifact that has got a key role in the coronary diagnostic work, the angio graphic.

In order to find out how the angio artifact is produced and used, I take two steps. First, through observations and interviews I construe an account of the

⁴⁷ However, the angio is sometimes also an object to be constructed and transformed. Tool use and construction/reconstruction of tools go together within the framework of work activities. For the interplay of artifacts as tool and object, see Engeström (1990).

⁴⁸ This is what Latour (1988: 39) has written: “Scientists start seeing something once they stopped looking at nature and look exclusively and obsessively at prints and flat inscriptions.”

institutionalized way of working, how “in general” the angio is created and used. The next step is to follow some actual cases in their creation and uses of the angio artifact.

In earlier studies on coronary diagnostic work, I have relied heavily on video-documentation. On those occasions my point of observation was the videoconference studio at the Karlskrona hospital. From my physical placement there, my “object of study”, the diagnostic work at the telemediated heart conference was possible to get a grasp of.” In the present paper, however, my object of study is the angiographic artifact, and it is not fabricated in one place and during a very concentrated period of time. The production and use of the angio artifact is distributed in space and time, and different people are involved, on different occasions. Therefore, my point of observation cannot be stationary. The methods I have used are observations and fieldnotes, questioning after the events, interviews, and collecting of graphic artifacts. I have been “hanging around” at the workplace, asked for details and expressions to be explained, I have asked the members for comments on texts I was writing, and so on.

Particularly, what I have done in this study is to combine observations and the method of “archeology of artifacts” that Petroski (1999) has suggested. One of Petroski’s main ideas is that engineering work (method) may be accounted for through studies of artifacts and their uses. Because Petroski’s methodology is not widely known, I will outline its key.

Petroski claims that artifacts have something to tell:

”Because all engineering, past and present, has a common feature to its fabric, the method of engineers and of engineering is embodied in everything ever made and thus is accessible through any single artifact.” (p. x)

“But in the same way the engineering method, which might be called the rhetoric of technology, can be the very reason for preserving the history of engineering achievements long superseded. While it may be difficult, if not impossible, to recover with any degree of certainty the unrecorded method of the past, we have begun to preserve the next-best thing – the artifacts produced by that method.” (p. 20)

What Petroski says has a bearing also on method. This is what I call “Petroski’s methodology.” When you are going to study aggregates of work actions that are distributed, and not connected to one person or one place, there is no center of observation. An appropriate unit of analysis might then be an artifact, its emergence and transformations. When the work practice cannot be studied in detail in real time, an alternative can be to follow its traces, the artifacts used and the metamorphoses of the artifacts. Their sediments – this is Petroski’s point – can be read, and the work activity of which they are an outcome, can be reconstructed. If you do not have access to the best thing: the present work activity, you can have “the next-best thing”, the artifacts that are produced. This is Petroski’s methodology for making work visible.

Therefore, what I will do in this study is to combine the methodology of “archeology of artifacts” (especially graphic artifacts) with observations of the production and use of the angio graphics.

An institutional practice of coronary diagnostic work

Activity of work is institutionalized in diverse ways. There is an organization with formal and informal roles and division of labor. There are rules, explicit rules and non-articulated but taken for granted rules. There are myriad of artifacts, some of which are central and almost “constitutive” of the work activity. And there are rooms, facilities, and buildings, and there are procedures and local cultures. All these ingredients of an activity system or a community of practice mould the ongoing activities. Some of them are more sustained, like buildings and physical artifacts, but others have to be reconstructed time and over again as part of the activities. However, they all form an activity system or a community of practice, which comprises a context for work practices and actions. What I say is in other words that interaction and communication at work are institutionally framed (e.g. Agar, 1985).

This section comprises an account of the institutional framing of ordinary work at a thorax clinic, as it was accomplished in September and October 2000. Focus is on work that is more or less directly concerned with the production and use of an angiographic representation of the heart. The description of the work is a description of the work as it is usually done, “everyday work” so to say. This description consists of three parts: (1) the production of the angio graphic in the angio lab, (2) the use of angio graphics in balloon dilatation (PTCA) and by-pass operation, and (3) the use of angio graphics in the heart conference. In a later section, the description of the institutionalized and generalized work with the angio graphics will be followed by some case stories, an account of the actual clinical work accomplished with some patients.

The institutional frame of the production and use of the angio graphic at the Karlskrona hospital (September-October 2000) is made up by a series of steps. What I describe is thus a generalized practice, the institutionalization of work, which any new string of actions or assembly of actions has to relate to.

1. The coronary angiography (“angio” for short) is accomplished in the Angio Lab (see Figure 1). The outcome is a “raw angio” in digital format (Figure 2). In a technical report, the team of radiologists and cardiologists at Karlskrona hospital has described the procedure of the angiography: “The examinations usually consisted of left ventricular angiography (frontal and lateral simultaneously), four to six runs of the left coronary artery, depending on anatomy, and four runs of the right coronary artery.” (Kehler et al., 1996, p. 161)
2. The angio film is looked through, and, if necessary, edited.
3. The raw digital angio is inspected by the radiologist that has shot the angio, and in collaboration with the cardiologist they edit the angio.

4. The edited digital angio video is stored, earlier on discs, videotapes, or CDs, and now in a PACS (Picture Archive Communication System).
5. An angio form is filled in.
6. Secretary-work with the angio form. It is edited and added to the patient journal that will be at hand in the heart conference.
7. The use of the angio form and the angio video in the heart conference, attended by surgeons, radiologists, cardiologists, and other staff.
8. Documentation of the heart conference decisions.
9. Information to the doctor who has referred the patient.
10. Possible use of the graphic artifact as a direct preparation for the operation, and during the operation.

Three patient cases

In each of the patient cases that comprise the empirical base of this study, the account of what happened is focusing on how the angio graphic is produced and used, and how its transformations look like. In the end I ask in what ways, if any, the angio graphic is instructive.

The scene of the three cases is the angio lab (Figure 1). At different places, by diverse ensembles of people and through individual work, the angio graphics are designed, redesigned and used, with the help of assisting artifacts. The work practice relating to one patient case, is often mixed with actions relation to another patient case. Thus, the work is distributed – in time, space, and between people.

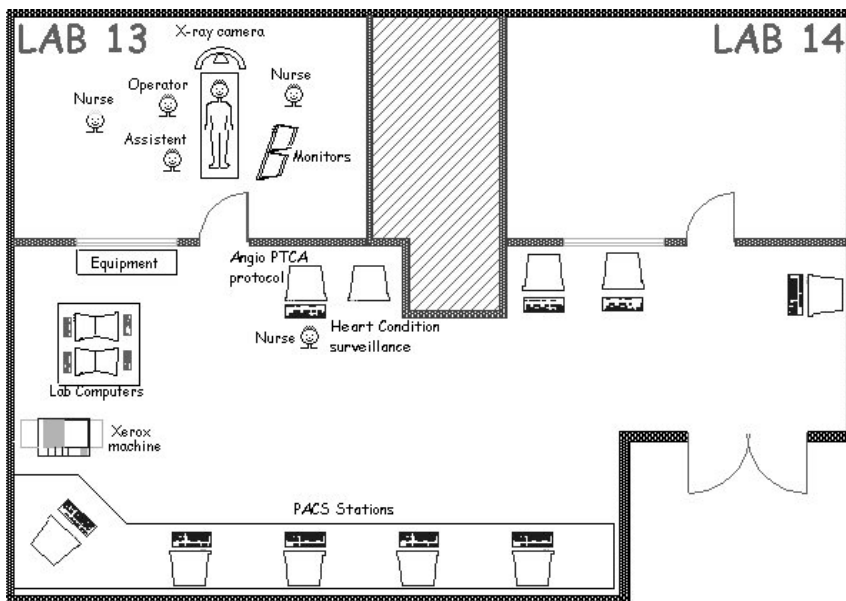


Figure 1. The thorax radiology clinic.

Case 1

The first patient is an “angio patient.” This means that the patient will be examined by means of coronary angiography. He was referred to the thorax clinic from a neighbor county hospital, and an angiographic investigation was made on him. The outcome of the angio was that no significant sickness was identified by this method. The doctor who had referred the patient therefore got the following answer: “Moderate ateromatotic alterations, not significant, at middle LAD.”

The cardiologist, C, is the operator for this case and he decides to advance the catheter through the arm (a technique called “radialis”), which is a rather new method used at the clinic. He keeps to the standard angio procedure: six runs on the left coronary artery, and four on the right. In Lab 13, the main coronary angio lab, the x-ray camera has double tubes that render digital videos with different projections each time, so he has only to shoot five times to get the ten standard videos.

When the operator advances the catheter to a position from where he can insert contrast liquid into the left and right coronary artery respectively, he is guided by a “leading light” X-ray picture, low in charge. The transitory “coronary angio graphics” that are produced in this way are thus a by-product of the investigative method. It is a means to create *the coronary angio graphics* that form the basis for the coronary diagnostic work.



Figure 2. A first step in the production of the angio graphics.

The angio investigation is documented by a nurse that is placed just outside the doorway to the inner angio lab (see Figure 1). In front of her are two screens, one belonging to the heart surveillance monitor (showing ECG and pulse), and the other belonging to the computer where data to the angio protocol are fed. For the current case it was recorded that, among other things, the investigation was started at 10:34 by getting the patient an injection of Dormicum 1 mg in left arm, and that the angio investigation ended at 11:06 as the catheter was taken out.

After the angio investigation, the operator, cardiologist C, sits down in front of the "lab computers." The lab computers have four monitors, two of which are showing in real time what is shown at the monitors in Lab 13. On the other two monitors can be seen the angio videos that the operator has saved by pressing a foot pedal. Cardiologist C is looking through the angio videos. "Here are a lot of vessel departures, difficult to find out what is what", he says. When finished he sends over the digital videos to the server, to the newly installed picture archive communication system (PACS). Then what happens, can be shown by an excerpt from my fieldnote (001005). First I asked him if he had done some editing: "Yes, he has taken away two sequences, one where the catheter slipped out, and one that was a copy of an earlier projection. Plus, that he had adjusted the picture definition." After that C crosses the room and sits down at two of the the PACS computers. He fills a form on the left one, and displays the angio pictures on the screen to the right. He looks through the video one more time at the same time as he makes comments addressed to me as an observer: "I inspect the film one more time. But then I want to discuss it with a colleague." It turned out that it will take a while until he will get the opportunity to discuss the angio with his colleagues because C has to rush to help another colleague, who has made an angio investigation on a patient. Now the angio investigation will be followed up by a balloon dilatation (so called ad hoc PTCA), and the colleague wants C to be operator on the PTCA because it preferably is performed as "radialis", and C is said to be better on that.

"14.03 After lunch. The radiologist J, the colleague with whom C wanted to discuss the angiofilm sits down to check C's angio patient. (C has a late lunch break.) Radiologist J starts by reading through the patient's journal, 'Hjärtutredning.' He thoroughly goes through the film. He underlines that he does it exceptionally close, because C had asked him to do that. What I have found, J says, is a stenosis at LAD. Perhaps also 'another thing: to the right far at the end it ends a little abruptly.'

Cardiologist C is back after lunch. J now is in Lab 14 with a patient. C is sitting down at the left PACS computer. J asks him to come over for a discussion in Lab 14. (...) Just before J returns to tell the patient what they have decided, J tells C that the only thing he noticed on C's angio patient was some stenosis at the departure on LAD. It is 14.28 o'clock. C returns to the PACS computer and fills in the form for his patient." (Fieldnote, 001005)

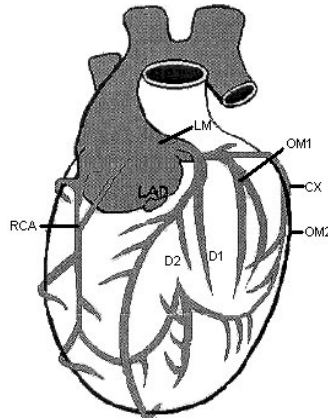


Figure 3. “Angio report” (part of) for the Case 1 patient.

The angio graphic depicted in the angio report for the Case 1 patient looks like an empty “Angio report” form: there are no additional marks made by the physicians. As part of an “Angio report” this “nothing has been recorded” is significant. Within the context of an “Angio report”, it is a form with an angio picture saying that “nothing” has been recorded, i.e. there are no significant stenoses found. Or in other words: the value of the sickness of the coronary artery is zero.

In the afternoon the daily “afternoon heart conference” was held at the thorax radiology lab. These afternoon conferences are intended to balance the workload at the main heart conference in the morning, and also make it possible to dismiss some of the patients on the very day. When the Case 1 patient was discussed, a surgeon and three physicians from the thorax radiology team took part. – A summing up of Case 1 is made in Figure 4.

The right column of Figure 4 (“Angio Graphics”) shows the angio graphic artifacts at work for the Case 1 patient. The forms of the angio graphics are described, and in the “Events”-column the corresponding work activity is given an account. The angio investigation is designed or “rigged” in such a way that it automatically produces an unedited coronary angio video. The physician who has been operator for the patient case is also editing the angio film. The result is the basic edited version, the “raw” angio, which is sent to the PACS system. In a way, the “raw” version by that is copied to another computer system. But there are also some additional features added automatically, which will be described more in detail later on. This PACS based angio video is from then on, THE angio video, the most basic recording that is available at the clinic. If the physicians want to check something, they have to use this version, “the angio video.” Using the angio video as a source, the Angio Report (see Figure 5) is constructed. For the Case 1 patient, the angio report is made by cardiologist J, and it happens to be made in three steps, because the cardiologist occasionally has to work with other patients.

Time (approx.)	Place	Events	Participants	Angio Graphic
Ca 9-9.30	1	Operator at the angio investigation in Lab 13 is cardiologist C. His coworker is radiologist J. A radialis investigation (i.e. through the arm) that took 17 minutes.	Cardiologist C (operator) Radiologist J 4 nurses	"Leading light" picture Unedited coronary artery angio videos
(9.30-35)	2	C is looking through the coronary artery angio videos at the "lab computers." He does some editing, and send the angiofilm to the "edit&report" computers (the workstations at the PACS server)	Cardiologist C Radiologist J	Unedited coronary artery angio videos Edited coronary artery angio videos
(9.35-?)	3	The operator starts to write "Angio report" on the edit & report computer. At the computer beside, he once more looks through the angio film. He freezes the film and shows me the part that he finds dubious. In this work he is interrupted, because he has to be operator at a balloon dilatation.	Cardiologist C Cardiologist K asks for assistance	The edited coronary artery angio videos, now at PACS, are used to start to create an Angio Report
14.03- (14.10)	3	"Radiologist J starts by reading through the patient's journal, 'Hjärtutredning.' He thoroughly goes through the film. He underlines that he does it in an exceptionally close way, because C had asked him to do that. What I have found, J says, is a minor stenosis at LAD. Perhaps also 'another thing: to the right far at the end it ends a little abruptly.' " (Fieldnote, 001005)	Radiologist J	The edited coronary artery angio videos are used for close inspection of dubious parts
(14.15- 14.22)	3	Continues documenting of the Case 1 patient	Cardiologist C	Construction of Angio Report continues
14.28	4	Joint decision about possible findings at the Case 1 patient's angio in an informal setting: the stenosis on the LAD is not significant.	Radiologist J Cardiologist C	
(14.28- 15)	3	Cardiologist is finishing documentation of the Case 1 patient's angio report	Cardiologist C	Angio Report, digital version, is finished (See Figure 3)
(15.30- 15.45)	3	A regular daily "mini heart conference" at thorax radiology clinic. Three patients are presented.	Cardiologist C Radiologist M Radiologist J Surgeon PA	Glancing through the edited angio videos

Figure 4. Coronary diagnostic work, Case 1 patient.

The pronounced distributed character of Case 1 interesting, it says something about the work activity and the artifacts used.. All cases of course are distributed – they span an interval of time, occur in different places, involve diverse constellations of people, and are mediated by a multiplicity of artifacts. But this time the time span is unusually long, and the collaborative work is improvised in a way that is, probably not unusual, but at least deviating a good deal from the standard script. The distribution is made possible by means of the angio video, which is a stable artifact, and also by means of the PACS system that make it possible to “stop wherever you are” and later continue the work exactly at the point where you stopped.

Case 2

The most frequent category of patient at the thorax radiology section is a patient that had got an angio investigation immediately followed by a PTCA intervention (that is, an “angio + ad hoc PTCA patient”). This means that the patient is initially referred for an angio investigation. When the angio has been accomplished and while the patient still is laying on the angio lab bed, an immediate decision is taken based on the outcome of the angio investigation: balloon dilatation will be made as a continuation of the angio. The Case 2 patient belongs to this category.

My fieldnote (001005) gives an account of what happened:

Cardiologist K is going to make the angio investigation. He advances through the groin. When he has finished the angio, he and his team partner, the radiologist J, are looking through the film at the “lab computers.” When they are done, they call the cardiologist C. [This is what interrupted C when working with the Case 1 patient analysis and documentation at the PACS computers. See above.] All three of them look through the film together. The question they have to answer is if they immediately are going to make a balloon dilatation on the patient. The vessel that is a possible candidate is the right coronary. On the film can be seen a stenosis on the middle part, followed by a thin trisecting part. Will the outer coronary be substantially bigger if it gets more flow of blood? The physicians consider the pros and cons. Thus, PTCA? Their answer is affirmative, and by that they have made a formal decision. There is namely a “carte blanche” from the surgeons saying that if the case is obvious, the responsible sub-team of cardiologist and radiologist is permitted to take a decision. Now they did, and the cardiologist C is the physician that will be the operator on the PTCA intervention. He prepares himself by looking through the patient journal, and by looking through the film another time (his second). On this occasion he measures the stenosis, got it significant with the aid of a built-in computer program.”

Cardiologist K who has been responsible for the angio investigation later produces the “angio report” which includes a schematized picture of the heart. On the picture the stenosed right coronary is marked. (See Figure 5).

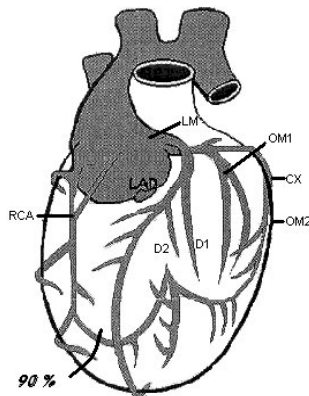


Figure 5. “Angio report” (part of) for the Case 2 patient

The next step in the procedure of dealing with Patient 2 is the continuation of the angio investigation by a balloon dilatation. It is performed by the cardiologist C, with cardiologist K participating as an “apprentice” learning the procedure of “radialis” (that is, intervention via the arm). Radiologist J follows the intervention from his place at the “lab computer.” On two occasions he assists concretely by going to the doorway of Lab 13 and commenting on the case. “It is placed perfectly,” he is feeding back, referring to the catheter-attached balloon that cardiologist C has advanced to a certain position in the middle part of the right coronary artery. On two of the lab computer monitors the radiologist J has access to the same picture as the operator C has on the monitors that are placed above the bed of the patient in Angio Lab 13.

A computerized record of each intervention is registered by a nurse. The record is called the “Cardiac Catheterization Report.” The current record tells that at 12.29 the following event is happening. The operator is blowing in segment 3 (what that is can be seen in Figure 6 below) at a pressure of 6 pounds per square inch absolute for 60 seconds. In the protocol can also be seen that the operator uses a balloon, trademark Adante, with a diameter of 2,5 mm and a length of 20 mm. It was, thus, this balloon that radiologist J communicated to the operator C as being placed “perfectly.” When the operator had blown the balloon, and he and the watching radiologist J got “back talk” from the situation (to use a good term from Donald Schön). Now they could see that the placement of the balloon was not “perfect”. Radiologist J comments on that to operator C: “The stenosis was longer. It wasn’t possible to see that [earlier].” As a consequence, the operator makes an attempt to expand the artery furthermore with the aid of the balloon. In the intervention protocol one can see that at 12.34 the operator once again blows the balloon in segment 3 at 6 absolute atmospheric pressure. This first part of the PTCA procedure thus consisted of these two attempts to expand the vessel. Twenty minutes later, the second part of PTCA is made. Now the operator makes a second balloon dilatation with a new balloon (3 mm wide and 25 mm long) strengthened with a “stent,” a wire or plastic mesh tube that is expanded with the angioplasty balloon.

The case is very illustrative. The angio investigation showed a clogged right coronary ending in a thin tripartite vessel. After the PTCA, a widespread and thick coronary artery emerges. The treatment is assessed as very successful of the participants. The cardiologist K tells that he, after finishing the angio investigation, had discussed the result with the patient. “You can get rid of your vascular spasm if the balloon dilatation goes well, but there is also a risk” he said to me that he had told the patient, “1 out of 100, that the artery gets injuries. Do you want to take that risk?” The patient decided to take the chance facing the risk. With the outcome at hand, you can say the patient made a decision that turned out to be a good one.

The PTCA report that was drawn up includes a figure that can be seen in Figure 6, where the part of the vessel (“segment 3”) that has been expanded by the balloon and strengthened by the stent is marked.

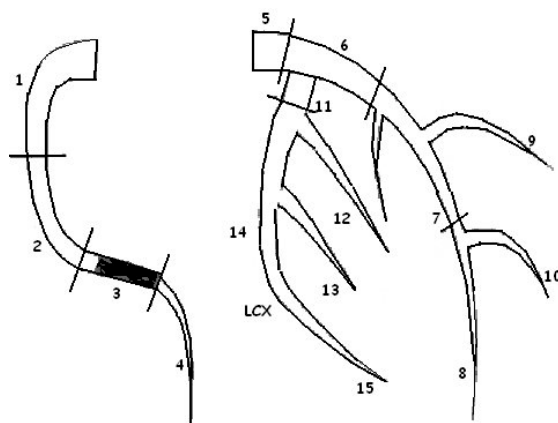


Figure 6. Angio report PTCA (part of), Case 2 patient.

The Case 2 patient belongs to the category of most frequent patients. It is a patient that after the angio investigation and after a decision made by the responsible cardiologist-radiologist duo in collaboration with the patient⁴⁹, gets a balloon dilatation (or PTCA) treatment. Statistical figures show that the PTCA part of the total sum of coronary interventions has grown rapidly. When the thorax clinic was started in Karlskrona 1996, the projected number of PTCA was 170 per year. This year the number is estimated to 500. 80 per cent of them are said to be *ad hoc* PTCA, i.e. the physicians decide, on the basis of the result of the angio investigation, and after discussion with the patient-person, that they will continue directly with balloon dilatation. (Fieldnote 000928).

⁴⁹ I prefer the term *patient-person* or person-patient depending on what is most appropriate in the situation. Below in the text I explain way.

Before I continue, I will give a remark on the problem of the patient. I said earlier that the doctors see the patient when they stop looking at the person and instead are looking at digital or paper texts and graphics. This is of course an exaggeration, but it is an exaggeration that holds the truth. The patient comes with the person, and therefore I sometimes speak of *the patient-person*. In acute cases, when the person is unconscious or in other ways not fully capable of making decisions for her or his own best, the person-part is not (fully) there. What is there is a patient who cannot give voice to her or his wishes. Under such circumstances the societal proxies come into the picture, and in the present case the proxies are the professional team with its institutionalized decision making procedures. (See Figure 11, p. 18.)

We have just seen how the physician's attempt to involve the patient in the decision to be taken. According to my fieldnote (001005) this is what he said he told the patient: "You can get rid of your vascular spasm if the balloon dilatation goes well, but there is also a risk, 1 out of 100, that the artery gets injuries. Do you want to take that risk?"

My fieldnote on another patient was focused on how the person-patient was involved in the decision or, rather, informed about why the only option that was practically available was OP. In this case the cardiologist and the radiologist were discussing with the person-patient before, during, and after the angio investigation. After the angio investigation the cardiologist showed the angio film for the patient-person that was lying on the bed in Angio lab 14. The cardiologist explained and showed that the patient's coronary artery was very bumpy or nodular. This could easily be seen on the monitor. The cardiologist explained for the person-patient: "Therefore, it is probably not possible to make a balloon dilatation, but instead probably an operation has to be made. However, the case has to be discussed at a heart conference." (Fieldnote 001017)

Case 3

The patient is coming for a balloon dilatation (PTCA). He has had an angio investigation last year at this thorax clinic and is now referred once again. He had had a new angio investigation in September 26, and the next day, on the daily heart conference, it was decided that he would have PTCA treatment. The patient was then sent back home, and the doctor who had referred the patient was informed. The doctor signed up for PTCA on the waiting list administered by the secretary, and the day before the PTCA the patient was called to the hospital. The operator, a radiologist, prepared the PTCA by reading the patient journal and by looking through the former angio video, that is stored in a database.

The radiologist's PTCA activity in the angio lab is documented by a nurse that fills in a standard form on a computer (see Figure 7). From the nurse's documentation can be seen that the patient "was blown" eight times at a pressure that varied between 6 and 14 atmosphere and had a duration from 40 to 60 seconds. The documentation also accounts that coronary stents – "small, tube like, expandable metal cylinders with a

mesh like structure that are implanted in coronary arteries to keep them wide open” (Medical and Health Annual, 1998, p. 182) - were inserted on three occasions. The PTCA intervention took in total 79 minutes. When the radiologist came out from the inner of Lab 13 he said: “That was too much, he was an OP candidate!” (Fieldnote, 001003)

The operator followed the normal procedure: looked through the angio in cooperation with a cardiologist, and then transferred the angio video to the PACS. In the next move he went over to the workstation computers, looked through the angio film once more and filled in the angio form.



Figure 7. Procedural record of the PTCA treatment (Cardiac Catheterization Report). Case 3 patient.

It is noteworthy that the radiologist made a very elaborated presentation of the PTCA intervention. It is a report primarily aimed and designed for the physician that has referred the patient. As the PTCA was a multiple one and the case complicated, there is a need for a comprehensive account of the treatment. This is what the radiologist makes. He fully exploits what the PACS work stations make possible. (See Figure 8)

To the left on the front display is a list of videos forming a column. In the present case the radiologist has shot 17 sequences, and as Lab 13 has two cameras that simultaneously take pictures from different angles, the result is 34 videos. By clicking on one of the numbered and listed sequences, the operator will have the sequence running, in half screen format to the right on the screen. Between the list column and the large picture are pairs of thumb nail photos, automatically generated in the PACS.

The photos are from the middle of the sequences, and they are intended to serve as memory aids. Regarding Case 3 patient, it is worth mentioning that on some of the angio graphics can be seen irregular ellipses: wires from an earlier by-pass operation holding together the chest during the healing up.

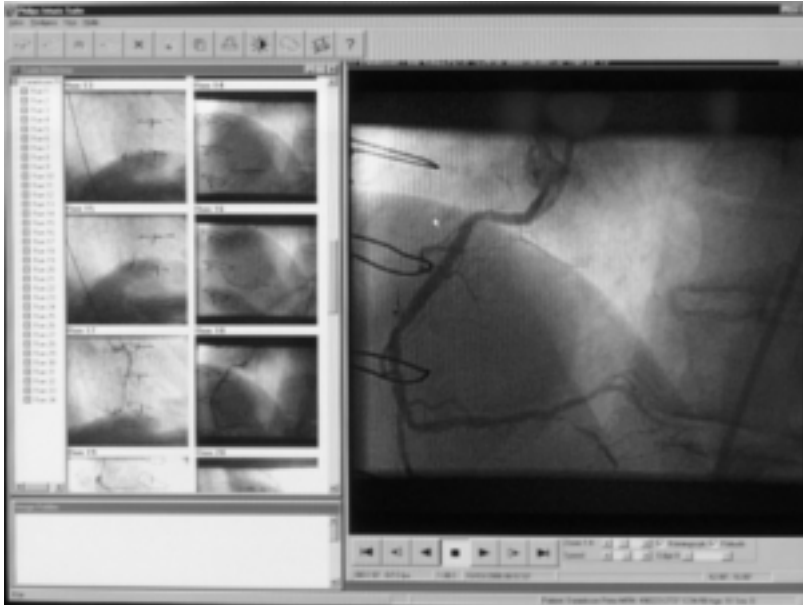


Figure 8. The front display of Case 3 at a PACS workstation.

Furthermore, the radiologist when editing the angio graphic selects four projections of the coronary arteries that displays the condition of the artery and what he has made, and prints them as a documentation. On these four graphics he has also added verbal commentaries and arrows that are highlighting the pertinent spots. (See Figures 9a-d).

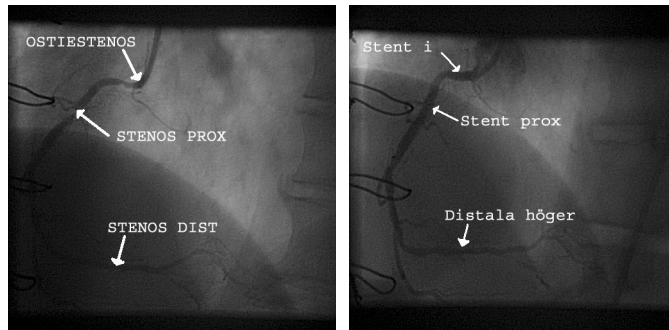


Figure 9, a-b. Edited angio graphics for external use. The Case 3 patient.

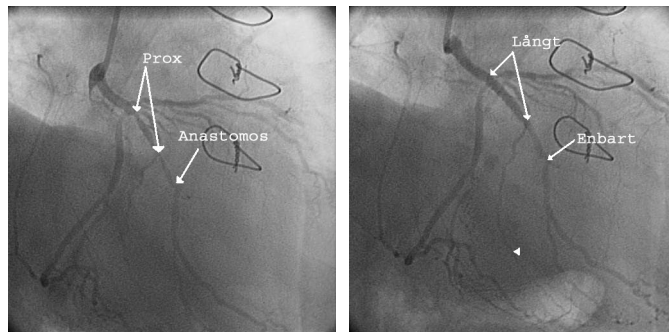


Figure 9, c-d. Edited angio graphics for external use. The Case 3 patient.

In the complete “Angio report PTCA” on the Case 3 patient the operator is giving a rather elaborated verbal description of the PTCA intervention as an addition to the graphic figure. In the verbal account is described in detail how the five balloon dilatations have been performed and what the outcomes are. (Figure 10)

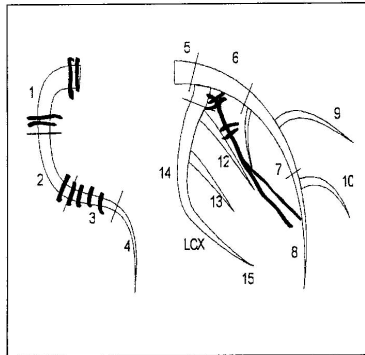
The schematized angio graphic is aimed primarily for a national statistical register. Of course it is also aimed for informing the referral doctor about the performed balloon dilatations. Note that in this case the schematized angio graphic is made more realistic by the operator (at the vessel, numbered 11 and 12, in the figure). He has made a drawing that gives a more concrete anatomical picture of the vessel of the left coronary that has got two balloon dilatations. Obviously the operator felt called upon to inform that the vessel is rather long and is ending in an elongated fork. His message is that the vessel is more than usual important for the supply of blood to the left coronary.

For me, the most salient feature of Case 3 is its “pedagogical” character. The patient came to the thorax clinic in order to be treated by balloon dilatation, a decision that had been made at the heart conference some time ago. It was a rather difficult case as the radiologist himself mentioned. Not long ago the heart conference decision would surely have been “surgery,” but now they had agreed upon trying “balloon dilatation.” Five balloon dilatations were made, of which three were strengthened with stents. Surely the referral doctor and the patient are interested in the details of the intervention. The cardiologist complies with their (imagined) request by giving a comprehensive “Angio report PTCA.” Another institutionalized receiver of the report is the team of colleagues at Thorax. For them an oral presentation is given in addition to the written records. The internal usage of the angio graphics is, as can be expected, diversified. In case the physicians are working together, and always when they are making collaborative decisions, the angio films are used. The angio films constitute the basis, the “raw material.” In other kinds of situations they use whatever representational artifact they find convenient. Still another receiver is the national PTCA register.

Angioutlåtande PTCA

Karlskrona 2000-10-03

Angio utförd: 2000-10-03
Remiss från: Ljungby



PTCA av Ost RCA: Ganska besvärlig procedur där man omedelbart får ocklusionsläge med guidekatetern. Därför är man tvungen att utföra hela hö-proceduren med "hängande" guidekateter. Det är därför nödvändigt först att göra vid ostiestenosen som fördilateras med en 2.5 mm ballong som man därefter för distalt och i samma seans dilaterar stenosen i prox huvudstam. Därefter stentas ostiet med ett 11 x 3.0 mm och prox huvudstam med ett 15 x 3.0 mm BiodivYsio-stent. Reststenos ca 0 %.
Nu har kärlet proximalt fått en bra diameter och man ser att det finns ytterligare en distal stenosis. Denna behandlas enbart med en 2.5 x 30 mm ballong med gott angiografiskt resultat.

Ptca av Angularisgren: Man börjar med att fördilatera med en 2.5 mm ballong proximalt och i anastomosen till vengraftet. Kraftig recoil varför man avslutar med att lägga ett 28 x 3.0 BiodivYsio-stent vid 12 atm. med gott resultat.

Operatör:

Summit Medical Systems: Page Number 1 of 1

Figure 10. The complete "Angio report PTCA" on the Case 3 patient.

The transformations of the angio graphics

Let me first state something obvious: the angio graphics and its transformations are part of coronary diagnostic work activity. Some decades ago, when there was no coronary angiography, coronary diagnostic work relied on other methods and procedures. The invention of the coronary angiography, and the launching of angio labs are well established improvements of the diagnostic activity. Let us see how this improvement is realized at the Karlskrona Thorax, and what role the angio graphics play here.

The rationale of Figure 11 is that “the social constitution of knowledge cannot be analyzed independently of the contexts of institutional activity in which it is generated and maintained” (Heritage 1984, p. 6). In the figure an account is made for what is happening in the Thorax Radiology Clinic, diagnostic work as well as treatment. (The parts of the cases that possibly are further treated by means of surgical operation are not accounted for in the figure.)

In the second row of the figure it can be seen that there are three institutionalized points-of-passage regarding collaborative decision making on coronary diagnostics and treatment. The most important of those “institutionalized points” is the *heart conference*. It is held everyday morning with all thorax physicians on duty participating (with the possible exception of someone occupied by emergent errand). From the beginning all patient cases were discussed at the heart conferences, but the workload compelled the team to find out new forms of decision meetings with a delegated responsibility. One of those meetings is an *afternoon conference* that takes place in the Thorax Radiology Clinic with only a few participants, but always comprising a surgeon, a radiologist, and a cardiologist. The third institutionalized meeting with the authority to make coronary diagnostic decisions is the *delegated PTCA decisions* that are made by the couple of cardiologist and radiologist on duty. They are commissioned to decide if a patient directly after an angio investigation would have a PTCA treatment, on the ground that it is evident that this would be beneficial for the patient (and provided that the patient accepts).

Let us follow our three patient diagnostics through this institutionalized order of decision making concerning coronary diagnostics.

The Case 1 patient had an angio investigation and it was ascertained by the responsible radiologist and cardiologist that it was not a case for PTCA. For the Case 2 patient however, they find, based on the angio investigation, that balloon dilatation would be an appropriate treatment, and, after consultation with the patient they made a PTCA. The Case 3 patient came to the clinic for a PTCA, and a PTCA was made, although the radiologist that did the work afterwards had the opinion that it really was a case for surgery. Before the Case 3 patient came to the clinic for the PTCA treatment, he had a prehistory at the clinic that among other things included an angio investigation. The outcome of that angio investigation was that the coronary artery was sick and had to be discussed at the heart conference. (In Figure 11 this “prehistory” for the Case 3 patient is depicted on a separate row, marked “[Case 3]”.)

As can be seen the angio graphics that are used as a central part of the work function as guidance for interventions (PTCA or surgery). Especially this is true for PTCA, because in those cases the operator has no other option than to start with the angio, and built on it for the advancement of the balloon-catheter into the right position in the coronary artery. For the surgery the guidance is important, but not crucial. One of the surgeons expressed on several occasions that he did not find the angio graphic that important. “What is important is when you are there with the heart laid bare, then you see.” (Fieldnote 001005)

Before I go to the main track, my close observations of how the angio graphics are transformed in order to produce angio reports and how they give support to PTCA interventions, I will say a few words about how the angio graphics are used as a preparation for and support at the surgical operations.

I have just told about a surgeon that claimed the angio graphics were not crucial in his own preparations for the surgical operations. There are other surgeons, however, which seem to rely more on the angio graphics as a guide for their surgery. For example, one surgeon regularly, after the presentation of the angio film for a patient that he is appointed, noted down the arteries that were to be operated, according to the decision of the heart conference team. He made his notes in a weekly operation schedule that he wore in his pocket, and he used linguistic artifacts for detailed remembering; for example he noted "LAD" or "D1" in his paper schedule, by that highlighting which parts of the coronary artery that he will give a surgery. Another surgeon drew a little sketch picturing the coronary arteries that were of immediate interest for the surgical operation.

Another use of the angio graphic is connected to the newly installed Picture Archive Communication System (PACS). Now there is a telephone connection between the OP room and the Thorax Radiology Clinic, which, for example, can be utilized when the operating surgeon will discuss the angio graphics with the radiologists. One such event occurred in September 2000. It is an event that I have not observed myself, but have been told a few days after its occurrence by the radiologist that was involved. This is his story: One of the thorax surgeons was just performing the surgical operation. At the morning heart conference he had been through the usual institutional preparation: been shown the angio film for the patient that would have the surgery. Now he had made a by-pass on one of the coronary arteries, exactly according to what was decided at the heart conference, but the problem was that he could not find the second artery that he had planned to take care of by surgical operation. He phoned the Thorax Radiology Clinic and asked the radiologist to assist him by consulting the angiofilm at the PASC workstation. I guess you already have made the operation on the vessel you are looking for, was the answer of the radiologist, the vessel you think you have been operating is very small and probably hard to find. After a short discussion the surgeon agreed that this was the case.

Now back to the cases I have been studied more carefully, cases that are about the angio graphics and PTCA. When making PTCA the angio graphics are essential. And the PTCA part of the total sum of coronary interventions has grown rapidly. When the Thorax Clinic was started in Karlskrona 1996, the projected number of PTCA was 170 per year. The year 2000 the number was estimated to be around 500. On "clean coronary interventions", that is, interventions except from aorta stenosis and ventricle problems, the team claims it has made 55% PTCA and 45% surgical operations. (Fieldnote 000928).

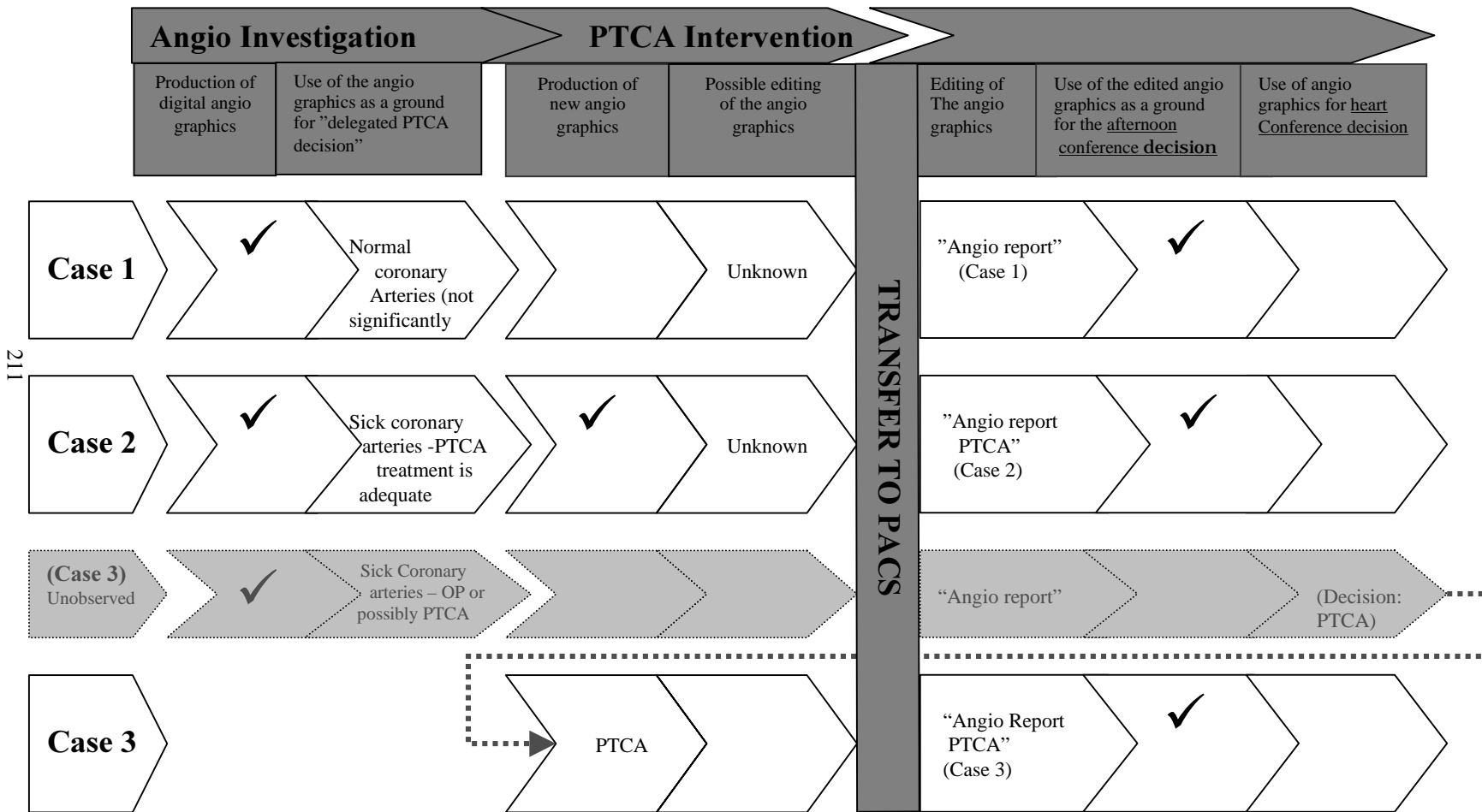


Figure 11. Institutionalized order of coronary diagnostics and PTCA treatment. Three cases.

Obviously coronary diagnostic work is collaborative work, and the collaboration is formed in many ways. Here I want to underline the teamwork conducted in making the diagnoses. To sum up, the formal decision-making is made in the *heart conference*. It is held every morning between 07.30 and 8. However, two more decision-making meetings of coronary diagnoses have been established. One is the already mentioned *afternoon conference* held in the afternoon in the thorax radiology clinic. The other is a kind of *delegated PTCA decision* organized by the cardiologist-radiologist duo on duty immediately after the angio investigation, and especially when it is followed by a decision of an ad hoc PTCA.

For the three patient cases I present in this paper, there are some common transformations in the production and usage of the angio graphics of the coronary arteries. These are the production of the original angio film, the auto-transformations made when the lab computer angio is transferred to the PACS, the editing transformations of the angio graphics made at the PACS, and the paper printed version of the angio graphics. I will discuss them in that order.

The production of the original angio film. A “leading light” angio graphic is accomplished by means of low energy X-ray and is used as a guide for catheter positioning. When the catheter is in correct position, radiopaque liquid is inserted and an x-ray film sequence is produced showing the blood flow in the artery of the working heart. Because Lab 13 have two cameras arranged in a preferred angle to the coronary artery or the ventricle, whatever is the target, each “shot” produces two angio film sequences. The standard procedure they follow is to shoot from three positions at the left artery (with two camera angles on each), which gives six film sequences, and from two positions at the right coronary (with two cameras) resulting in further four angio sequences. Often, but not as standard, they also film the left ventricle. The angio sequences are saved on the lab computer in the order they are shot. The outcome of all these sequences makes up the original angio film.

This original angio film sometimes gets a little editing. For example, such it was for the Case 1 patient, where the operator that had produced the angio film took away two sequences, one where the catheter has slipped off, and another which was a copy of an earlier projection, and besides, he adjusted the sharpness of the picture. The possible editing of the original angio film is only for taking away some “obvious noise” or “cleaning up the picture” as in the just told example. When the angio film is transferred to a permanent memory of some kind (disc, CD, or, as in the current case, the PACS), it is that saved version that represent the original angio, which is most often used in the coronary diagnostic work.

The auto-transformation when transferring to PACS. When the original angio film is transferred to a permanent memory, in the current case the PACS, it gets the status as the working angio film, that is, “*the angio*.” It is this film the physicians individually or jointly are working with in their diagnostic work. In the transfer process to PACS there is a built-in transformation of the angio graphics. However, the angio film as such is not transformed (unless one does not regard the format of the lab computer

angio film modified when it is sent to the PACS, a modification that nevertheless is without relevance for the diagnostic work studied here). What the transfer to PACS automatically generates are thumbnail stills of each angio sequence, the sum of which makes up the angio film. These thumbnail pictures were, according to my informant,⁵⁰ generated from the middle of each angio film sequence. The idea is that they serve as memory aids to facilitate orientation and make it easier to find the events you are interested in on the angio film. (In Figure 8 some of the thumbnail pictures for the Case 3 patient can be seen; they form two columns to the left of the display.) At the working stations connected to PACS, the physicians are working with the angio film. They look it through carefully, and the operator always includes his pair-colleague in the collaborative decision making process to get a preliminary diagnosis that in due time will be presented at the heart conference.⁵¹

Edited transformations of the angio graphics. As I have stressed, the angio film is basic in the work with the angio representations. It is the most comprehensive material to use so to say. When the basic and close diagnostic work is conducted, the angio film is always used. By that I do not say that the angio is standing alone, because it does not. It is complemented by a lot of other means.

Electronic still graphics turned into paper format. An angio film, however, is not a very handy artifact. It is not easy to overlay with (other) inscriptions, and it is not easy to get access to on-the-fly. For that reason stills of the angio are designed, redesigned and used. They are produced as electronic graphics, and in the end they are converted into paper format. Figures 3, 5, 6, 9, and 10 show examples of such angio graphics. As can be seen, especially the Case 3 patient did generate a good many of angio-graphic stills. The case was, as the operator expressed himself, “rather difficult” and the operator obviously felt called upon to state reasons for the variegated balloon dilatations and the use of the stents.

As a summing up one can say that the graphic artifacts are fabricated of the physicians in the radiology clinic while considering different uses and different target audiences. Diverse formats of a graphic representation (paper, digital) are integrated. And graphics are combined with text. Almost never are graphic pictures good enough as standing alone graphics. In the three cases discussed in the paper no angio graphics are presented only as graphics, they are constantly backed up with written accounts. In some of the cases (Case 1 and 2) the verbal companions are shortly held and standardized. In Case 3, the “rather difficult” case, the enclosed verbal account is extensive and detailed.

⁵⁰ My informant has been the driving force among the thorax physicians in introducing new technology in their diagnostic work.

⁵¹ This presentation can be accomplished in two ways. One way is a presentation at the afternoon conference with the angio film as a central artifact. This presentation is followed by a presentation based on oral saying and written documentation at the “real” heart conference the next morning. Unless the case is complicated or interested for some other reasons, the angio film is not presented. The other way is to present the case directly at the heart conference. When that is the case, the angio film is presented.

Discussion

In this section I am going to deal with how the angiographic artifacts are related to instruction (and learning). I start with a discussion of methods for “making work visible” (Suchman 1995), and especially how they apply to the study of coronary diagnostics presented in the paper.

Making work visible

A key task for researchers of work practice or work activities is to “make work visible” (Suchman) or the “visibilization of work” (Engeström 1999). One reason for the importance of making work visible is that “how people work is one of the best kept secrets” (to shorten a quote from sociologist David Wellman, quoted by Suchman, 1995). As work activities are central in human life, it is reasonable to have them described, to get to know them, and to learn to master them.

Professionals are making the work visible for themselves as an aspect of their work activity. Donald Schön (1983) uses the terms reflection-in-action and reflection-on-action to describe this phenomenon. In the vocabulary of cultural-historical activity theory one can say that what the professionals are doing are working on, being guided by, and making explorations of *the object of the work activity*.

The object of work is both a concrete object to work on and a projected outcome. It is “both something given and something anticipated, projected, transformed, and achieved” as Engeström (1990, p. 181) has pointed out. He also has stressed the dependency between the object of work and the tools used in the work activity: “In the transformation of the object, also the tools, or mediating artifacts, are transformed.” (ibid.) On the one hand, new tools make possible development and expansion of the activity. By that the object of work is changed – there are new things to work on, there are new transformations possible, and there are new possible outcomes. Conceive for example how the new medical technology introduced in coronary diagnostics – more flexible and handy catheters, stents, better image processing systems, etceteras – has changed the activity of coronary diagnostic work. On the other hand, the changed activity feeds back on the tools of work, which ones to use and how to use them.

I will take for granted that researchers and professionals do similar things in their work activities. We are thus talking both about the methods the researchers and the methods the professionals are using in their work. They use “techniques of visualization” (...) “to *make one see* what is invisible” (Francoise Bastide, 1988, p. 188-189). From the perspective of cultural-historical activity theory the *focus* of any work activity is the *object of work*. From such a perspective attention is called to the evolving character of the object of work, which is bridging between the material,

traditional, sturdy side of “real” work and the imagined, projected outline of possible work.

In both research and professional work activity, there are needs for documentation and inscriptions. Researchers and professionals alike need to warrant objectivity in the form of intersubjectivity, and they need to convince their team, themselves, benefactors, and hopefully even critics. In that process they have to bring evidence. As a matter of fact, professional work as well as research can be characterized in the way Latour and Wolgar (1986/1979, p. 88) describe “laboratory activity,” namely as “the organisation of persuasion through literary inscription.”

Making work visible means that researchers and professionals make visible what was not visible beforehand. In other words, they understand and master their work better than beforehand, they transform their object of work. The methods they use to make their work visible are primarily internally motivated methods deployed in order to better get the work done. However, when the practitioners themselves, by some means, have transformed their work activity, and in a sense made it more visible for themselves, the same methods can also be used to inform others about their work. At least this was the case in the coronary diagnostic work discussed in this paper. “Making work visible” may therefore also mean that I, as a researcher of the work activity of the professionals, here coronary diagnostic work, will be able to make the professionals’ work activity – my object of research – visible.

As can be seen, I am suggesting that I as a researcher have to build my description and analysis on the professionals’ methods to make their own work visible. In other words, in order to understand the professionals’ work I have to find out their way of “visibilization” of their object of work. If this is a general rule for the study of professional work I do not know, but I would be surprised if researchers could “bypass” members’ methods for finding their object of work.⁵² To sum up. Professionals master their work, and central in mastering the work is the mastering of the object of work. One part of this mastering is to make work visible. Researchers of the professionals’ work activity describe their work, and in the description of the their work activity the researcher has to focus on their ways of making work visible.

For the clinicians at Thorax, the angio graphics make the work more visible than before. The deployment of new artifacts, the angio graphics, and the establishment of the heart conference and the angio lab have changed the circumstances for coronary clinical work. What we can see here is – as Latour (1988, p. 42) has pointed out as an

⁵² Thus, for example, Gunnel Andersdotter (1999) in describing the work of software designers, makes the point that their program writing activity makes the standard paper page and the text line pivotal. The pages and the lines mediate the program that is oriented to people and their mutual understanding as well as the program as something a computer can read. This is what is important for the software designers she has studied, and consequently it is important for her as a researcher describing their work activity.

aspect of laboratory work⁵³ - “the staging of a scenography in which attention is focused on one set of dramatized inscriptions.” The angio lab and the heart conference setting are working “like a giant optical device that create a new laboratory, a new type of vision, and a new phenomena to look at.” (ibid.) What we can see in the clinical coronary work is that a physically new laboratory is created, the angio lab, which is part of the larger laboratory that is established as a result of work practices and inscriptions. There is also a new type of vision: the angio graphics are there literary to inspect. The result is that the angio lab makes coronary diagnostic work visible in a way unseen until now. This is what science demand and professionals know and promote. You need evidence on phenomena that are not well known. As Charles Goodwin (1994) reminds us: “professional vision” is what constitutes a substantial part of work activity. From a natural science point of view this is to be desired because science makes vision the primary organ of knowledge.

Against such a position I can imagine objections à la Walter Ong (1982) and perhaps also Jesper Svenbro (1993) who focus on the consequences of making written language an important form of communication: Vision, graphics, inscriptions, and written texts – as if vision is all that is in the human sensorium! An answer to such an objection can be what I have just mentioned, namely that in one sense science makes vision the primary organ of knowledge. In fact, in science you must discuss with other people, you must persuade them and try to come to a mutual agreement. That makes science a democratic device, and vision is a sense that promotes discussions with critics and non-believers without involving them in a lengthy practice (which perhaps need to be conducted in far-away places). When you bring evidence on paper or other suitable forms, it is possible to have an intellectual discussion and perhaps a settlement “here and now.” But in another sense, and here the critics are right, “seeing” is an activity that involves all kind of senses, not only vision. From that critical perspective, vision as *the* source of knowledge is an one-sidedness that writing seems to stimulate, perhaps resulting in the idea that visual representations “in the head” are synonymous with grasping a phenomenon.

Like Lynch (1988) I am interested in the idea of *representation as a cultural-historical concept*, and not as a restricted individualistic cognitive concept. From such a perspective the image of the retina is not the interesting thing, but the “externalized retina”: “the graphic and instrumental fields upon which the scientific image is impressed and circulated” (Lynch, *ibid.*, p. 154). Of course, I do not doubt that the individual physicians are thinking when performing coronary diagnostic work. It makes sense to say (although the expression is far from enjoyable) that there is “thinking in their heads”, and that they as individuals see things and know things. My focus however is on their collaborative efforts that are motivated by the object of the activity, and which are artifact-mediated. In that perspective “seeing” and “representation” are the production of pictures and texts, the use of those artifacts, the

⁵³ Laboratory work has a very fundamental character for Latour, because as he says: “For the world to become knowable, it must become a laboratory” (Latour, 1999, p. 43). And of course, laboratory work is not laboratory work restricted to a natural science lab.

naturally occurring human interaction of making them intelligible for colleagues and other people. “Seeing a graphic representation” is not primarily a psychological phenomenon. In a cultural-historical perspective, it is primarily interpersonal, and only secondarily it is intra-psychological. To “see” what a graphic artifact “represents” is not a natural capability, but a cultural and historical one. When the medical technology of ultrasound scanning was realized, “seeing with sound” became possible. But it was a long and difficult process as Yoxen (1989) has shown, and even when developed, it is a seeing that is enacted within the framework of an activity system or in a community of practice - you are not bowling alone. It is also a seeing that is artifact-mediated and often in the form of inscriptions. When Latour reminds us: “Thinking is hand-work, as Heidegger said, but what is in the hand are inscriptions” (Latour, 1988, p. 46), I would like to re-remind that we must not forget that representing is part of an activity that is object-oriented.

The machinery of seeing

This paper has focused on the role a central graphic artifact, the angio picture, is playing in coronary diagnostic work. Constructing and using images as an important aspect of work thus is what I concentrate on. Therefore, my choice of focus is different from the focus that Amann and Knorr Cetina (1988) had when they investigated scientific seeing. When they discuss how participants in a research group use autoradiograph films, they, in a first step, claim that “seeing is work”. In next step they go further and pose the question: “But what sort of work?” (p. 90). In an interesting way they show how “the machinery of seeing is talk” and how the “image analyzing talk is attached to objects.” What Amann and Knorr Cetina show is, in my activity-theoretical understanding, the object-orientedness of work. It includes, as they are underlining, exchanges about an object and also exchanges with an object. They found, as we have seen, that “the machinery of seeing is talk.” My results are compatible with theirs. Talk about the pictures is essential also in the work practice I have studied, which I hope has been clear from my case studies. The angio graphics “are talking”, but they do not speak for themselves. Only in a community of practice, only as part of a work activity do the graphics render meaning.

Therefore, to ask what meaning a graphic artifact *has* is not a fruitful question. You better ask *how* the artifact renders meaning. In an episode I have from my fieldwork, one of the radiologists, J, had prepared his presentation of the angio films by putting the icons that are representing sequences of the films in appropriate order on the workstation display in the heart conference room. Those films had been prepared in the angio lab, now they were to be examined by the entire Thorax team. Suppose the films were examined individually by each physician. I guess their interpretation of the case, their diagnoses, would have a high degree of interjudgeability. If the artifacts would be able to speak for themselves, the addition of individual and separated assessments perhaps would have been sufficient. However, in the thorax practice this is not enough. There need to be a joint decision, a more communal meaning making process. The episode that I am telling may illustrate how that can occur. With the

exception of one trait, the outstanding “pedagogical” character, this example is similar to what is going on in workday practice when radiologists or cardiologists are “presenting the case” in the heart conference. The radiologist had the day before got remarks that he was too fast in his presentation of the angio sequences. His colleagues had difficulties to follow, or got lost. The next day the radiologist changed his way of presentation. He slowed down the speed of his performance, and in addition, he had invented a new way of doing the presentation. First he showed a still picture that displayed the dubious parts of the arteries that he wanted to focus on in his presentation, and then he followed up by going through film sequences that showed more dubious parts in a more relaxed pace. This way of making the presentation of the angio films was appreciated by his colleagues. But whatever the way, “pedagogical” in a more narrow sense or not, as long as it is understandable, a story is being told, a story that had started in the angio lab, if not earlier. The angiographics were transformed to be more informative to diverse audiences, and those transformations were guided by the questions *What is?*, and *What to do?* The cardiologist’s way of organizing the interaction at the heart conference, e.g. by pointing out the possible problematic parts of the coronary artery on the still picture before showing the film, was a step forward in the process of rendering meaning to the graphic artifacts.

The angio sequences can be said to show what they show for a professionally trained eye. In the institutionalized activity, however, all angio sequences are not given the same attention and are not being inspected evenly by all members. On the contrary, the activity in the clinic produces patterns, a practical order that make it possible to get the job done given the practical circumstances. Not all parts of the angio films can be given equal attention of all physicians. There is a division of labor where one or two of the team members do the more close and time-consuming preparatory work. By that they make it easier for their colleagues to give their opinion – and even correct the one that submits the report– and be part of the robust collaborative decision making activity on equal terms.

Vision and inscriptions are paramount in scientific and professional work. The studies I have referred to in the paper are only a small part of the state of the art. Many studies have shown, what I also have found in the present study, that there is a lot of work in all modalities to produce and use the graphics or other inscriptions. Talk is of course involved, lot of talk, which give rise to Amann and Knorr Cetina’s expression “The machinery of seeing is talk!” although they showed that it is more to it than talk. Isolated graphics and inscriptions are inert and superficial, but as part of work activities they may turn into mighty means. If we will have a summing up slogan, we better return to the position Amann and Knorr Cetina started from, and state that *the machinery of seeing is work*.

In order to influence or persuade other people you have to instruct what there is to see and how it ought to be seen. That is, *seeing presupposes instruction*. There are several ways of instructing. Talk is important, and talk-at-work was regarded by Amann and Knorr Cetina, as we have seen, as the machinery of seeing. Talk at work

encompasses, besides talking, showing, demonstrating, highlighting, in short what can be called “bodily based indexicality.” But through my research I have become inclined to think that also artifacts can be instructive. In the present paper I have made an attempt to find out if, and how a graphical artifact, the “angio”, is instructive.

Artifacts can be distinguished in various ways. For example, Vygotsky and Luria (1984/1931) made a distinction between symbols and tools, and within activity-theoretical and sociocultural research approaches this distinction is taken up and rings the changes on the theme. Wertsch (1991, p. 33-34) distinguishes between “psychological tools” and “technical tools,” and Resnick, Pontecorvo, and Säljö (1997, p. 3) make a differentiation, “for analytical purposes,” between “intellectual (mental) tools and physical (practical) tools.” As pointed out above, in my investigations of instruction and learning in coronary diagnostic work I have found it fruitful to discriminate between three kinds of artifacts: linguistic, physical-material, and graphical (Sutter 2000b).

Conclusion: Instructive artifacts

In this study about medical interaction a taken for granted is that any human activity is artifact-mediated and object-oriented. The focus of the study is on the production and use of angio graphics in clinical coronary work. The kind of medical interaction being discussed is actually a series of interactions covering many hours and taking place in different places within the thorax clinic. Various assemblies of staff are involved, as well as a multiplicity of artifacts that are secondary in relation to the one that has come to be the focal artifact, the angio graphic. Thus, in the present study one kind of artifact, the angiographic artifact has been in focus: its production, redesign, and use.

A hint of what makes artifacts so special can be read out from Wartofsky’s claim that it is (1979, p. 201): “this ability to *represent an action* by symbolic means which generates a distinctive class of artifacts, which we may call *representations*.” What he stresses is that artifacts have the ability to represent an action, and when this representation is accomplished through symbolic means, the artifacts are representational, or comprise what Wartofsky calls “secondary” artifacts. Wartofsky’s explication of course raises questions: Where does the ability to represent an action come from? Does the ability come from the artifacts themselves, from the designer of the artifacts, or from the user of the artifact? Further, and more important in the context of the present paper: Are graphic artifacts only accounts of past activities, or are they also future-oriented suggestions of what to do, i.e. are they or can they be instructive?

Wartofsky suggests that “The cognitive artifacts we create are models: representations to ourselves of what we do, of what we want, and of what we hope for. The model is not, therefore, simply a reflection or copy of some state of affairs, but beyond this, a

putative mode of action, a representation of prospective practice, or of acquired modes of action.” (1979, p. xv). This is what Wartofsky has suggested. My empirical study of the use of angiographic artifacts in coronary diagnostic work does not contradict his suggestion.

The research question I pose in this paper is if the angio graphic reasonably can be regarded as an instructive artifact, and if so, in what ways? So what is the answer? My short answer is that they do, by being designed, redesigned and used as graphic representations. *They are made instructive*. They are redesigned in several steps, for different purposes and for diverse users. There are at least four categories of users of the angio lab’s creations of angio graphics, which the redesigners of the angio artifacts are working to inform and instruct, namely the colleagues at the lab, the surgeons at thorax, the doctors who have referred the patients, and national statistical documentation center.⁵⁴

Artifacts are made instructive. They are created in such a way that oneself or others, in a next step, can continue the work activity. In the most obvious way this can be done by means of “affordances” or “sociomaterial structures” (Østerberg 1985), physically implanted directives how to act in the situation. This is also true for the graphic artifact I have studied in this paper, the angio. Artifacts are instructive, they echo a past activity: “This is what we have done, come on, take on and continue the work!” And as we have seen, the artifacts are further transformed, and in these transformations there are intentions, focuses on what the work is aiming at. The transformations are providing signs and tools.

It may look like artifacts are active, are agents, but in my opinion, this is only how it looks superficially. Rather, the artifacts are “maintenance objects” for past activity. With help of them we can make use of earlier actions (at least partially). The crucial point then, I think, is that by using the artifacts we incorporate them in the activity of which we are a part. In one way it is magic – dead things are awoken to life! But if it is magic, it is the magic of everyday life, something that happens again and again, all the time.

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⁵⁴ The person-patients are also informed, but as far as I have seen the artifacts are not transformed for them. The patients get to know the graphic artifacts only mediated by a physician, by his or her face-to-face talk, and the pedagogic explanation the doctors are offering.

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Paper V

Berthel Sutter. Instructional artifacts. Paper accepted for the Computer Supported Cooperative Learning Conference (CSCL2001), Boulder, Colorado, 7-11 January 2002.

Instructional artifacts

Abstract. This paper addresses the question of attribution of agency to artifacts. Taking an activity-theoretical perspective, I argue that artifacts are used to guide actions. In other words, I claim that artifacts have instructional impact. The introductory part of the paper is an account of how three kinds of artifacts - physical artifacts, linguistic representations, and graphic representations – are instructionally used in coronary diagnostic work. The main part of the paper is an empirical exploration of how a fourth kind of artifact, organization of work, is instructionally used. The empirical case analyzed involves clinical diagnostic work conducted as a video-mediated conference between two collaborating diagnostic sub-teams, one of which had made the coronary investigation by means of coronary angiography, while the other was to take actions in the form of by-pass surgery or balloon dilatation. In the concluding sections, I discuss in what way it makes sense to say that organization of work and other artifacts have instructional properties.

Introduction

The role of artifacts, material and ideal, the role of the body as a source of knowledge, and the role of the “situatedness” of action and learning has met a growing interest in research approaches dealing with the new information and communication technologies (ICT). The reason is probably that the material of ICT, a “material without characteristics” (Löwgren & Stolterman 1998) forces us to sharpen our attention for matter, bodies, and local circumstances. Whatever the reasons, at least within some research fields and approaches, there is now a new attention to those phenomena. My paper also addresses the phenomena by exploring possible instructive properties of artifacts.

In my opinion, instruction, in diverse forms, is an aspect of collaborative work. Instruction, I claim, like all kinds of activity, has two forms of existence, the artifacts and the activity of the subject (Enerstvedt, 1982, p. 179). Another way to put it is to say that there are live praxis and inert artifacts (Sartre 1960), or that human activity has a “live” (subjective) side and a “frozen” (objective) side (Lektorsky 1982; Popper 1972), or that there is a duality of participation and reification (Wenger 1998). In my opinion, all these formulations can be read as attempts to grasp the basis of human activity (“Gegenständliche Tätigkeit”).

As said, I will approach the distinction of the inert and the live aspects of activity from the perspective of instruction and collaborative work. In earlier studies on clinical diagnostic work (Sutter 2000a, b), I have come to the conclusion that the representational aspects of artifacts, which Wartofsky (1979) calls “secondary artifacts,” can be described as artifact-bound instruction. To “represent” means to “instruct.” Artifacts are instructive. I have discerned three kinds of artifact-bound

instruction - physical-artifact representations, linguistic representations, and graphic representations. I will illustrate them in turn. An example of a linguistic artifact used in coronary diagnostics is a “coding scheme” (category and event relevant for a group of professionals) (Goodwin 1994). One such coding scheme can be called “Fifty percent,” a shorthand for a risk criterion based on experience. It refers to a coronary artery where the diameter of a stenosed part of a blood-vessel is measured to 50% or less of the normal artery. If the criterion is met, the physicians are expected to take measures or explain in view of the circumstances why they do not. The coding scheme “Fifty Percent” is a linguistic artifact used in oral and written forms in this community of diagnostic practice to say “we take measure when the stenosis is 50% or more.”

We can take an artifact associated to the “Fifty Percent” coding scheme to illustrate a graphic representation. A standard graphic representation that is used in the heart conference is a schematized drawing of each patient’s coronary arteries. If there are stenosed or blocked parts, they are marked with a line and a number that indicates the percentage of the stenosis. Thus, the graphic representation gives a comprehensive picture of the patient’s heart and instructively points out what parts to inspect and how they are to be evaluated as a single condition. (For a detailed study of the production and use of the angio graphic, see Sutter 2001.)

I am sure the reader can imagine many physical artifacts that are used in this clinical diagnostic work. One is a special device that the radiologist is maneuvering when presenting and commenting on the angio video at the heart conference. With the help of the special device the radiologist controls a video display pointer in the form of an arrow, with which he can pinpoint details and comment on them. The special device has instructive affordances offering how it should be handled.

To sum up, I operate with a conception of mutual dependency of inert artifacts and live actions, or in other words, of artifact-bound instruction by means of physical-artifact representations (e.g. affordances), linguistic representations, graphic representations, and corresponding instructional praxis when the artifacts are put into use. Based on my empirical investigations I have come to realize that there also are “organizational representations.” It is the specific purpose of this paper to consider what organizational representation may mean.

Artifacts are often imagined as sustainable and robust. “Technology is society made durable”, to use Latour’s expression (Latour 1991). But of course artifacts also can be fragile, unstable, transitory – before they are abandoned or transformed into more durable artifacts. The organizational artifact that I present here is fragile, and it was abandoned as part of organizing the thorax clinic at Karlskrona. Nevertheless, it is an example that displays how an organizational artifact may function before it has been stabilized and turned into “infrastructure” (Bowker and Star 1999) or part of the organizational base (“division of labor,” “community,” and “rules” in Engeström’s

model of an activity system). The taken-for-grantedness of the artifact is not yet established and, thus, the artifact has not turned invisible.⁵⁵

The overall aim of this paper is to argue that instruction is built into artifacts, and that this built-in property is used in collaborative work. The more specific aim is to explore how one kind of artifact, organization of work, is used as a heuristic device in a work setting of collaborative clinical diagnoses. More specifically, I claim that organizations have an instructional impact on work.

Background

The specific case I will discuss is the organization of coronary diagnostic work as it has been developed at Blekinge hospital in Karlskrona, Sweden. Only lately coronary diagnostic work has become an issue to be dealt with locally in Karlskrona. During the 1980's and up to 1993, patients suspected to suffer from coronary illness were sent from the regional hospital to the University Clinic at Lund, some hundred kilometers away. In 1993, primarily of economic reasons, the Karlskrona hospital decided to conduct the coronary angiography on patients from the county (and a neighboring county) and then let the cardiologist and radiologist from Karlskrona take part in the heart conferences that were held weekly in Lund, at the thorax clinic. At the same time, technological deployment made it possible, first, to test, and later on to conduct regularly heart conferences between the Karlskrona team and the Lund team by means of a video conference facility equipped with a special video within the video conference. This special video made it possible for the two sub-teams simultaneously to watch and discuss the X-ray videotape of the patient coronary, which always was presented by a Karlskrona radiologist.

Such was the background to the appearance of a uniquely organized coronary diagnostic activity. For a short period of three years, 1993-1996, special circumstances concerning coronary diagnostics and surgery in the south of Sweden led to the emergence of a distributed clinical heart conference. (For details, see Kehler et al. 1996, and Sutter 1999.) At the clinical heart conference a number of patient cases were presented to and discussed among surgeons, radiologists, and cardiologists, with the aim to make a joint diagnosis for future treatment. A central input in the heart conference was the video-taped coronary angiography of the patient, i.e. a short video sequence of the X-rayed coronary in action. It is aspects of this distributed and telemediated clinical diagnostic work that I discuss in this paper.

For the sake of comprehensiveness, I need to mention that the next step in the development of the local coronary diagnostic work was the establishment of a thorax clinic at the Karlskrona hospital. In December 1996 the unique telemedicine project that had been launched for full three years came to an end. The telemediated and

⁵⁵ In Sutter (2001) I have described two organizational artifacts – a cardiologist-radiologist dyad and an afternoon mini heart conference – which have been made more durable at the radiology unit of the thorax clinic.

distributed heart conference was replaced by a regular one, locally organized within the thorax clinic.

The organizational forms of the heart conferences corresponding to the phases in the development of coronary diagnostic work at the Karlskrona hospital of course varied. However, the organizations displayed one feature in common, namely that the organizational form had an instructional impact on the collaborative work practice. In another paper I have tried to show how it works in the thorax clinic (Sutter 2001). In this paper I will restrict my detailed account to the organization of work that the video-mediated heart conference made both necessary and possible.

The coronary diagnostic work I have been studying is saturated with computer support for collaborative learning, but the CS and CL parts are so embedded in the work activity that they may go unnoticed. Some decades ago, when computer use was not so frequent, CSCL was established as a special field of research and artifact innovations (Koschmann 1996). Now when computers are ubiquitous we do not primarily need specially designed gadgets (“computer support”) to promote learning; to a great extent they are already available. What we need, in my opinion, is to research how collaborative learning is carried through and how artifacts of all kinds interweave in productive work and learning activities. This is how I see the context of my study.

Organizing work – three empirical examples

The empirical part of the paper will address the organizing and use of a patient queue in distributed clinical diagnostic work. The queue of the patient-cases stems from the fact that only one patient case can be discussed at a time, and that about 10-15 cases have to be presented at each heart conference. The imposed order is a way of coordinating the actions of the physicians, and particularly the actions between the two sub-teams, the cardiologist and radiologist in Karlskrona, and the surgeon and the radiologist in Lund. It might be the case that the imposed order is just a casual order, but most often this is not the case. Instead, the ordering takes into account that a radiologist in Lund needs to be present at the patient cases where balloon dilatation or “PTCA” (an acronym the members themselves most often use in their internal talk) is the expected outcome of the diagnosis. At the time of the study the radiologists were the specialists that made the PTCA interventions, and therefore the possible PTCA patient cases (normally) were placed first among the patient cases that were to be presented. The rationale of this “queuing procedure” is that when the PTCA candidates have been presented the radiologists could leave the heart conference and continue with their other duties.

My method in this study is to pick out three video-documented weekly held heart conferences (out of 17 that I have recorded from March 1995 to August 1996). In these three cases the use of the queue-organization or the presentation order of the patients is obvious also for me as an observer because such usage was expressly

stated by the members themselves. The first reason why I have picked out these cases is that they show that the organization works as an instructive artifact. The second reason is that they throw light on the relation between inert artifacts and live actions, and thus problemize my idea that artifacts are instructive. The heart conferences from which I will use data here were held in January, February, and August 1996.

I will present data from the conference, first, by giving the structure of the three conferences, and then by discussing some details of special interest for the concern of this paper.

Let us start with a first glance at Figure 1. It shows that the number of patients (P) that have been discussed at the selected heart conferences is between 10 and 17. It is possible to discern a pattern in each of the conferences: In the site in Lund there are, at the start of the conference, other physicians present in addition to the surgeon. These physicians (in the examples, a radiologist and, in two of the cases, also a cardiologist) leave the conference before it is finished. In the February conference it happens after the first patient has been discussed, in the January conference after Patient 7, and in the August conference after Patient 4. *Before their leave*, the decisions made of what action to take are (with few exceptions that I will discuss in a moment) PTCA or balloon dilatation. This is what happened in 6 of 7 cases in the January conference, 1 of 1 case in the February conference, and 4 of 4 cases in the August conference. *After their leave*, the decision pattern displays a similar uniformity in favor of surgery (7 of 10 in January, 10 of 13 in February, and 4 of 6 in August). The “few exceptions” I just mentioned comprise Patient 1 (January), where the decision was to make a new investigation; 4 patients that had “normal coronaries” according to the Karlskrona team, assessments that were accepted from their words by the team at Lund (i.e. no video film was presented); Patient 8 (February) who was “already presented,” namely at a demonstration of the videoconferencing technology some days before, and finally, there is a PTCA decision at each conference breaking the rule (P10, P9, and P7, respectively). These latter exceptions are of special interest in this study, and I will discuss them in detail below.

So far I have given an account of the overall pattern of organization of work and which decisions were made that can be seen in Figure 1: There is an organization of the patient order to be presented. This order at the same time contains a “hypothesis” of the Karlskrona team, a hypothesis of which patients will get balloon dilatation as a recommended move and which will have surgery. In my opinion, instruction is taking place here, and it can be stated: “Take into consideration our preliminary decisions!” or “Let us discuss our suggestions!” or “Mind the indications favoring PTCA!”

When I talk about instruction, I have in mind instruction as *actions* or strings of actions as well as instruction as a specific *activity*. One sort of instruction as activity is school teaching (at least in its best forms), where the grown up generations teach the new generation what they hold important (and which is not learned “spontaneously”). Thus, school instruction has as its objective “learning the given

new” (“new” for the children, and “given” for the culture at issue) (e.g. Engeström 1987).

Heart conference January 1996	Heart conference February 1996	Heart conference August 1996
Present at Lund: Surgeon, radiologist	Present at Lund: Surgeon, radiologist, cardiologist	Present at Lund: Surgeon, radiologist, cardiologist
P1: a combined heart- and kidney case. Decision: Make an angiography	P1: PTCA? Check at Lund	P1: PTCA
	<i>Radiologist and cardiologist leave</i>	
P2: PTCA	P2: OP	P2: PTCA
P3: PTCA	P3: OP	P3: PTCA
P4: PTCA	P4: OP	P4: PTCA
		<i>Radiologist and cardiologist leave</i>
P5: PTCA	P5: OP	P5: OP
P6: PTCA	P6: OP	P6: OP
P7: PTCA? Check at Lund	P7: “normal coronaries”	P7: PTCA
Radiologist leaves		
P8: OP	P8: “already presented”	P8: OP
P9: “normal coronaries”	P9: PTCA	P9: “normal coronaries”
P10: PTCA	P10: OP	P10: OP
P11: OP	P11: OP	
P12: “normal coronaries”	P12: OP	
P13: OP	P13: OP	
P14: OP	P14: OP	
P15: OP		
P16: OP		
P17: OP		

Figure 1. Organization of a patient queue in three heart conferences: “expected outcome” and real outcome of the collaborative decisions. (*Legend:* P1= patient case 1, OP=surgery, PTCA=balloon dilatation, PTCA?=postponed decision (the team in Lund will check the case more thoroughly later), “normal coronaries” = what the coronary angiography investigation showed according to the Karlskrona team, an assessment that was accepted by Lund on their words, the video film was not presented.)

Another kind of activity of instruction is, I believe, the kind of mutual coaching that colleagues are doing when supporting each other in collaborative work. I call this kind of instruction “co-coaching.” Instruction here is connected to development of the

work activity, and to learning of what is new in the society. Nobody has a priory position as “instructor” or “learner,” the positions change depending on circumstance. It is about mutual instruction-*and*-learning, or “co-coaching.” In other words, instruction is a specific activity with the motive to assist a (collective or individual) subject’s self-organized activity to change its way of working, and it can take the form of, for example, school instruction or co-coaching at work.

It is common today to say that learning occurs whenever one is taking part of a community of practice or is active within a learning environment. In a way, I agree. Learning actions are part of every activity. Not only learning actions, but also instructional actions are involved. Instruction and learning go together. Therefore, instructional actions and learning as actions are inseparable from human activity. Instruction as a general activity has nicely been described by ethnomethodology. Instruction in that sense is what ethnomethodology calls members’ methods of “making instructably observable” (Garfinkel 1996). When interacting, people point out aspect of the world they pay attention to and want others to pay attention to. Thus, whenever there is interaction, “making instructably observable” is an aspect of the interaction. I summarize my activity approach to instruction and learning in Figure 2.

	INSTRUCTION	LEARNING
GENERAL ACTIVITY	Members’ method: “making instructably observable” (Garfinkel 1996)	Side effects of every activity
SPECIFIC ACTIVITY	e.g. school instruction; or co-coaching at coronary diagnostic work	Learning activity (a subject’s – collective or individual – self-organized activity to change its way of working)

Figure 2. Instruction and learning as general and specific activity.

Now, let us continue and look more in detail on the three heart conferences that I have chosen as empirical material. In Figure 1 there are two features addressed in this paper. The first feature is organization of work, on a low level so to say⁵⁶, the arrangement of the order the patients are to be presented. There was a “list” order of patients, an order that is rearranged before or in the beginning of the heart conference.

⁵⁶ Organization of work is a sort of classification and standardization (Bowker and Star 1999) with consequence for people’s handling and thinking. The organization of work is instructional in a sense that may be regarded as trivial. Trivial or not, what I intend to do is to see how organization of work is *used* as part of activity of work. On higher level of organizations of work this can be difficult to show at the same time as it is trivially evident that division of labor, compartmentalization, and other kinds of groupings are of great importance.

The arrangements take into account two factors: (1) patients that according to the preliminary decision of the Karlskrona team may be treated by means of balloon dilatation (PTCA), and (2) the time interval during the fixed heart conference meeting time when radiologist(s), and often also cardiologist(s), are able to attend (most often in the beginning of the conference). The outcomes of three of these rearrangements can be inspected in Figure 1. What we can see is thus an arrangement of things, the building of an organizational artifact, which is expected to support the work practice. The second feature which is addressed in the paper is the strings of actions that make up the collaborative decision, and where the decision at the same time “deviate from the plan.” It is, in other words, the open nature of actions and the collaborative diagnostic work that are made visible here.

Now we move to a more detailed analyses in which I focus on the two features of work that are being dealt with in this paper, work organization as an instructional artifact, and the relation between inert artifacts and live actions as part of an ongoing activity. I do so by giving an account of the interactions of relevance for the local organizing of work, and for the “unexpected decisions” (at least for the Karlskrona team) that were the result of the collaborative diagnostic work. The presentation will start with the February conference, followed by the August conference, and finally the January conference. The reason for this order is that the January conference is rather complex, and is easier to understand if we have looked at the other two conferences first.

Heart conference, February 1996

The first patient is a possible PTCA candidate. “It is number four on the list,” explains the Karlskrona cardiologist who presents the patient history, by way of helping the Lund colleagues to find the patient journal in the paper stack in front of them. The list mentioned by the cardiologist is the patients ordered in the order they underwent angiography in Karlskrona. Now the order is rearranged in such a way that patients that possibly may have balloon dilatation are discussed first. In this case, there is only one PTCA candidate. “Then I think we only have old jalopies,” said the radiologist, meaning that the patients were so sick that only surgery was an alternative. After that, two persons, the cardiologist and the radiologist, leave the studio at Lund. The presenting cardiologist in Karlskrona continues: “Then we start from the beginning [of the list] – with the ‘old jalopies’ if one says so.” As expected the following patients all got a surgery decision, except in one case, patient 9, for whom PTCA was recommended. It was a decision that was suggested by the surgeon, and it is obvious that it was surprising for Karlskrona team, although they quickly did adapt to the surgeon’s proposal:

Surgeon	Yes, should one make PTCA on that LAD?
Radiologist	Yes, that you could do of course. <i>(Intonation and his voice indicate that the radiologist is surprised.)</i>
	And then let ... then leave the marginal as it is yes ... sure
Surgeon	I think so
Radiologist	We do that then
Cardiologist	Yes <i>(The cardiologist also approves)</i>
Surgeon	We do that then

Commentary: The case is clear-cut The decision suggested of the surgeon for Patient 9 is totally unexpected for the Karlskrona team. However, they have no objections, on the contrary, they quickly accept the proposal of the surgeon. Despite the efforts to plan the work activity, unforeseen things pop up. From the planning view, this is a disturbance, but from the activity perspective, a good complexity. The surgeon's suggestion was "better" in that it quickly got matter-of-fact approval from the Karlskrona team.

Heart conference, August 1996

Surgeon	Let us start with those acute PTCA cases. <i>(Patient 1-3 got a PTCA decision)</i>
Radiologist	We have one patient left, so if you have time to stay <i>(addressed to the radiologist and the cardiologist in the studio at Lund)</i>
	Also this patient, Patient 4, got a PTCA decision. After that the radiologist and the cardiologist in at Lund leave, "Have a nice weekend!" Patients 5 and 6 got a decision of surgery.
Surgeon	<i>(He points out that the patient has a thin main stem of the coronary artery, and the cardiologist in Karlskrona agrees.)</i> Isn't it possible to make a PTCA on the circumflex only, and wait with the others? He <i>(the patient)</i> has, as we know, nothing on scint arteriot. <i>(The meaning is that the scint measurement shows that it is not life threatening for the patient to neglect "the other" stenosed arteries for the moment)</i>
Cardiologist	No, nothing, it is inferiot, posteriot with central spreading."
Surgeon	We can show them <i>(the radiologists at Lund)</i> the film. It is pretty tiny to make a surgery on in my opinion." <i>(The cardiologist also approves)</i>
Cardiologist	But it was the fact that he had so many different parts <i>(stenosed)</i> that I thought they <i>(the radiologists at Lund)</i> wouldn't accept PTCA. But, sure, if you take that aspect into account and see how he is doing, he is doing rather well now.

Commentary: It seems that the unexpected decision for Patient 7 stems from the fact that the surgeon and the Karlskrona team stress different principles in their (first)

assessment. There are two general principles guiding physicians, and consequently also the decisions in the heart conferences. Conditions that are immediately life threatening should be treated immediately, and conditions that are severely debilitating to a person, too. To judge from what the Karlskrona cardiologist said in his last quoted utterance, he (and his team) initially seems to put forward the "many" significantly blocked parts of the coronary arteries. They can be a threat against the patient's life, so action has to be taken. But, the surgeon brings into the overall picture indications from another measure, the scint, which shows that there is sufficient delivery of oxygen to the heart muscles. The patient's life is not at stake, but his well being can be improved by making PTCA on the artery called Circumflex. When the surgeon suggests this possibility, the Karlskrona team changes their initial assessment in favor of the alternative launched by the surgeon.

Heart conference, January 1996

In the preparatory talk in the Karlskrona studio the radiologist that is going to present the angio videos says to his colleagues before the Lund people are connected: "We have, I will look ... one, two, three, I think four PTCA candidates."

Cardiologist	<i>(When Patient 1 has been finished.)</i> Then we jump directly to a possible PTCA candidate <i>(Patient 2, 3 and 4 got a PTCA decision.)</i>
Surgeon	That was that. Do you have more PTCA cases?
Cardiologist	We have one more, yes. <i>(Patient 5 got PTCA.</i> <i>Also Patient 6 got a PTCA.)</i>
Surgeon	How many are there on the PTCA side?
Cardiologist & radiologist	<i>(They speak simultaneously, stuttering. It is not possible to hear what they are saying)</i>
Radiologist	It is (name of patient 7), shall we take him? <i>(addressed to the cardiologist)</i>
Cardiologist	I do not remember it, but (name of patient 7) ... I did not mark him (as a PTCA candidate).
Radiologist	But when I look at ... two stenoses, it ought to work.
Cardiologist	It is difficult to find it here now <i>(He browsed through the stack.)</i> It is before <i>(name of a patient 8)</i>
Radiologist	Yes, before <i>(name of patient 8)</i> <i>(Patient 7 was an unclear case. It was decided that they check him later in Lund.)</i>

Surgeon:	Send it (<i>the film</i>) and we will take a closer look at it and roll it back and forth. <i>(After that the radiologist at Lund leave the meeting with a 'Have a nice weekend!')</i>
Cardiologist	And then we continue. Now we start from the beginning (<i>of the list</i>) <i>Patient 8 got OP.</i> <i>Patient 9 was "skipped" because he according to the cardiologist had "normal arteries."</i>
Surgeon	<i>(Patient 10 is presented.)</i> PTCA?
Radiologist	Yes, you could do that
Surgeon	Peter (<i>name of the radiologist at Lund that left some minutes ago</i>) ought to have seen it
Radiologist	Yes he probably should
Cardiologist	Shall we ask for PTCA?
Surgeon	I write that and you send the film
Cardiologist	Then we do that
Surgeon	And then I leave it to Peter (<i>the radiologist</i>)
Cardiologist	Now we go to (<i>name of patient 11</i>) and I don't think we can do anything for her, with PTCA in any case

Commentary: Here it is obvious that the ordering of the queue by placing possible PTCA patients in the former part, is not an organizing that take place once and for all as in the other cases. This can be inferred from the radiologist's words just before the conference started ("We have /.../ three, I think four PTCA candidates") and the cardiologist's answer to the surgeon's question (after Patient 4), if there were more PTCA candidates ("We have one more, yes").

Discussion

In what way does it make sense to say that organizing of work and other artifacts are instructive? This is the question this paper tries to answer. Here I will discuss some themes that compose an answer.

To "make instructably observable." The ordering of the patient cases by putting the PTCA candidates first on the list before the by-pass candidates, presupposes diagnostic work made by the angiography team in Karlskrona. It also includes a pre-assessment of what treatment to recommend, which, of course, is of a preliminary nature. The organizing is thus a hypothesis of the decision, or a "proffered truth" (Wartofsky 1979, p. xviii) of what is the patient's problem and its proper treatment. The standard procedure in the heart conference is that the Karlskrona angiography team conducts the coronary angiographies and assesses partial conditions of the coronaries. Measurements of critical states of the coronary are recorded on a patient

form that is attached to the patient journal. This journal is at hand for each of the participants at the heart conference. If the Karlskrona team has an opinion about what kind of overall decision is appropriate for the patient, this is not expressed in their preparatory work handed over to the surgeons and radiologists in Lund. However, when they rearrange the patient queue with the additional verbal comments that they first want to present a number of potential PTCA patients, they effectively express their pre-decision of the patient cases. The team's rearrangement of the patient list is a way of "making instructably observable" to the colleagues in Lund of their hypotheses of the cases. It is a pre-evaluation they have made based on the indicators they have available.⁵⁷ This is the reason why this work situation is suitable to study if one is interested in how organization of work can be used as an instructive artifact.

Instruction - potential and realized. It may be correct to claim that past activities are "resting" in artifacts and used in later activity, but it is only one side of the matter. The other side is that the "use" of the artifact in an activity does not follow an instruction inherent in the artifact. The artifact-bound instruction is only a suggestion, a potential instruction, which is turned into a real instruction when the agent/subject accepts the suggestion and makes it his/her/their own.

Therefore, how to make sense of the interaction between the inert (or static) artifact-instruction and live actions in the situation is the problem. If the potential artifact-bound instruction is used as a resource and in that way is turned into a real instruction is dependent on the situation as a whole, and not only on the artifact. There is an interplay between artifacts as potential instructions and actions, which are situated and thus open until they are accomplished. After the fact it can be stated if the potential instruction was turned into a real instruction or if other potential resources in the situation were transformed into real resources.

Artifacts are "structured." It is a fact (in my opinion) that artifacts are potentially instructive and that this potentiality is realized, under certain circumstances, in human activity. The potential intentions/instructions are meritoriously recognized by Actor Network Theory (although the step to interpret the potentiality as an actant-capacity of the artifact is, for me, to go too far).

But how to understand the instructive potentiality of artifacts and its realization? I will try a line of argumentation that artifacts are (potentially) instructive, taking as a starting point the two famous thought experiments of Karl Popper (1972, pp. 107-108) and Lektorsky's critique of them. Popper's thought experiments both have a common pre-condition, namely that "All our machines and tools are destroyed and all our subjective learning, including our subjective knowledge of machines and tools, and how to use them." In Experiment 1 the libraries and our capacity to learn from books survive, but in Experiment 2, this is not the case. The outcome of Popper's

⁵⁷ They are fully aware that the final decision of treatment will be made at the heart conference. It may happen that the final decision is further postponed and delegated to the team in Lund. It may also happen that a decision made at the heart conference will be changed later at Lund because of unforeseen events.

thought experiments is that the "objective knowledge" that is inherent in the texts matters. In Experiment 1 our civilization will recover within reasonable time, but not in Experiment 2, where the evolutionary process has to start over again. Against Popper's argumentation Lektorsky (1984, p. 237f) raises the objection:

"Assume that a civilisation is dead and no one knows the language once spoken by its subjects. Although the books written in that extinct language survive, no one is capable of decoding them and the connection is thus lost between the defunct culture and the actual social-cultural process, including the cognitive one. And that means that the books preserved no longer contain any knowledge. Properly speaking, they are not even books but simply objects with strange strokes in them."

Although I generally agree with Lektorsky's critique of Poppers epistemology, I do not in this case. In my interpretation Popper says that artifacts ("World 3 objects") have something to tell, there are in them inherent properties that we can use and have to count with. So far I think Popper is correct. I will argue that artifacts are men's offspring, and in them humans recognize themselves and their activities. There is a "grammar" or structure of human activity, a structure that is built into the artifacts, and make it possible for humans (with their activity and its structure) to "see" that there is a structure in the artifact. The "objects with strange strokes on them" that Lektorsky is talking about, are, in my view, man-made objects and they are discernable as such. There is a structure in them, which make them possible to decode, at least in principle. This fundamental condition makes archeology possible, and, I am convinced, gives the possibility to decode codes and extinct languages. Artifacts speak, and in an ongoing practice, their voices are made instructive.

"The riddle of things." Men are not only single individuals thinking with their brains, and things are not only dead artifacts. These are insights nowadays spreading in not so few circles. We can talk of "The return of the artifact" (a title of collection of Latour papers published as a book in Swedish 1996) referring to Latour's (1993) idea that "we have never been modern" because we thought we could be totally separated from things and thus modern, but we did not succeed, and now they are back again, the artifacts, in the networks that, together with us, make up the world. So, if things are not only things, what are they? A riddle. How can they be explained? In the article "The riddle of things" Miettinen (1999) makes an attempt at a serious answer on several points. Two of them are similar to what I have found. First, the interplay between artifact with its potential instruction and the use of the artifact-bound instruction (thus making it realized) cannot be solved theoretically (When is a potential instruction realized?). It depends on thousands of details. If there is a solution of this conflict, it will be found in the situation, or, in Miettinen's words, in an "object-oriented, culturally and socially mediated local activity" (p. 190). In my case: When is a local work organization created for instructive purposes? The other point where my answer is close to Miettinen's concerns the future-orientedness of what Wartofsky calls "tertiary artifacts" (artifacts used for imaging future possibilities to state it shortly). How to imagine future coronary diagnostics? In the paper I have not dealt with this issue, albeit it is touched upon, again and again, by the physicians

(What criteria is fitting when doing interventions? How to combine PTCA and OP?). Obviously the object of their work have a regulating role on their actions.

Artifact-bound instruction. Two of the kind of artifact-bound instruction mentioned in Figure 1 above are more “reflective,” the linguistic and graphic ones. They are what Wartofsky calls “secondary,” that is, they constitute “*reflexive* embodiments of forms of action or praxis” (...) “created for the purpose of *preserving* and *transmitting* skills” (1979, p. 201: italics in original). The other two, the physical-material and the organizational, are not that reflective, but they nevertheless have a reflective quality, i.e. they represent aspects of human activity. In this paper I have attempted to show, in some detail, (1) how organization of work also represent human activity, and thus is instructive for how to accomplish work; and (2) that instruction as an activity emerges out of an interplay between artifacts and their uses (artifact-bound instruction does not work alone, and neither do unmediated instructional actions).

By way of introduction I discerned four kinds of artifact-bound instruction. This does not mean there only are those four. Lucy Suchman (1987; among others) has studied the use of linguistic artifacts (“manuals” and plans), Charles Goodwin (1994; among others) has studied how graphic artifacts are used in work practice, Donald Norman (1993, among others) has studied how affordances give directions for actions, and I have in this paper made an attempt to demonstrate how organization of work can be used as an artifact with instructional properties. I do not say these four kinds of artifact are all that are. It only means that these are the ones I have observed in my studies of coronary diagnostic work. I see no reason to imagine there are limits to what artifacts can be representational. On the contrary, I believe, to put it in Wartofsky’s vocabulary, that “Anything (in the strongest and most unqualified sense of ‘anything’) can be a representation of anything else” (1979, p. xx). If this is trustworthy, we will surely find representational usage of other kinds of artifacts, and we will surely find the uses of a great variety of instructional artifacts in human activity. But we have to find it out, by close studies of work practices.

Conclusions

Organizational artifacts have instructional properties, and as with all artifacts, they have “humanized” properties. They bear evidence of having been structured by human activity. The structure of the artifacts can be used to re-represent human activity, and its intentionality to direct one’s own actions. The bridging of the past to the present of work activity, here accounted for in terms of instructional artifacts and their uses, needs to be complemented by a future-orientation offered by the object of work. Therefore, “situated actions” are determined/informed by a “situatedness” that includes potential artifact-bound instruction as well as the comprehensiveness and future-orientation that are rendered by the object of the work activity.

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Paper VI

Berthel Sutter. “Shall we do that then?” On the guiding function of the object of work. Paper presented at the 2nd Nordic-Baltic conference on activity theory and socio-cultural research, 7-9 September, Ronneby, Sweden.

“Shall we do that then?” On the guiding function of the object of work

Abstract: The paper explores how work activity gets its orientation. With the help of Ilyenkov’s conception of activity/object and Leontiev’s conception of activity as layered, I make an analysis of all patient cases presented in a heart conference with the aim of finding out *how* the motivating character of the object of work influences the aggregates of work actions. The voices of the patients, as they are made heard in the clinical work, are taken into account as one determination of the object of work. Finally the paper discusses what the object of coronary clinical work is.

Introduction

This paper is one in a series of papers exploring how work activity gets its orientation. In (Sutter 1999, 2000, 2001) I have studied how artifacts are made instructive in coronary diagnostic work. The theoretical ground of the paper is based on Ilyenkov’s (1977) analysis of activity and the object of the activity, and on the conception of activity/object as layered, as suggested by Leontiev (1979). From this theoretical perspective, I make an analysis of an activity system of coronary diagnostic work. Taking for granted – based on an activity-theoretical approach – that the object of an activity has a guiding function of the activity, the aim of the study is to find out *in what ways* guidance is achieved.

The Russian philosopher Evald Ilyenkov has developed the concept of activity by elaborating on how artifacts, man made objects, relate to living human activity. He conceptualizes his ideas in the concept of “ideal object” or “the ideal” (Ilyenkov 1977). As I understand it, Ilyenkov’s philosophy is a way to stand up for materialism (but not vulgar or silly materialism, as he says), which encompasses the active side of human life, including consciousness, intention and motivation. I will try to point out the central issues in Ilyenkov’s position with two claims:

- ❖ There is no “pure activity”, no activity without “traces of palpable corporeality.”
- ❖ There is an ongoing dialectical transformation between activity and object.

Very briefly I will argue for the “two claims” with reference to what Ilyenkov has written in a chapter from 1977.

Concerning the first claim, that activity is always object-mediate,. Ilyenkov on several occasions points out that “ideality” cannot be restricted to something mental or individual. “Social consciousness is not simply the many times repeated individual consciousness” (p. 77). He refers to Hegel’s understanding of what is meant by “social consciousness” and claims that the “*social consciousness* as an ‘entity’ is

certainly not built up, as of bricks, from the ‘sameness’ to be found in each of its ‘parts’ (individual selves, individual consciousness)” (p. 80). Social man is something else for Hegel and Ilyenkov. “It is these forms of the organisation of social (collectively realised) human life activity that exist, before, outside and completely independent of the individual mentality, in one way or another established in language, in ritually legitimised customs and rights and, further, as ‘the organisation of the state’ with all its material attributes and organs (...)” (p. 81). “Ideality,” he sums up, “is nothing else but the form of social human activity represented in the thing.” (p. 86)

Concerning the second claim, that there is an ongoing transformation between activity/object; “The ‘ideal’ plane of reality comprises only that which is created by labour both in man himself and in the part of nature in which he lives and acts,” Ilyenkov says (p. 96). Human activity is social, purposeful, and transforming. The ideal form of labour is realised in the substance of nature. Sometimes he says that labor is embodied in the substance of nature, or is alienated in it. This means that man’s labor presents itself to “man the creator as *the form of a thing* or a relationship between things in which man, his labour, has placed them” (p. 97). By rephrasing, he states the same thing in the following words: “‘Ideality’ (...) exists only through the unceasing process of the transformation of the *form of activity* – *into the form of a thing and back* – *the form of a thing into the form of activity*” (...) (p. 98). Ilyenkov has a wording that I like very much. It is as follows:

“And only in the reciprocating movement of the two opposing ‘metamorphoses’ – forms of activity and forms of things in their dialectically contradictory mutual transformations – DOES THE IDEAL EXIST.” (p. 99. Capital letters in original)

I am sure the meaning of this sentence can be discussed in length, but I will not go into such a discussion. Instead I will accentuate what I will take as central for the analysis of this study: there are transformations between activity and object. There is no activity without an object, and there is no object without activity. They are mutually determined, they are dialectical entities. Even shorter, put in a formula: *activity/object*.

Material, embodied activity shapes the ideal. In my reading, “ideal object” is the trace of human activity in materiality. In other words, artifacts are activity products. Without activity, the object would not be an artifact, but pure nature. Thus, according to Ilyenkov, there is “ideality” in all things made by humans. I can guess many may accept such a position. However, I think his idea that all “ideal objects” have a material aspect is harder to digest. This being the case for a table or a computer program, will for many people probably be recognized as an acceptable philosophical position. That it also would be a valid statement for mathematical concepts, procedures, and conceptions of health, disease and illness, I guess, many people would find unacceptable. But what are the alternatives? An ideal parallel world to the material world (like Platon, Kant, and Popper suggest)? An independent world of

human consciousness (as Popper would have it)? Ilyenkov persistently refutes those alternatives. For example, on several occasions he repeats that one should not conceive of “social consciousness” as the many times repeated individual consciousness. It is more than the sum of individual minds. With such a perspective, is there not a risk that “subjectivity” might be lost? Do not the imaginations, goals and intentions of the individuals play any role? Of course they do, is Ilyenkov’s answer, but even if we take for granted that other people have a consciousness and intentions, we come to the conclusion through their actions and talk and influence on the material world. What we want, strive for and intend are “made instructably observable” in the interaction with other people (to use the wonderful phrase from Garfinkel, 1996). How else could they know? How can something be “made “instructably observable” if it is without “traces of palpable corporeality” (Ilyenkov, 1977, p. 87)?

In our time of “postmodernism” or “cultural modernization” (Ziehe 1989), when “make-ability” is a highly praised quality, it is important to understand the limits of make-ability (or constructionism). There is an “inertness” in human affairs depending on the role of artifacts. There is a “given” to count with in any action. This means that artifacts are to be taken seriously. Actor Network Theory (ANT) is a perspective that takes the role of artifacts in human activity seriously. As a reaction to the persistent tendency to ignore or underestimate the importance of artifacts, ANT has an essential message, although, in my opinion, it goes too far when it, with the concept of “actants,” places artifacts on a par with humans. From the point of view of activity theory, Ilyenkov and Wartofsky (1979) have made attempts to deal with the problem. Here I make use of Ilyenkov’s idea of a dialectical relationship between forms of activity and forms of ideal objects (artifacts), as a point of departure to describe how teams of physicians accomplish their work of coronary diagnostics.

The object of work is something given, but also something projected and open. This is something that Engeström time and again underlines, for example in Engeström (1999b, p. 65), where he says that the object

“is to be understood as a project under construction, moving from potential ‘raw material’ to a meaningful shape and to a result and an outcome. In this sense, the object determines the horizon of possible goals and actions. But it is truly a horizon: as soon as an intermediate goal is reached, the object escapes and must be reconstructed by means of new intermediate goals and actions.”

A consequence of the unfinished character of the object of activity is that planned or scripted actions are not enough. In advance you cannot comprehensively know what to do. There will always be “corrective” actions to accomplish the activity. Leontiev describes some aspects of this multi-level characteristic of human activity as the “structure of human activity” (Leontiev 1978, 1979). He has developed his now famous idea that there is a level of activity related to motive, and levels of actions and operations related to goals and conditions. In that way an activity is layered. In his own words:

“In connection with selecting the concept of action as the most important ‘component’ of human activity, we must keep in mind that any kind of well-developed activity presupposes the attainment of a series of concrete goals, some of which are rigidly ordered. In other words, an activity is usually carried out by some aggregate of actions subordinated to partial goals, which can be distinguished from the overall goal.” (1979, p. 61)

An activity is also layered in that it encompasses activity/object, present and past in the same moment. In addition, it encompasses intentions about the future. Thus, activity is a weaving together of objects and of past, present and future. The purpose of the paper is to describe in detail this “interweavingness.”

That the object is “a project under construction” (Engeström) does not mean that the “ideality” of objects is a property of mind. Rather, as Ilyenkov has stressed, “mind” as well as “ideality” is an outcome of human activity, palpable corporeal activity. It is easy to slip here, and before I go to an account of my empirical studies, I want briefly to discuss a project similar to mine. This is Keller and Keller’s analyses of blacksmithing (Keller and Keller, 1993, 1996, 1999). Our culture predisposes us to associate construction, constructivism, and mental work of an individual person. Even people like Keller and Keller, who have studied something as palpable as “working with iron” and have beautifully demonstrated how material artifacts are interwoven into and are a constitutive part of the work activity, slip here. They ask: “What is it that an individual needs to know to produce a material artifact?” (Keller and Keller 1999, p. 3) “What does someone need to know to produce an artifact in iron?” (ibid, p. 12) Their answer: “One needs a stock of knowledge that represents past accomplishments and experience, and one needs conceptual representations of the goals or plans that guide ongoing action.” (ibid, p. 15.) To the question - What is the stock of knowledge? - they reply: “It is an encyclopedia of [1] schemata held in mind or [2] constructed in response to visible reminders.” (ibid.). Although Keller and Keller state their ambition to focus on “the inherent integration of internal representations and external actions and objects in the accomplishments of a task” and to look at “the conceptual organization in practice” (Keller and Keller 1993, p. 141), it seems that they explain what is going on in the work of blacksmiths by referring to schemata, visual imagery and cognition mainly in the individual’s head.

The objective to describe the activity/object dialectics in a concrete work activity is not an easy task. But I have come to the point where I need to do this. In my earlier studies (e.g., Sutter 1999, 2000) the object of work occasionally emerged, as a theme in the empirical material, but it was not subjected to an analytical discussion.

Methodological considerations

In activity theory, the unit of analysis is often said to be an activity system (e.g., Engeström 1987). During several years I have studied coronary diagnostic work which can be described as an activity system. This specific activity system was characterized by being distributed between two sub-teams and using special videoconference facilities as a central mediating artifact. It was run between 1993 and the end of 1996, and ceased to exist when it was transformed into two independent (but collaborating) activity systems. The outcome of the transformation was the founding of the Thorax Clinic at the Blekinge hospital in Karlskrona as a new actor on the medical scene in Southern Sweden, in addition to the already well-established University Clinic in Lund.

Among the 17 heart conferences I have videotaped and studied from March 1995 to August 1996, I have selected one (from June 1996) as an *empirical unit of analysis* for this paper. The rationale for this is that the heart conference is a microcosm of the activity system of coronary diagnostics. A heart conference is a formalized meeting place for collegial decisions, limited in time and involving staff from all relevant professional disciplines. Using the heart conference as a practical unit of analysis of coronary diagnostics means that I can catch some essential parts of what constitutes the institutional order of coronary diagnostic work. The institutional order is *given* – by way of tradition, habits, procedures, work descriptions, coding schemes, and other artifacts. At the same time, the institutional order is *accomplished in and as part of everyday work*. The institutional order both *is* and *becomes*, it consists of something given and something projected. In my presentation I will utilize the given/produced institutional order of the heart conference as a microcosm. The heart conference is a gathering, a concentration of the activity that most often is distributed over time, places, and people. On the occasions of the heart conference, the activity becomes focused in one place. This is the reason why the heart conference gives an excellent opportunity to study how coronary diagnostic work is done.

The patient case is *another empirical unit of analysis* in coronary diagnostic work. It is as such the patient problems are made visible and it is primarily as individual problems they are tackled. This does not mean that a patient can be taken as a given. Patients are fabricated in the course of the diagnostic activity, and an analysis also has to take this into account, not just start with the patient as a given quality. Thus, my approach to the study of coronary diagnostic work is to study the activity in a heart conference, focusing on the patient case.

I realize that I face a problem here. I have two “empirical units of analysis” – the patient case and the case of the complete heart conference comprising 17 patient cases.⁵⁸ Because I am interested in how the object of coronary diagnostic work exerts its guiding function on the work practice, including how a patient case is established, I have to go beyond each individual patient case in order to find of a more molar unit.

⁵⁸ The heart conference I have selected for this paper comprises 17 patient cases and lasted for 75 minutes, with usually a patient case taking 4-6 minutes.

However, when I think of presenting all cases of the heart conference, I realize that this will be impossible; even if I manage to, no reader will get through such a text.⁵⁹

How should I attack this problem? There is no theoretical way out of this situation, only a practical one. My choice is to outline the activity of the heart conference. I will do that by giving an account of, first, how the patients are classified in the heart conference, and second, the voices of the patients⁶⁰ as they (indirectly) appear in the heart conference. In addition, I will select one patient case, one which I will present by means of a comprehensive video log with a commentary. Furthermore, from the heart conference I will pick out two episodes with the aim to explore and understand how the object of work is established and gains impact. The first step, the classification of patients according to what was planned for them as a result of the heart conference, is depicted in Figure 1.

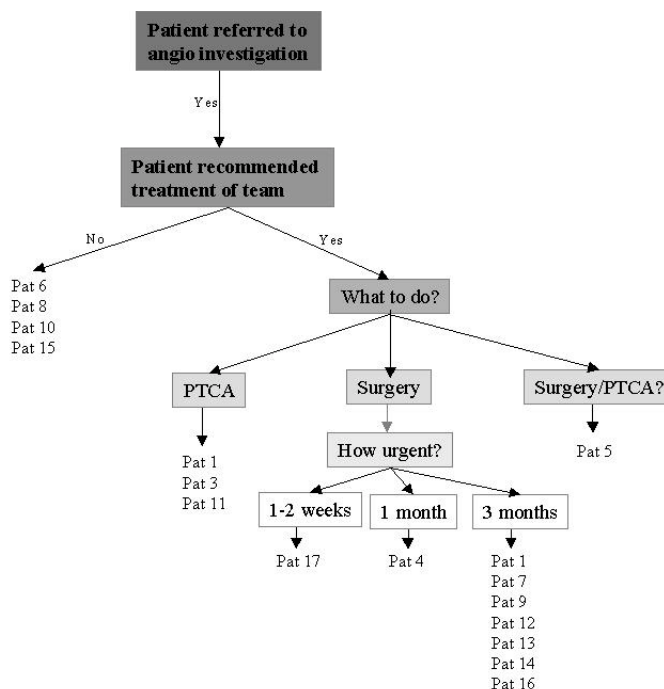


Figure 1. Categorization of patients in the studied heart conference.

⁵⁹ In discussing the methods of Conversation Analysis and Critical Discourse Analysis, Engeström (1999a, p. 173) claims they face the artificially-isolated fragment problem respectively the ambiguously-global argumentative social fabric problem. And he sees a solution: "the middle ground of situated activity system." Although I play on the middle ground, I still have a fragment-fabric problem to cope with, albeit not so critical.

⁶⁰ "Voice of the patient" is a theoretical concept. It is introduced in order to describe the patients' interests in the activity, which ultimately is built up to the benefits of the patients. However, the health care activity system has its own momentum, where the patients tend to be marginalized..

As a preparation for the heart conference, 17 patients were referred to an angiocardiographic investigation (“angio” for short), where the coronary artery was x-rayed. Later the patients were put on a list for the heart conference in question. As part of the heart conference, the patients were classified into several categories, 4 or 6 depending how one counts. If all patients that are recommended surgery are lumped into one group, there are four categories, but if a distinction is made based also upon how soon the surgical operation is planned to take place, there are 6 categories. The physicians themselves explicitly state the period within which surgery is recommended, and they categorize the surgery patients into three sub-categories. Thus, the members of the activity system themselves use 6 categories.

Patients 6, 8, and 15 are discussed very shortly at the conference. “We’ll skip her,” said the presenting cardiologist about Patient 6, “because she has no significant stenoses.” With similar phrasings, the other two just mentioned patients were also dealt with in the meeting. The reason stated is that all three patients had normal coronary arteries. In the greeting ceremony of the heart conference, the surgeon got a hint about these three patients from the cardiologist. (Surgeon: “Good morning. It is a thick collection you have to offer today.” Cardiologist: “Three will disappear, I think.”). The surgeon accepted the short explanations from the team in Karlskrona regarding the three patients, and by that the decisions were a fact. For the fourth patient in this category, Patient 10, like all other 14 patients, a full presentation of the patient history was given by the cardiologist, followed by a angio-film presentation by the radiologist and a discussion. The decision for the Patient 10 case was to return it to the referring hospital, because there was not enough evidence to motivate PTCA⁶¹ treatment or surgery.

Patient 5 constitutes a single case category. The case was complicated and a conclusive decision could not be formed at the heart conference. Therefore it was decided that the patient should be sent to Lund and get some kind of treatment, but more exactly which treatment had to be based on more careful consideration. The remaining four categories of patients are the patients the team assesses to be in need of treatment, either in the form of balloon dilatation or surgical operation.

The category “surgery within 3 months” comprises 7 patients. Judging from a comment by the surgeon, There seem to be unusually many patients in this category in this heart conference: “There are many three-month cases today.” He made the comment directly after Patient 14 had got her 3-month surgery decision. As can be seen from Figure 1, still another 3-month decision will follow. A 3-month decision means that the patient is not in acute need of a surgical operation. The risk indication says this is not an emergency case, but surgery is recommended for the wellbeing of the patient. Research shows (Socialstyrelsen 2001) that surgery for these patients does not improve their length of life, but improves their quality of life. In light of the

⁶¹ PTCA (percutaneous transluminal coronary angioplasty) is an x-ray based method for surgical repair of a coronary blood vessel by means of balloon dilatation.

existing long patient-queues for surgery, this category is somewhat of a dilemma. By ameliorating life for some of the patients, whose lives are not at stake, resources become scarcer for patients with life-threatened conditions.

The first step in my method was to describe an aspect of the fabric of the institutional order of classifying patients (Bowker and Star, 1999). The next step in my method is to distinguish *layers of the activity/object* of the physicians' work at the heart conference. By this I refer to patterns like aggregate of actions, overall goal and partial goals (to speak with Leontiev), and tools and objects (to speak with Engeström 1990). Proceeding in this way, I can see that there are patterns or layers in the heart conference forming a kind of natural order of distributed work. First, there is a move of bringing evidence concerning the patient to the "center", that is, the angio lab and the heart conference. This move is about institutional remembering of what has earlier been distributedly achieved in the health care system. It means updating the case, grasping "the state of the art" for the patient - in figures and descriptive vignettes. Second, there is confirmation and assessment of the tests that are made especially for the heart conference. This includes x-raying of the coronary artery as well as measurements of the working capacity of the heart (ventricle and cardiac valve) and bedside talk with the patient. Third, there is an overall assessment of the heart as a whole. Based on noticing many pieces of information, pieces that are not always coherent and sometimes apparently contradictory, a picture is formed weighting in reliability of facts and relevance for treatment. Fourth, a decision is made, consisting of a strong recommendation to the colleagues in Lund concerning the future treatment of the patient.

There is an institutional order in dealing in with the patients in the heart conference. The order consists of four phases: Updating the case, Inspection of parts, Overall assessment, and Decision of action to take. The phases are sequential. Sequentiality emerges from the fact that the career as a patient unfolds in time, and there are indications of how, but it also originates from the fact that the physicians have to face patient-sequences and facts one at a time. My presentation of the patient case (Patient 4) will be structured according to these phases.

I have chosen a patient case, which I present comprehensively. The patient I have selected, Patient 4, comes from one of the four "action-demanded" categories the physicians have used in the heart conference in question (Figure 1). Patient 4 got a surgery decision with the specification of "one month."

Let me sum up the approach of my study. I want to give a picture of a whole heart conference, and I do this by outlining how the 17 patients are classified and by presenting the voice of the patients as they are heard in the conference. I also want to present detailed descriptions of the patient cases. I do this by giving an account of one full patient case complemented with details from how the voices of the patients are expressed in the heart conference. Furthermore, I present two episodes which also refer to the voices of the patients, and, in a broader context, the object of clinical coronary work.

The object of my study is how the object of the work activity is manifested in how the work is done, or, in other words, how the guidance of the object of work is accomplished. Thus, I aim at an activity-theoretical study (that is both holistic and detailed) inspired by “Ethnomethodology’s program” which means to “make intractably observable” (Garfinkel 1996) and give an account of “the interactional what” (Button 2000). My course of action to explain these dense theoretical expressions is the same as I apply in the case of Ilyenkov’s, that is, to outline how the expressions are important in my analysis, and then let the fuller explanation of them unfold along with the description of the work practice.

I will present the phases of activity/object as they are particularized in a patient case at a heart conference held in June 1996. Through the patient case, I describe in detail how the mutual transformations of activity/object occur.

The Patient 4 case

Phase I: updating the case

The cardiologist is updating the patient cases as part of his presentation of them. He summarizes the patient history and brings to the meeting results from taking of specimens, anamnesis, and assessments from his own encounter with the patient. I will present the Patient 4 case as an example.

What the diagnostic team has to tackle in the first phase of the patient case are the patient’s significant problems according to earlier tests, and the stated reason why she got a referral for an angio investigation.

The cardiologist, who is presenting the patient case, builds his presentation mainly upon the patient journal. The patient journal is at hand for all the participants during the conference, and the cardiologist uses it as his manuscript during the presentation. This is how the cardiologist who is presenting the case in the conference always works, and sometimes he also adds commentaries from his own memory of his meeting with the patient at the clinic (probably backed up by notes). How this was done in the Patient 4 case is presented in Figure 2a.

Evidently the reason for sending Patient 4 to Karlskrona is not explicitly stated in the patient journal. (Line 1) The presenting cardiologist corrects the omission by pointing out a specific page in the patient journal, “here, page 24b,” where the diagnosis of the referral should have been stated. I can only speculate as to how the cardiologist knows the reason. Probably he has addressed the complete journal of Patient 4, which is placed in a pile together with the other patient journals that are placed in a shopping trolley within reach of the cardiologist.

	Actor		Commentary
1	Cardiologist	There is no stated diagnosis here, but there should have been a notation, "aorta stenosis" here, page 24B	
2	Surgeon	Mm (<i>He makes a note in the patient journal</i>)	
3	Cardiologist	This is an 82 year old vigorous widow, who earlier has smoked a little, but that is long ago	
4		No problem with varices, asthma pains however.	
5	Surgeon	Mm	
6	Cardiologist	She had surgery for (inaudible) cancer autumn - 92. Post-surgery tests are said to be okay. She also has had (inaudible) treatment.	
7		A known murmur since at least 20 years	
8		In connection with an infection she got accentuated asthma pains, that is pains correlated to breathing. And in connection to that an echo test was made and then a dense aorta stenosis and left ventricle hypotrophy was found	Hypotrophy = abnormal growth. Echo = echography, diagnostic examination using ultrasound.
9		And she has, according to the doctor who has referred her, pains with pressure on the chest.	
10		But the patient does not believe she does. She is digging in the garden without real pains. But she has fainted on several occasions. She experiences that it can come at any moment	
11		I think this patient really ignores the symptoms.	
12	Surgeon	Mm (<i>He turns over the pages and makes a note</i>)	
13	Cardiologist	I think this is important to stress because ...	
14		Besides that she is alert. She has several medicines, not the least ... mainly asthma based.	<i>Surgeon turns over the pages</i>
15	Surgeon	Mm	
16	Cardiologist	In connection to undressing and dressing she displayed some dyspnea, so she is more bothered than she is willing to admit.	Dyspnea = difficult or labored respiration
17	Surgeon	Mm (<i>He makes notes or markings and turns over the page</i>)	
18	Cardiologist	The heart displays the murmur (Ψ) that can be expected for an aorta stenosis. (Φ) Echo from (<i>name of the neighboring county town</i>) in April shows measure of 42 mm of the left ventricle, with concentric left ventricle hypotrophy and growing thickness of the walls. And a gradient between 90 and 100 Hg. (Φ) Also a little leakage of mitralis.	Ψ = <i>surgeon turns over the page</i> Φ = <i>surgeon makes a note</i> Mitralis =mitral valve
19	Surgeon	Mm	
20	Cardiologist	We have not tested pressure, because we were not able to penetrate the ventricle, it was too tight.	Pressure = a measure of the ability of the heart to pump blood
21	Surgeon	Well	<i>Surgeon turns over the pages</i>
22	Cardiologist	And then we have the angio	

Figure 2a. Patient 4 - updating the case.

One might perceive of the presentation of the patient case as a monologue conducted by the cardiologist. This is not the case. The presentation is an updating for the whole team, and all team members are engaged in the updating – in different ways. The updating comprises material work and a dialogue. Although Figure 2a does not manage to do full justice to what is going on in the conference, it gives a picture of the dialogue. Notice that the surgeon responds to the presentation of the cardiologist and he attentively follows the presentation of the case – by reading and turning pages in the patient journal (lines 12, 14, 18, and 20), listening to the cardiologist’s oral presentation, making notes (lines 2, 12, 18) and going into dialogue (minimalistically, I admit) by means of his mm-responses (lines 2, 5, 12, 15, 17, and 19) and also his concluding “well” (line 21).

In the heart conference I present here, the whole team consists of three physicians, which is a minimum – a radiologist and a cardiologist in Karlskrona, and a surgeon in Lund. Actions of the later two are possible to infer from Figure 2a, but what does the radiologist do? He is also taking part with his specialty in the division of labor.

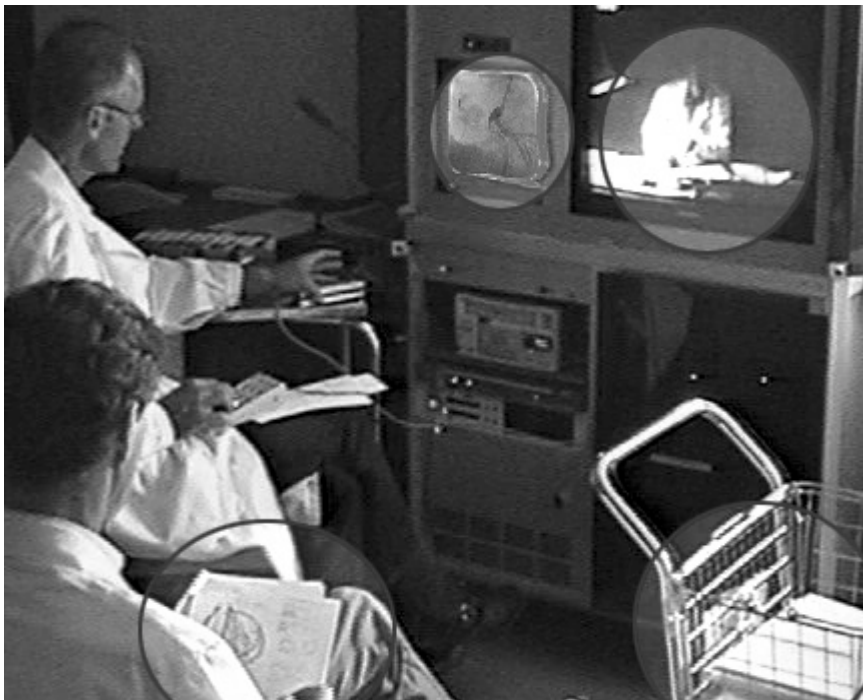


Figure 3. The participants in the heart conference

When the cardiologist starts to present Patient 4, the radiologist directly turns the pages of the patient journal to a certain page. This page shows the result of the angio

investigation in graphics, numbers and statistical figures, and texts.⁶² During the updating phase of the patient case, he has this page spread in his lap, and now and then he looks at it. He is following the presentation of the case, and, most certainly, he is preparing the next phase, where he will have a very active role.

A dilemma or contradiction is evident in this first part, where the case is updated. The clinical measurements that caused the referral to the hospital strongly indicate that the patient is suffering from a clogged aorta, which is a serious problem. On the other hand, however, the patient is vigorous, and she denies she has any serious problems. Life threatening problem according to objective tests versus subjective reports of wellbeing – how do the physicians cope with this contradictory evidence? Referring to more evidence is what the cardiologist does. He finds new indications of the seriousness of the problem in the life-world of the patient. Sometimes she faints away (line 10) and she displayed difficulty with her respiration when she undressed and dressed for the consultation meeting with the doctor (line 16). The cardiologist's suggestion is that the woman psychologically denies her problem. This is what the cardiologist points out in his presentation (lines 11 and 13).

This first phase of the presentation of the patient case I have called “updating of the case.” It is not just a mental updating. Indeed, it regards all-round work activity. It means, among other things, updating of the patient journal (writing in the referral diagnoses, “aorta stenosis”, in its proper place, “page 24b”). It means following routines important for the encirclement of coronary illness, it means applying coding schemes, embodied in paper forms, in organizational procedures, and in behavioral habits (for example, “has smoked a little”, line 3; “no problem with varices”, line 4; “we have not tested pressure, because we were not able to penetrate the ventricle,” line 20).

Updating, of course, means much more. And then I am only talking about the updating work going on in the 70 minutes long heart conference, not the preparations or infrastructural work that has been accomplished before the conference, in several places, also with other people involved.

In sum, we have seen “updating work” accomplished by the diagnostic team, comprising a cardiologist and a radiologist in Karlskrona having a videoconference meeting with a surgeon in Lund. The updating or re-presentation of the patient case is “just” to pick out what is relevant from the diagnostic work done beforehand, and add some more information. With the approach of this study, to describe in some detail “the interactional what” of coronary diagnostics, this “just” picking out and adding a little information should not be misunderstood. This “just” is hard work. And it is only the beginning of the patient case.

⁶² At this heart conference, we researchers (Bo Helgeson and myself) had two video cameras in action. One was focusing the radiologist and his handling of the special device that made it possible to show the angio video within the framework of the regular distance-mediating heart conference.

Phase 2: Inspection of parts

In the special meeting called “heart conference,” collegially organized for a comprehensive diagnosis of the heart by means of the major professionals involved, the angiocardigraphic film (the “angio”) has a central place. Angiocardigraphy means a “roentgenographic visualization of the heart and its blood vessels after injection of a radiopaque substance” (Marriam-Webster’s Medical Dictionary). By means of this powerful method, the team can make a detailed inspection of the coronaries and the heart. This inspection is what the second layer is about. Before we go into the activity/object transformations in this second phase/layer, first some words about the production of the angio film.

23	Radiologist	She has a lot of calcification	
24	Surgeon	Well	
25	Radiologist	Light insufficiency, stiff and calcified mitralis, and also much calcification in (inaudible)	
26	Surgeon	That ventricle is not well, right?	
27	Cardiologist	From sitting markedly leaning forward and attentively looking at the display of the angio video, he now leans back, and turns over the pages in the patient journal. After some seconds he says: It is said, in April at least, that it was not that ...	
28	Radiologist	Normal right as you can see there	Right = right ventricle
29	Surgeon	Yes	
30	Radiologist	And the aorta we have not (inaudible)...	
31		She has two LAD stenoses around 50%, especially the distal one	<i>Surgeon makes a note in the patient journal</i>
32		Normal circumflex, normal main stem	
33		It is this area (<i>he is showing with the pointer on the screen</i>) that (inaudible) diagonal	
34	Surgeon	The diagonal will pass?	
35	Radiologist	Well, the diagonal will pass, yes	
36	Surgeon	Mm (<i>makes a note</i>)	
37	Radiologist	And if you want we can show the right in high speed to show that it too is normal	The right = right coronary
38	Cardiologist	In any case they said from echo that there were normal contractions of the ventricle, in April	
39	Surgeon	Well (<i>makes a note or underlining</i>)	

Figure 2b. The Patient 4 case – searching for significantly diseased parts of the heart.

There is a standard shooting of the angio film, which has been described in the following manner by members of the team: “The examinations usually consisted of left ventricular angiography (frontal and lateral simultaneously), four to six runs of the left coronary artery, depending on anatomy, and four runs of the right coronary artery.” (Kehler et al., 1996, p. 161). Because the film is composed as it is, in a

standard order, it follows that the heart and the coronaries are examined in the same order in the heart conference (unless the team wants to jump between the sequences of the film). The order of the angio investigation and, thus, the order of the radiologists' presentation of the angio film, can be read in Figure 2b.

The presentation of the angio film starts with inspection of the ventricles, first the left ventricle (lines 23-27) and then the right ventricle (lines 28-29). Then the aorta, which has not been examined in the angio lab (line 30). In the next step the left artery is gone through: LAD (lines 31 and 33), Circumflex (line 32), main stem (line 32), diagonal(s) (lines 34-36), and finally the right artery (line 37). Notice that the order of the parts of the heart and the coronary artery, which are to be inspected in the heart conference, is more or less given by the order laid down through the work in the angio lab. In that respect, the angio-film strongly determines the work practice of the meeting.

The dialogical pattern that was observable in phase 1 can be observed also in phase 2. In the latter, the radiologist and the surgeon are most visible through the log records, but the cardiologist is also active all the time, which is suggested through his emergence in the log (lines 27 and 38).

Although the angio film can be regarded as the central artifact during this phase of the heart conference, other artifacts are important too. The division of labor between the participants is striking. The radiologist is the operator of the angio film, he loads the video-cassette, runs the film, manages the maneuvering-device that regulates the arrow-pointer for the monitor, and orally he comments upon the film. In his lap he has the patient journal, with the particular page earmarked for the angio graphics turned over as front page, and upon it he has placed one of the operating devices he uses (Figure 3). His specialized work activity has been noticeable also earlier in the conference. I did not mention it in Figure 2a, but I will here. When the cardiologist and surgeon are talking (lines 1-6 in Figure 2a), the radiologist minds his own business: he writes down the decision taken for Patient 3 on the front page of his issue of the patient journals, he turns over the pages until he finds the page with angio graphics of Patient 4, puts the journal with the angio-graphic page upward in his lap, takes out the video cassette for Patient 3 and puts in the cassette for Patient 4.

As part of taking part in the interaction by talking, the surgeon consults the patient journal, at times turning over the pages, or making a note.

The cardiologist looks at the film, at any moment with at least one eye on the patient journal, as if he wishes to assure himself that there is a correspondence between the pre-angiolab diagnoses and the partial diagnoses that are suggested through the angio film. He also browses through the patient journal to get an answer to the question of how the left ventricle has been diagnosed before the patient was sent to the angio investigation (lines 27 and 38).

The surgeon continues with his “defensive” role in the dialogue. In the Part 2 sequence, he adds four more “mm” or “well,” but he also takes more apparently active actions by asking how to interpret what is shown (line 26: “That ventricle is not well, right?” and line 34: “The diagonal will pass?”). That much about the *form* of interaction. What about the content?

I will pick out two topics that seem to be important, in the sense that it is not self-evident how to understand their conditions. The first is about the (left) ventricle, and the second is about stenoses on the LAD-vessel. The ventricle is the first topic and it is commented on. It is calcified, but how it should be assessed is an open issue. “Light insufficiency” is a judgement from the radiologist, but the surgeon is hinting at a more serious assessment (“That ventricle is not well, right?”). The cardiologist comments on the condition of the ventricle, and he bases his argument on indications available before the heart conference (lines 27 and 38) – electrocardiography (“echo”) has shown that the ventricle is OK. The fact that he brings it up twice indicates that he finds this information important and wants it paid attention to. The second topic that, according to the visible interaction, needs to be given a second thought is the stenosed LAD. This is central because LAD is usually one of the three most important vessels of the coronary-artery. At LAD there are two reported stenoses, which are said to be “around 50%.” This is a measure saying that the blockage is so substantial that there is a coronary-artery disease to take into account. The physicians are also concerned about the “diagonal,” a vessel that branches off from the LAD. Might it be affected by the LAD stenoses? It is a question they pose and answer: no, it passes.

Phase 3: Overall assessment

Phase 1 and phase 2 contributed with indications of the condition of the patient’s heart and coronary arteries. A large amount of clues have so far been provided. In phase 3 the task is to distill the significant features out of the range of pieces of information.

When the team has updated and commented on the Patient 4 diagnoses (phase 1) and inspected the angio film, one might expect that the physicians, as they normally do, explicitly state what is the significant problem that is to be taken care of. This does not appear in this case. The team immediately starts to discuss what action to take. The explanation is that the overall assessment is interleaved with the other actions. Given the professional conception of heart disease and given what is shown, it is evident for the members that the aorta is sick and so is LAD, and both of them have to be cared for. The left ventricle, despite calcification and stiffness, is not judged as significantly sick, and consequently there is no need to take measures. Without summing it up explicitly, the team has decided that the aorta and the LAD have to be treated. Based on this, the team continues their work by discussing what action to take in the next step.

Phase 4: Deciding what action to take

Four topics are covered in the third phase: 1) The aorta was diagnosed by means of echo before the investigation in the Angio Lab, and it did not get any further investigation by means of angiography. Nothing brought up in the heart conference suggests that the echo test is not valid, and therefore it is taken for valid. This is implied without saying. 2) The surgeon and the radiologist speculate about the coming bypass operation (lines 40-46). This is very unusual, I have not seen it in any other of the heart conferences I have videotaped, and the physicians soon drop the theme, saying that it is not their problem. So this is a dead end. 3) The patient's conjectured sublimation is taken into account. The cardiologist's calling attention to that (in the first phase, lines 10, 11, 13) bear fruit. 4) A rather high priority is set for the treatment, "one month." although they expect it might be difficult to realize during the summer because of vacations and shortage of staffing. (According to my observations, they usually use the scale: one week, 1-2 weeks, one month, three months.)

40	Surgeon	Thus ... on the diagonal you have to do something surgical between there, right? So that ... the diagonal with LAD (<i>he makes a note</i>)	
41	Radiologist	If you put mammary - LAD distally it will settle	Mammary = Internal mammary artery
42	Surgeon	Was it after you put it, was it?	
43	Radiologist	No, it was between the diagonals, so it will settle	<i>Surgeon makes a note</i>
44		And that makes it easier	
45	Surgeon	Okay. I don't think it will be mammary to LAD, I don't think so. (<i>He makes a note</i>) But this is not my headache.	
46	Radiologist	And mine even less	
47	Surgeon	Then we have to take her a little earlier, if on top of that sublimation is involved	
48		Okay, let's put her on 1 month and then we will see when it will be realized here during the summer. (<i>Makes a note or underlining</i>)	
49	Cardiologist	I think that is reasonable, indeed	

Figure 2c. The Patient 4 case – What action to take?

The voice of the patient

In general, the patient who has qualified to be a patient in the heart conference is not in a very strong position to make her voice heard there. One reason is of course that he or she as a person-patient is not present, but is represented by proxies, first of all the cardiologist, who in particular has that role in the division of labor within the clinical team. True, the person-patient regularly is asked about her opinion as part of the clinical process, and that is normally accounted for in the heart conference. But in her position she is at a disadvantage – what can she say when she does not feel well, and the doctors have tests objectively showing this and that? It is easy to imagine that the person-patient in such a situation has difficulties in speaking with an independent voice. However, this is speculation. Let us see what it looked like in the heart conference I am discussing in this paper. (Thus, here I am not only discussing the Patient 4 case, but all the patients in the heart conference.)

As can be seen from Figure 4, most of the patients at the heart conference indirectly had a say on their own heart-disease problem.

In the clinical praxis of diagnosing a patient, assessments from the life-worlds of the patient are used together with objective tests from science and professional activity. Life-world signs can be reported, as for Patient 12, “Does not even manage to walk on slopes and stairs,” or “May have pains when she lifts her grandchild and when she walks” (Patient 2), or “When effort a substantial feeling of pressure on the chest” (Patient 1). In all cases, you can hear the patient’s “voice” from her life-world. The voice of the patient is always mediated by the cardiologist, and always rather weakly. But it is there. Exceptions are the patients that were not presented at the conference, just mentioned and “acquitted” – no significant problem of the coronaries (patient 6, 8, and 15). One other patient (Patient 5) had no say on her problem. I can only guess why Patient 5 did not have a life-world related indication of her health status. She had got a referral on suspicion of a severe problem (ascending aorta stenosis), a clear risk-indication, and therefore, I imagine, it was judged not necessary to report life-world indications of minor importance. However, my point is not to speculate, but to state what happens in the heart conference. happens is that, as a rule, the voice of the patient comes up in the heart conference, admittedly indirectly and faintly, and mediated by clinical proxies and documentation. It is asked for and it is heard, through evidence from life-world behavior or oral declaration of the patient.

So far, I have talked about what I call “patient’s voice on her problem” (left column of Figure 4). There is also a column for “patient’s voice on treatment,” and with reference to that the picture is quite different. In the heart conference, only two of the patients had a say on their own treatment. Patient 3 wanted a new balloon dilatation, because he had appreciated the treatment he had got the year before, and Patient 16 was reported “not uninterested in surgery.” In addition to that there is an additional voice popping up.

Patient Case No	Patient's voice on the problem (as echoed by medical staff)	Patient's voice on treatment (as echoed by medical staff)
1	"When effort a substantial feeling of pressure on the chest."	
2	"May have pains when she lifts her grandchild and when she walks."	
3	"He got much better from it [PTCA 1995] but now it has grown worse. He has been at the hospital during the end of May and the beginning of June."	Radiologist: "the patient ought to have the last word." Cardiologist: "actually I have discussed this already with the patient and he is thus (1.0) he would (1.0) be happy for PTCA yes, he thinks it was a very good way to (...) the stenoses fit well for that so I think that it ... he was satisfied with the last treatment, he wants to try it again"
4	"Referred because of pains and pressure in the chest. But the patient does not believe she does. She is digging in the garden without pains."	
5		
(6)		
7	"He feels pressure in the chest with radiation to arm and neck when he is stressed and when the weather is cold."	
(8)		
The "Almost Patient"		"He is not sure he will do anything of the kind"
9	"He really is in big trouble."	
10	"Manages to walk on flat ground, but not on stairs and slopes."	
11	"Pressing work, 60 to 80 hours a week."	
12	"Does not even manage to walk up slopes and stairs."	
13	"Has been able to do forestry work, but now he is only able to walk a few hundred meters before he feels pain."	
14	Earlier she was able to walk several kilometers, but now she cannot go down to the cellar without getting chest pains.	
(15)		
16	Light breathlessness caused by hard physical effort, but no pains when in rest.	K: What does he think? Is he keen on ... C: Yes, I really asked him myself, directly after, and he was not uninterested in surgery
17	Daily he has had pressure in the chest, but less than before	

Figure 4. The voice of the patient.

I said above that 17 patients were put on the list for the heart conference in question. This was not quite exact. In fact, an additional patient was put on the list, but he was later removed (The “Almost Patient” in Figure 4.) His case is interesting in several ways. It shows what a strong patient voice may mean. It also sheds light on mundane circumstances necessary for being a patient in the heart conference, circumstances that are so commonplace that we may fail to recognize them. In my further presentation of the voice of the patient, I will start with this second aspect and give an account of how the “Almost Patient” became visible in the heart conference. (See Episode #1.)

Episode #1

When the Patient case 8 had been discussed, a coordination problem appeared between the presenting cardiologist at the Karlskrona site and the surgeon at the Lund site.

Surgeon Let us see (*turns over the pages of the patient journals*). I received
 [name]
 (*the surgeon has a paper besides the pile of the patient journals*)

Cardiologist You can put that aside because we ...
 If you look at the front page, there is a space between the names on
 the first page. There was [name] but we will not present him now
 because he is not convinced that he wants do anything about this.
 Therefore, Peter (*a physician*) will meet him on Thursday.

Evidently there are many things necessary to turn a person into a patient, or a patient of one kind into a patient of another kind. In order to be a heart conference patient, you have already to be a patient in a hospital that is authorized to make a referral to angio investigations. In the present case, the “Almost Patient” was referred by a cardiologist from a regional hospital to the Karlskrona Thorax Clinic, and he was put on the list to the heart conference. At that moment he is a patient, patient number nine according to the front-page list of the patient journals. Then something happened. We do not know exactly what, but he must have spoken up and raised his voice, saying to the cardiologist or one of his colleagues that “he is not sure he will do anything of the kind” (i.e., treatment of balloon dilatation or surgery). Therefore his name is removed from the front-page list, leaving a space between the names of Patient 8 and Patient 9, and he gets an appointment with a doctor to discuss his situation. Now he is not a heart-conference patient any longer. The work of the physicians (which I have described) has turned him to a different kind of patient. After the heart conference had been held, it is obvious that he was not a patient. He was an “Almost Patient.” The hospital documentation of the heart conference will not witness that he had been there at all. (Unless the “space between the names” is sustained in the documentation, leaving a trace, which, in the future, will be far from easy to interpret.)

In my Figure 4 (and in my video tape and log) he is visible. He is one of the three “patients” who in the heart conference explicitly had a say on his own treatment. Paradoxically, his voice was so strong and carried so much impact that he disappeared as a patient.

An activity is a social phenomenon. The interests of many people are involved, which characterizes activity as a multivoiced phenomenon. Let us look at the activity/object in Episode #1 which illustrates how an “Almost Patient” is produced. There some of the actions conducted to sort out the patient and transform him into a non-patient were illustrated.

Let me remind the reader of what Ilyenkov said Hegel said: “It is these forms of the organisation of social (collectively realised) human life activity that exists, before, outside and completely independent of the individual mentality, in one way or another established in language, in ritually legitimised customs and rights and, further, as ‘the organisation of the state’ with all its material attributes and organs (...)” (p. 81)

I have tried to give a description of some of the medical “attributes and organs” of clinical coronary work. I will give a further example. It is from the Patient 3 case. The voice of that patient has already been presented in Figure 4, but this time I add the context, which is a friendly dispute between the surgeon in Lund and, mainly, the cardiologist in Karlskrona.

Episode #2

- 45 (S) shall we do that then?
46 (C) yeah it’s up to you
47 (S) (laughter) or you
48 (C) no no yes I think
49 no but
50 the patient ought to have the last word
51 actually I have discussed this already with the patient
52 and he is thus (1.0) he would (1.0) be happy for PTCA yes
53 he thinks it was a very good way to
54(S) [yes
55 the stenoses fit well for that
56 so I think that it
57 (R) exactly
58(C) he was satisfied with the last treatment
59 he wants to try it again
60 you may listen
61 (S) [okay
62 (S)] you got a new try then
63 (C) (laughs) before the definite cure (short laugh)

There are two issues I want to stress in Episode 2. The first is just to restate what is seen in Figure 4, namely that the voice of the patient is heard also concerning his own treatment. This is not usual. He was one of two patients (three if one counts also the "Almost Patient") for which that came true. The second issue is the dispute that is made visible in the Episode (lines 46-49 and 62-63). The background of this dispute is the fact that coronary diagnostic work in Karlskrona has undergone a dramatic change within a short period of time. In 1992 there was "nothing" of the kind in Karlskrona: the coronary patients were sent to the regional center, the University Clinic in Lund. The following year Karlskrona opened its own angio lab, where coronary angiography was done for patients in the county and a neighboring county. Shortly after that, the videomediated heart conferences got started and soon became a regular practice, until late 1996, when Karlskrona inaugurated its own thorax clinic. The heart conference I present in this paper is from that period (June 1996). To the picture belongs the fact that a thorax clinic in Karlskrona meant a threat to many surgeons in Lund. It took away the business from a private clinic where they had well-paid extra work. In addition, their professional status lost some of its exclusive character, for two reasons: more surgeons became available, and PTCA as a treatment method, which in recent years had become a more frequent procedure than coronary surgery operation, was in Sweden reserved for radiologists and cardiologists. From my fieldnotes, I can see that on several occasions the tensions between Lund and Karlskrona have become visible in the heart conferences. For example, in 1995 the surgeon suggested "Skip that project," apropos the ambition to establish an independent thorax clinic at the Blekinge hospital. Later at a heart conference, close in time to the one presented in this paper, another surgeon teased the Karlskrona team for not getting anything done, now when the decision to start the thorax already has been made; "Haven't you started yet?"

Discussion

In this section, I discuss what constitutes the object of coronary clinical work, and how to describe and analyze it.

The cultural-historical activity approach of my study implies that an activity is regarded as object-oriented. In other words, there is an activity/object dialectic to take into consideration. As a consequence, the question “What is the object of coronary diagnostic work activity?” is equivalent with the question “What kind of activity is coronary diagnostics?” The questions differ in what they focus on, the “product” or the “process”, the object or the activity. Whichever the question, an answer has to give an account of the activity and the object, which are intertwined and cannot be separated, except for analytical purposes. I will deal with these questions by discussing the concept of object of work, starting from Ilyenkov’s concept of the ideal object and using it as a guiding idea for an empirically grounded analysis of coronary diagnostic work as it appears in a heart conference. The ambition is to grasp “the reciprocating movement of the two opposing ‘metamorphoses’ – forms of activity and forms of things in their dialectically contradictory mutual transformations” (Ilyenkov 1977, p. 99).⁶³

The activity/object is a complex and layered phenomenon. In my analysis of the heart conference, I have found it appropriate to discern four phases. *The first phase* is “Updating the status of the patient.” This phase consists of (a) the assessment of earlier measurements and (b) the life-world assessments made specifically for the heart conference. At the same time as it is an assessment, this part of the activity is also “bringing together and bringing to life” that which, so far, has been distributed, and, lately, been inert. Now it is “updated” in a situation.⁶⁴ *The second phase* consists of “inspection of parts,” based upon fresh and advanced measurements that are producing data at the edge of what is possible in the medical culture of today (coronary artery angiography). *The third phase*, “Overall assessment of the patient problem,” faces the problem of grasping the whole picture. There are a lot of data related to the condition of the patient available to the physicians at the heart conference, data fabricated at different times, with different methods, and by different professionals. Some of the data may point in the same direction, some may be seen as contradictory or do not fit together in an obvious way. The problem for the team of physicians at the heart conference is to come to an agreement on the main diagnosis of the patient as it is related to their domain, the heart. *The fourth phase* is the “Decision of action to take.” The main diagnosis of the patient is determined by

⁶³ I think this is similar to what ethnomethodologists term the “interactional what” (e.g., Button, 2000), provided that the object aspect of the interaction is accounted for. However, a comparison between the conception of activity theory and the conception of ethnomethodology is beyond the scope of this paper.

⁶⁴ This “updating” should in no ways be regarded as automatic. The inert artifacts of measurement notations are used in the diagnostic activity. The notations are turned into tools in the diagnostic activity.

treatment procedures that are available⁶⁵ - surgical operation, balloon dilatation, and conservative treatment (“wait and see,” and possibly changing of medication).

What is the object of coronary diagnostic work?

The object of clinical coronary work can be described by means of an application of Engeström’s (1987, p. 87) triangular model of a general activity system. In this case, the subject and the object are the interesting things. The subject is the clinical team of Karlskrona-Lund. The object is depicted in Figure 5.

First phase: <i>Updating the case</i>	Second phase: <i>Inspection of parts</i>	Third phase: <i>Overall assessment</i>	Fourth phase: <i>Decision of action to take</i>
Object as incoming “raw material”	Object as it appears “unsorted” in the heart conference	Object as it is created through clinical work in the heart conference	Object or outcome: Overall diagnosis and recommendation for treatment
E.g., - asthma pains - pains correlated to breathing - echo test indicating aorta stenosis and left ventricle hypotrophy - pains with pressure on the chest - patient seems to ignore her problems - some dyspnea - little leakage of mitralis	- calcification - stiff and calcified mitralis - ventricle not well? - Normal contractions of the ventricle according to echo test	[aorta sick] [LAD sick] <i>(not explicitly stated)</i>	- Surgery on aorta and bypass of LAD - Within one month

Figure 5. The transformations the object of work in the Patient 4 case.

⁶⁵ Or, can be made available, because there is room for innovations as the Patient 3 case (Episode #2) has shown.

According to the analysis shown in Figure 5, the object of coronary diagnostic work is transformed in four phases. The first transformation takes place on basis of “raw material,” which is “produced” as a preparation to the heart conference, and which is possibly informative of the condition of the patient. The clinical activity of the team in the first phase of the patient case transforms the inert “raw material” into a live “actual updating” of the case. In that way the center gets to know what has been distributed “out there.”

The second transformation is an adding on of more recent and (probably) more central information by means of the angio film. The core of the activity here is to go through parts of the heart and the coronary arteries and assess the conditions of those parts.

The third transformation is, on the basis of available pieces of information, to “get the picture,” that is, to lay down what is the problem of the patient. This third phase of overall assessment, as it is displayed in Figure 5, illustrates the shortcoming of analyzing the activity only in sequential phases. The column of the third phase shows that there is nothing to be seen! It is as if the team had skipped this third phase, and jumped directly into phase 4. The only reasonable explanation of this seems to be that the team already has made the overall assessment, in parallel to the inspection-of-parts work done in phase 2. (This indicates that activities occur not only sequentially, but that they are layered and unfold on several planes simultaneously.) The fourth phase is the transformation of the diagnosis into a strong recommendation about treatment. In other words, the consequences of the diagnosis, in the light of available treatment procedures, are spelled out.

Another way to describe the diagnostic activity is through what Engeström (e.g., 1996, 2001) has called the third generation of activity theory, a network of at least two interacting activity systems, or practiced before it had this designation (Engeström and Engeström, 1990). In his 2001 article, the model has got the following shape:

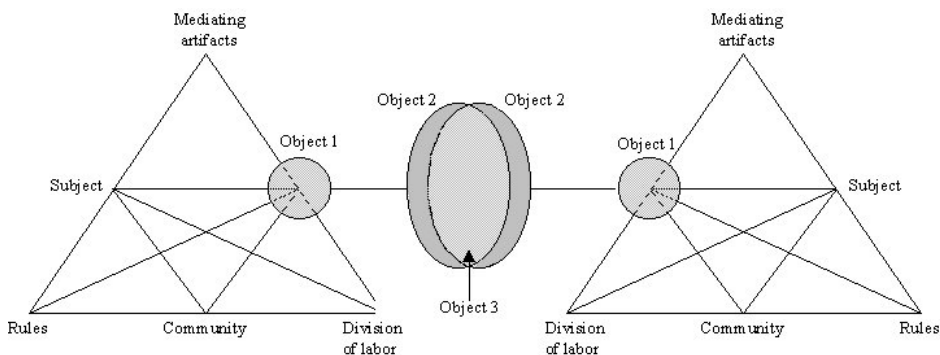


Figure 6. Two interacting activity systems as minimal model for the third generation of activity theory. (After Engeström 2001, p. 132)

Let me, tentatively, use Engeström's model of two interacting activity systems on my heart conference case. One of the activity systems is the one with the surgeons and radiologists in Lund as an actor, and the other activity system is comprised by the cardiologists and radiologists in Karlskrona as an actor. The two activity systems form a minimal network by means of the teleconference system and the more basic infrastructure that make the heart conference meetings function (joint educational and job-cultural background, established routines of communication, telephone, fax, and so on). Object 1 is the "raw material" in the form of the patient history available in paper format and presented orally by the cardiologist in Karlskrona (see left column in Figure 5). It is also the additional "raw material" that is added by means of the angio film and the angio graphics on paper (see second column in Figure 5).

Object 2 in Engeström's example is the "shared patient" between a primary care health center and Children's hospital. Object 2 in my heart conference case is more temporary and fragile. It is a characteristic valid for both of the activity systems, but especially for the team in Lund. They bring the patients' journals to the conference, but usually they have not read the journals before the heart conference, and they form their Object 2 on the fly so to say. The team in Karlskrona has prepared the angio graphics for each patient. On the paper based graphics depicting the coronary artery they have marked if and where vessels are suspicious-looking. Thus, the Karlskrona team is more prepared and has formed an Object 2 before the heart conference. It is not stable however, as it is in the case Engeström has presented. Also, for the Karlskrona team, the Object 2 is revised "on the fly" during the heart conference at the same time as Object 3 is jointly constructed. Object 3 for the Patient 4 case is indicated in column 3 and 4 in Figure 5.

For what is the Figure 6 model useful? As I have said, I did the modeling tentatively, and I will take up the question here for a short discussion of how to make a description or analysis of an activity. The modeling has an empirical foothold in the existing two activity systems that over and over again (every Friday morning, and in addition occasionally in case of emergency) conduct a videomediated heart conference. Therefore, it is not just modeling of imagined activity systems. In comparison to the modeling in Figure 5, where the teams of Karlskrona and Lund are regarded as sub-teams that make up the clinical team, which is the acting subject, the current modeling accentuates the difference between the teams. Such a modeling can be useful, for example to analyze the conflicts between them, which were manifested in Episode #2. However, for the purpose of my analysis, where the conflicts between the two teams are of subordinate interest, the model depicted in Figure 5 is the most appropriate, because it captures the essence of what the physicians are doing: collaborative diagnostic work.

But I will not let go of the question of how to make a fruitful modeling of an activity. A characteristic feature of activity systems is their multivoicedness. In the case of diagnosis and treatment of coronary-artery disease, there are many interests involved, although most of them are without immediate presence in the heart conference. So far

in the paper I have dealt with interests of the Karlskrona team of cardiologists and radiologists, of the team of surgeons and radiologists in Lund, and of the person-patient. A further interest is represented by the Swedish National Board for Health and Welfare, which issues guidelines for the clinical activity and also asks for input for the statistical figures the National Board makes up in order to get an overall grasp of the coronary-artery activity on a national scale. Still other interests are those of the cardiologists at the local hospital who have referred the patients to Karlskrona, and the interest of the people closely related to the patients. All these interests are present in the heart conference, although most of them indirectly.

Of all those interests, the interest of the patient-person is of special importance. It is for him/her the diagnosis and the treatment are made. Nevertheless, not even the patient is directly present in the heart conference, s/he is only re-presented by patient-case documents and proxies in the form of the physicians, particularly the cardiologists.

Let us imagine a vision of the future, where the voice of the patient is louder and more influential. A distinction launched by the German philosopher Jürgen Habermas (1981) may be useful here: life-world versus system-world. The former comprises a spontaneously organized activity. The second is a world of activity systems, systematized mainly by power, money or science. There is a dialectic movement between the two worlds, they mutually educate each other. However, there are two threats against the mutual educative process of the two worlds. One is that the system-world isolates itself too much from the life-world. When this tendency goes far enough, the system world will atrophy. The other threat is that the life-world is “colonized” by the system world. If this happens, the viability of the life-world declines. An actual example could be when the “the emergency treatment model,” which has been so successful within one sector of the health care system, is applied also for illnesses and aging or used in phases of the “health-care-chain” where it is not appropriate. Then the outcome is often contra-productive (as shown e.g. by Gustafsson, 1987), because illness and ailing (at least to a large extent) are preferably handled by general practitioners with access to the patient’s life-world context, or perhaps by laymen within the life-world and sometimes in collaboration with professionals.

Now while the future is not yet here, the different interests are mediated by the physicians. They have to cope with the interests indirectly as part of their work. There are no upholders of the interests present in the heart conference, but the interests are there as “rules” and “professional standards.” The physicians embody the many interests and conflicts in their work practice. The many interests are not negotiated in the open, but are taken care of in an indirect way. This is the way the object of coronary clinical work is formed. Thus, the clinical team members have to be craftsmen “in the small,” but also to be delegates for diverse and public interests. This explains how “object and motive give [their] actions coherence and continuity” (Engeström 2000, p 964), or, in other words, how the object and motive give guidance to their work actions. The multivoiced character of the object and motive also

explains the urge to develop the activity, to find out innovative ways to better accomplish the work, as a way to manage the internal contradictions in the object.

What I have tried to do in this section is to give an answer to the question what the object of an activity is and how to describe and analyze it. Now I want to give a complementary answer by linking up with Keller and Keller's explanation. They took their point of departure in the question "What is it that an individual needs to know to produce an artifact in iron?" Their answer was in terms of schemata, visual imagery and cognition in the individual's head. When they presented, for example, a generalized schema for production of a 'basket twist'" they showed a picture of an anvil and iron bars in different stages of working ups. The schema was thus (for the reader and perhaps also for the blacksmith) a picture, or forged iron bars. I have no objections against the conviction that there is something "in the head" of the actors, but why make that so basic when describing the activity of work? There is the activity of people and there are things that they transform – isn't that enough for their companions to collaborate and communicate with them, and isn't it enough for us as students of their work? Therefore, I want to reformulate Keller and Keller's question and ask "What is it that the subject of the clinical team at the heart conference needs to do to accomplish their work?" – My paper can be regarded as an attempt to answer this question from the perspective of the object of work.

How do aggregates of work actions gain guidance from the object of the activity?

In this paper, I have explored the mutual transformations of activity/object from a special perspective, namely from the perspective of how the object gives guidance to the activity or motivates the activity. It has been actualized through a series of studies I have done on coronary diagnostics and the use of artifacts in the activity (Sutter 1999, 2000, 2001). I have come to the conclusion that artifacts of different kinds – for example, linguistic, graphic, practical-material, and organizational artifacts – play an instructive role in the activity of work. The reason is that they are *made* instructive. Things are designed or redesigned as part of work, and the (re)designing aims at pushing the work a little further and leaving over to or informing others. Things are, to use Ilyenkov's words, "created by human beings for human beings" (quoted after Bakhurst 1991, p. 199). When we encounter a thing, an artifact, we are able to "read" it – at least in part – and go back and trace what activity has been going on here. We are also able – I quote Bakhurst (1991, p. 197) – "to reproduce the forms of activity that endow the world with ideality, to mould one's movements to the dictates of the norms that constitute humanity's spiritual culture." It is from activity things get their instructive power. In other words, to become a human means learning to cope with a world already endowed with meaning, and in this world things are not mute, they speak and one has to learn what they say at the same time as one learns the speaking and doing of the other inhabitants of the world.

In my earlier studies, which had a focus on the interactional use of artifacts in the work activity, the object of work kept popping up. Already from the first paper (1999) I have claimed, and suggested by examples, that the object of work is central in the activity, but how the object of work is constructed and is made essential was not demonstrated in detail. In this paper, however, with its focus upon the object of work, my aim has been to make a detailed analysis of just this. I have also suggested that, generally speaking, the patient is the object of work. But also, that what makes up a patient case has to be explored and shown in detail.

From the perspective of activity theory, it is obvious that the object of work has a guiding function for the work practice. The object of an activity is the “true motive” of the activity, as Leontiev says, or in other words, “It is exactly the object of an activity that gives it a determined direction” (1978, p. 62). If this is so, then the guiding function of the object is part of the “language game” of that perspective. Therefore, I have argued, the interesting thing is to go further and ask *In what ways?* The answer that my investigation has given is that the guiding function of the object of work comes through in (at least) two intertwined ways:

There is a guidance from the *object/activity*, the “given” (the tradition, the infrastructure, the “raw material”), which controls and regulates what ought to be done. There is also guidance from the *activity/object*. The “processing of the raw material,” the possibilities, the openness that always characterize activity and actions are regulated through “negotiations” of what ought to be done, and of what might be fitting and appropriate. There are many voices heard, many actors and interests involved. The “negotiations” are dialogical and conflicting and embodied in the work of the clinicians.

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