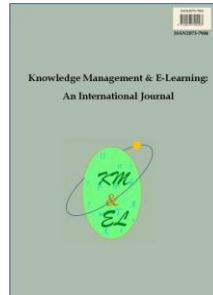


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Interacting orientations and instrumentalities to adapt a learning tool for health professionals

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Abstract: Web-based instructional software offers new opportunities for collaborative, task-oriented in-service training. Planning and negotiation of content to adapt a web-based learning resource for nursing is the topic of this paper. We draw from Cultural Historical Activity Theory to elaborate the dialectical relationship of changing and stabilizing organizational practice. Local adaptation to create a domain-specific resource plays out as interactions of orientations and instrumentalities. Our analysis traces how orientations, i.e., in situ selection of knowledge and mobilization of experiences, and instrumentality, i.e., interpreted affordances of available cultural tools, interact. The adaptation processes are mediated by a set of new and current tools that interact with multiple orientations to ensure stability and promote change. *Practice* and *project* are introduced as intermediate, analytic concepts to assess tensions in the observed activity. Our analysis shows three central tensions, how they are introduced, addressed and subsequently resolved. Considering the opportunities help understand how engagement with technology can lead to new representations for introduction to a local knowledge domain.

Keywords: Knowledge construction; In-service training; Adaptation of generic learning tool; Cultural historical activity theory; Nursing practice

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1. Introduction

The inherent complexity of healthcare and increasing use of advanced medical technology has expanded and specialized the roles of all health professionals, including nurses (Sandelowski, 1999). Skilful application of knowledge, accumulation of experiences, and engagement in the practicalities of local practices are vital for specialization and professional performance. Viewed over time, advances in medical technology to aid in diagnosis and treatment are important drivers for this specialization. Moreover, such technologies contribute to blur the professional boundaries and change the division of labour in, and between, nursing and medicine (Snyder, Keeling, & Rationale, 2006). Specialization in nurses' professional practice calls for new competencies, and development of expertise to utilize new tools. Nurses trained in a specialty assume responsibility for taking on complex, technology-mediated functions. Changes in practice often relate to use of these tools in everyday work.

Web-based learning tools are being increasingly used for introduction and in-service training in most professional practices. These tools have several advantages, including flexible access, structuring introduction to work, cost-reduction, streamlining knowledge, and documentation of procedures. The tools also come with the potential to support open-ended knowledge creation in increasingly complex knowledge communities (Muukkonen et al., 2013). However, any generic learning tool must be adapted to the local domain to accommodate specific and new forms of instruction. Participating in the adaptation of tools can enable transformation of practice over time, due to the dual nature of tool-object and the potential resolution of contradictions (Mørch, Nygård, & Ludvigsen, 2010). When implementing new knowledge tools, the planning for, and integration with, local practice is critical (Muukkonen et al., 2013). We have previously illustrated how tools for introduction to local practice combine explanations of expected performance, standardization of guidelines, and procedures and opportunities for collaborative decision-making (Nygård, Mørch, & Moen, 2013).

To further add to the understanding of adaptation of new technological tools for in-service training relevant for everyday practice situations in a profession like nursing, we will report on how processes of knowledge construction unfold. In this paper, we use examples from a process whereby nurses prepare a web-based learning tool to provide training in specialized tasks in Scope-watch practice in a cardiac unit. More precisely we ask: *How do interactions between orientations and instrumentalities play out to mediate local adaptation of a purpose-specific learning resource?* We present an analysis at the interactional level, accounting for institutional and historical aspects, as we scrutinize unfolding interaction and tensions to empirically illustrate orientations and instrumentalities in co-construction of the common, emerging object.

2. Framework for analysing local adaptation of the learning tool

Our analysis is rooted in the understanding of social activity as a "human form of sociality [...] objectified in the use of shared artefacts" (Miettinen & Virkkunen, 2005, p. 443). This is at the heart of the chosen Cultural Historical Activity Theory (CHAT) framework. According to this, human activity is basically social in origin, mediated by cultural tools, and open to scrutiny as dialectical relationships between *what* the activity is directed toward, and *how* the object of activity materializes (Leont'ev, 1978). The concept of activity emphasizes the complex, mediational, and systemic structure of collective formations as they "produce events and actions, and evolve over [...] time" (Engeström, 2008b, p. 26). The object is what actions are directed toward. As such, the

object has a structuring effect on activity, providing direction for actions. In other words; the object of activity informs us of the reasons for people's actions. An object of activity may materialize as outcome, in terms of concrete results or products, but not necessarily so. They can also be of a more imaginary nature. Cultural tools are material and non-material means, that is, modes and concepts, for enabling human activity in the cultural setting. The everyday actions and engagements of humans relate to the overall cultural historical activity of which they are a part (Roth & Lee, 2007). In addition to being directed by shared objects, activity is also defined by a common set of available tools. In other words, there is a dialectical relationship between activity and cultural tools. Therefore, change in activity demands new cultural tools on an action level. This means that engagement with such tools in everyday situations is likely to re-direct activity.

Taking 'human activity' as the unit of analysis shifts the analytical eye from the here-and-now, situated activity to elaboration of instrumentalities and orientation when professionals interact with each other and with local rules, interpretations of obligations, and social scripts of their everyday practices. Herein are mutual dialectical and structural relationships of cultural-historical processes (sociogenetic) and situated, interactive, processes (microgenetic) that produce actual, conceptual, and material artefacts. The concept of *activity* capture historical, long-term processes, and *strings of actions* that members of a social practice use to position themselves in concrete situations. Hence, activity describes interdependency between the *historical* and the *here-and-now*. Instrumentality describes the cultural tools available in the setting *in-situ*. But this concept also refers to how these tools are made use of in various situations. Orientations refer to how people in the setting, on the basis of their prior experiences and knowledge, choose to use these instrumentalities towards materializing objects.

To facilitate the analysis, we introduce two intermediate, analytical concepts: *practice* to focus on on-going, long-term, perpetual institutionalized activities, and *project* to focus on actions with a limited time-span. *Practice* expresses shared, scripted patterns of interaction, and provide resources for interpreting activity and guiding participation in order to stabilize local social practice (Gutierrez, Rymes, & Larson, 1995). *Practice* is tied to collective learning over time, focusing on the community of production and their social relationships. *Project* is characterized by a short time-span and task-oriented participation that often comes with a potential for change. *Project* relates to unfolding interactions, that is, strings of actions and tasks, motivated by the activity itself and the outcomes of the activity (Engeström, 2008a; Miettinen, 2005; Miettinen & Virkkunen, 2005). As analytical concepts, *practice* and *project* offer possibilities to connect analyses of *unfolding* interactions and the cultural-historical activity of which these interactions are a part. Tensions exist among the actions in, and scripts of, multiple activity systems, and potential for redefining what counts as knowledge in the specific setting offers potential for changing situated, practical doing (Gutierrez, Rymes, & Larson, 1995). This implies that *practice* relates to activity systems over time and corresponds with the cultural-historical perspective (sociogenetic), while *project* relates to an intermediate level, corresponding with strings of actions and tasks (microgenetic). However, before entering into analysis, we will provide a description the context of the study and the approach of our methods.

3. Methodological approach

The empirical material selected to illustrate the account presented in this paper is from a longitudinal, multiple-case study that was established to explore transformation of

practice in a Norwegian University Hospital. At this hospital, they sought to implement comprehensive, institution-wide changes to achieve “patient-centric, evidence-based, comparable treatment trajectories” when they relocated to a new, technologically advanced facility. This specific case regarding web-based learning tools for the Scope-watch function in the cardiac unit is part of their institutionalized training initiatives to augment institution-wide change processes.

3.1. Setting

A cardiac unit in a hospital is a technology-rich work environment for monitoring patients with regard to variations in heart rhythm or signs of myocardial ischemia in order to provide early, correct intervention to prevent premature death. The technology setup includes a *central unit*—“the hub”, comparable to a dashboard or coordination centre—which connects and collects information from a number of bedside monitors and mobile units (telemetry). As shown in Fig. 1, the left part is a textual presentation of a procedure for the Scope-watch function; the right is screenshot of placement of electrocardiogram wires and feedback of correct placement. In this context, a *Scope-watch* is a specially trained nurse who oversees outputs from the monitoring devices in order to interpret heart rhythms of patients under diagnostic, cardiac surveillance. Traditionally, experienced nurses introduce new colleagues to Scope-watch work individually, conveying accumulated experience and recommending local best practice. This has gradually been complemented by topical seminars regarding cardiovascular monitoring, more specifically 1) interpretation of normal heart rhythm, 2) arrhythmias, 3) advanced cardiopulmonary resuscitation, 4) a practical introduction to the cardiac unit, and 5) formal explanations of Scope-watch responsibilities. When design of the learning resource began, new work descriptions for a) tasks and responsibilities as Scope-watch, b) principles for monitoring in the cardiac unit, c) telemetry monitoring of patient in other units, and d) pre-hospital electrocardiogram became available. In addition, work to formalize a description of “monitoring patients post-percutaneous coronary intervention (PCI)” was on hold.

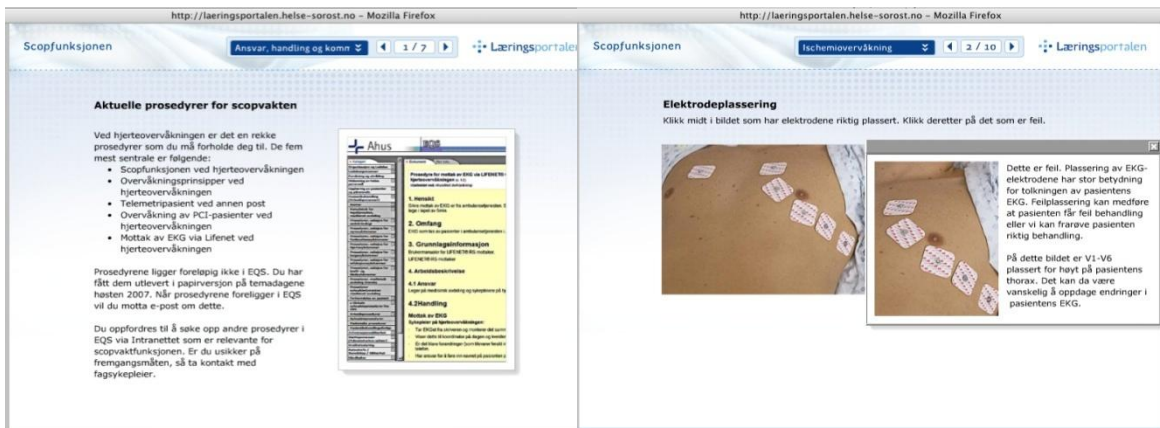


Fig. 1. Technology setup for Scope-watch

The generic Learning Management System (LMS) came with a specific interface and media repository for storing, grouping, searching, and manipulating content. An integrated, add-on authoring tool provided a set of templates with which to construct, represent, and publish content. The templates combine text and pictures to present

content or create exercises, for example, complete statements or tasks, a multiple choice quiz, drag-and-drop and video/Flash sequences.

The unit of analysis used in this particular paper was the way in which members of the project interacted in planning the future learning resource. Their activity is directed toward the imaginary new learning resource, and we discuss this process as co-construction of the emerging object.

3.2. Participants

We observed a group of four registered nurses (RNs) during the process, in which they were given time off from their everyday work to prepare a domain-specific, web-based learning resource to train colleagues for the Scope-watch function. Mia, Maria, and Amanda have different levels of experience of working in the cardiac unit. None of the nurses had any prior experience of adapting web-tools. Their work specifically focused on two topics in the introduction program: “practical introduction to the cardiac unit” (see above; topical seminar 4) and “formal explanations of Scope-watch responsibilities” (see above; topical seminar 5). They had participated, as tutors, in an introductory course of the learning tool to be implemented. Mia is an experienced Scope-watch nurse, bringing practical experience, and she has interacted with patients undergoing heart monitoring on a daily basis for several years. Her contributions to the interactions are often narratives explaining current, everyday practice in the unit. She also has a very positive attitude toward technological learning aids, and some experience in using such tools. Marie and Amanda are critical care nurses, experienced in Scope-watch, and responsible for in-service training and introduction of new staff. They contribute deep insight regarding the theoretical side of the knowledge domain, and experience with learners that are novices to the Scope-watch function, to the interactions. They also have experience of adapting generalized best practice into local work descriptions. The fourth group member, Ann, also an RN and critical care nurse, worked in the competency department and participated and led all project meetings. She contributes to the learning tool as the local expert. Mia, Amanda, and Marie acted as the experts on local practice; that is, everyday work and introduction to Scope-watch practice. Ann represented the project side and contributed with her knowledge of the tool and the framing of the project in the organization. All four nurses actively participated in the adaptation process, although Ann only joined in the conversation on particular issues, as we will exemplify in the third extract shown in Table 4.

3.3. Empirical material

Our data corpus for this case study include 20 hours of videotaped observations from seven project meetings and a pilot test session (all digitalized and transcribed), seven interviews with key healthcare professionals, 12 hours of field observations in the cardiac unit, a tool-analysis of the emerging website (learning environment), and purpose-specific documents¹ from the institution. The most important purpose-specific document was a manuscript explaining content, use of LMS, and the authoring tool to construct the future website. The manuscript is here referred to as a user requirement description

¹ Documents are, for example, current instructional texts, project documentation linked to implementation of web-based learning, and written work descriptions.

(URD), written in Word and used throughout the development process to construct and reconstruct the content and adapt the learning tool to the local setting.

The first author collected all the empirical data. For video recording, we used a camera on a stand and an additional table microphone. This made it possible for the observer to take notes and look at the monitors used during the meetings. As a semi-participant in the interactions, the most time was spent in observing, and occasionally contributing to, the conversation. The video-data were then digitalized and transcribed. The transcripts underwent a preliminary analysis, in which we identified episodes for detailed analysis to trace interaction where tensions arose in the material.

3.4. Analysis

We present an interaction analysis of video recordings of the group's unfolding activities and negotiations for selection of content and presentation in the emerging learning resource (Jordan & Henderson, 1995). In the initial review of the data corpus, we found that available, written work descriptions complemented the URD and the learning tool itself, and were central purpose-specific resources for their co-construction process. For detailed empirical analysis, we selected video extracts showing critical episodes from three planning meetings. These extracts were selected for two reasons: 1) during initial review of the data we found that interactions in the planning meetings revealed tensions that influenced the adaptation of the learning resource, and observations of follow-up and production of the documented plans, and 2) these episodes allowed us to trace different orientations and instrumentalities, how they interacted and the way in which tensions were either resolved or left unresolved. Excerpts to illustrate these three dimensions and how their clarification adapts to the learning resource are included in this text.

The analysis of interactions, when planning content in the learning resource, illustrates interactions of instrumentalities and orientations, and exemplifies how central resources such as affordances in the LMS and the URD mediated the group interactions to construct the learning resource. We will trace individual orientations in the processes of tension resolution and analyse how the group members' orientations are mediated by cultural tools. We seek to grasp how the emerging object is negotiated and constructed in unfolding interactions. Addition of a systemic perspective includes institutional and historical dimensions of the activity (Engeström, 2008b), and points to how the new instrumentality of the object of activity is co-constructed during the development process. The systemic perspective enabled us to analytically relate insights from the interactional data to the mutual impact of sociocultural community. The data extracts are presented in chronological order of the unfolding co-construction process.

4. Findings

The group settled the overall purpose of the learning resource: to clarify responsibilities, and explain how the Scope-watch should be carried out and facilitated for efficient communication with other nurses. Our analysis illustrates their unfolding interactions to adapt the web-based resource to meet this overall purpose and goals. Each extract illustrates a recurring pattern, where tensions materialize, are acted on and either resolved or remain unresolved. We refer to the tensions as "*representational aspects of the learning software*", "*settling core aspects of the knowledge domain*", and "*representing a knowledge domain—work descriptions as resource*". The notations used in the excerpts are described in Table 1. Before presenting each extract we give a short contextualization,

and then the data extract is followed by an empirical analysis of the interactions. This findings section is followed by a conceptual discussion and some concluding comments.

Table 1
Descriptions of notations used in the excerpts

Notation	Indicating
[...]	Excluded speech from the person speaking
((text))	Comments/explanations of the interaction (researchers' added explanations)
[Text[Talking on top of each other
(...)	Short pause in talk, 0-0.5 seconds
::	Cessation of talk
<i>Italic</i>	Written text read out loud

4.1. Representational aspects of the learning software

The illustrating interaction took place during the second project meeting. The participants elaborate on how to utilize different representational modes in the learning tool while working on the URD. They discuss admission procedures. As shown in Table 2, the excerpt begins as Mia follows up on Marie's suggestion of incorporating a Flash film to aid in further explaining how to start heart monitoring.

Table 2
Extract 1: Exploring how to present a core admission procedure in the learning resource

1.	Marie:	Well, I was thinking of the one (application) that runs like a film [...]
2.	Ann:	Yes, One of those Flash-films?
3.	Marie:	Yes.
4.	Mia:	((You mean to)) make a Flash film from the Scope as well as the admission on the bed ((monitor by the bedside)) ; is that what you are thinking?
5.	Marie:	Yes, maybe; maybe the one with hot spots would be good, because that's a screen shot, but the other one[...]
6.	Mia:	If you think admission[
7.	Marie:	[but in the patient room, it might be a good idea, m-hm?
8.	Mia:	That might be a good idea, because you do a lot of stuff, sort of
9.	Marie:	M-hm!
10.	Mia:	and it states illustratively what you are doing step-by-step and you see the whole thing; should we go for that, then? Yes.

As shown in the example, the group's discussion revolves around how to introduce the technologies present in the cardiac unit, and performing according to best practice. They discuss how to represent "admitting a patient to ischemia monitoring". Being proficient in this is a core learning goal, and points to the advisory and bridging responsibilities of the Scope-watch. The interaction centres around two central work procedures, one performed by the Scope-watch nurse at the "hub", and one performed by the nurse admitting the patient to the bedside monitor. Marie and Ann are oriented

towards the affordances of the LMS and authoring tool (turn 1-3). Mia asks Marie to clarify if she suggests representing the two work procedures for ischemia monitoring (the whole) separately as two sequences (turn 4). She directs the talk toward everyday work. Mia's line of questioning seeks to clarify if admission of patients to the "hub" and to the bedside monitors should be presented as one or two workflows. From her point of view, representation of the admission procedures as two separate representations illustrates a workflow that is not in accordance with her position. Marie then modifies her previous utterance, suggesting an alternative presentational mode in the learning software, "use screenshots", to illustrate the steps necessary for successful admission to bed-monitor (turns 5 and 7). Hence, she seeks to bridge her own position with Mia's position, when she suggests alternatives to represent admission of a patient to ischemia monitoring, in terms of the workflows at the central unit and the bedside. Mia acknowledges this bridging-operation (turn 10) and supports Marie's new idea of giving a step-by-step illustration of all components in the admission process in the learning resource.

In the above interaction, the LMS and authoring tool's available functionalities provide instrumentalities to mediate local knowledge construction, observed in how they negotiate, build consensus, and select alternatives to represent ischemia monitoring in the cardiac unit. Two central orientations surface; one is directed at using experiences from the practical, everyday work from the cardiac unit to explain, reflect on, and potentially change aspects of current practice, while the other is directed toward the potential of the learning resource and points to the projective aspect of the emerging object.

Negotiations in how to organize the content of the learning resource appear to be mediated by the available sets of templates and opportunities for using available representational modes in the learning software. A central issue is whether ischemia monitoring should be represented as one or two separate workflows. This is illustrated as a tension between cultural tools of existing practice and new instrumentalities represented by the web-based learning tool's different options for structuring. Representing actions at the "hub" and actions around the bed monitors as two separate workflows implies a change in how they may view their everyday practice. To settle this core issue, "admission to ischemia monitoring", they agree on Flash application to illustrate the steps for ischemia monitoring at the bedside monitor and at the hub (central unit). To support best practice they suggest that the Scope-watch oversees, and carries overall responsibility for, the process to set up ischemia monitoring, including overseeing the actions of the nurse at the patient's bedside. This dilemma of having two workflows in ischemia monitoring is tied to the analytic concept of *practice*, as the current social scripts regulating current Scope-watch practice are questioned and change is suggested.

4.2. Settling central aspects of the knowledge domain

The group proceeds to discuss how to add more resources to address other frequently encountered problems with ischemia monitoring. The next extract shown in Table 3 is also from the second project meeting. Here, they elaborate on how the Scope-watch can notify the attending, patient-responsible nurse to apply bedside monitoring, if the setup procedure is not performed correctly and the output on all monitors becomes unreliable.

Table 3

Extract 2: Negotiation of a problem situation in heart monitoring and discussion of the Scope-watch's role

1.	Amanda:	In my mind, the Scope-watch sees that it's not applied ((ischemia monitoring)); only 10 wires are applied and not the others, and then you as the Scope-watch informs the attending ((nurse)) that you haven't applied 10-channel; can you do that? No, I don't know how one does that; you have to show me, right? And then you could add one of those [
2.	Mia:	[One of those Flashes?]
3.	Amanda:	[Flash-things
4.	Mia:	OK.
5.	Amanda:	No, I don't know. It's only a suggestion.
6.	Mia:	Then that would be the next[
7.	Amanda:	[because that is often the case, they[
8.	Mia:	Yes, the patient admitted. Well the NURSE admits ((applies)) the patient, it says[
9.	Amanda:	[haven't applied 10-channel ((monitoring))
10.	Mia:	Nurse:: But I think that we should have a picture of correct application of the electrodes, because we mess that up so much so it's not even funny; V6 ends in all directions from just below here, to ALL THE WAY over here ((illustrates by pointing to her own torso)). That's not how it should be(...) should we include a picture of how it is actually supposed to look?

In this interaction, the nurses elaborate on how to represent ischemia monitoring of admitted patients to achieve the following instructional goals: a) provide information regarding correct wire application for bedside monitoring, and b) support communication and guidance by advising when it is appropriate for the Scope-watch to give instruction to the patient-responsible nurse. Amanda's utterance (turn 1) is oriented toward practical work. She describes the common situation in which the Scope-watch cannot commence ischemia monitoring at the hub because the patient-responsible nurse has applied the monitoring wires in the wrong positions on a patient's torso. Mia (turn 2) directs attention to the learning software by asking Amanda to clarify what would be represented in the Flash application. Amanda elaborates on alternatives and argues her position by referring to recurring problems in the Scope-watch practice (turns 7, 9). Mia suggests sequential build-up of the learning resource (turn 6), again directing attention to the software, and what they wrote in the URD (turn 8). She focuses on the actions at the bedside, directing attention away from the Scope-watch (turns 8 and 10). This indicates that Mia acknowledges the correct placement of monitoring wires as a primary instructional goal.

The above interaction is a good example of how to combine practical work with knowledge tools to represent best practice, and how the learning resource can support interaction between the Scope-watch and patient-responsible nurse. Their collaborative discussion centres on how the learning resource can address a common situation in which errors lead to deficiency or unreliability in "ischemia monitoring". A central feature is to support the Scope-watch's communicational aspects, and their suggestion means another deviation from current social scripts in practice. Two orientations are traced in their discussions to frame the learning content. One emphasizes frequently used instructional methods in healthcare, learning from solving problems in simulated and unscripted practice situations. The instructional software represents a constructed episode that can be

linked to local practice, and by solving this, and similar typical problems, the learner can prepare for comparable situations in everyday practice. This orientation links best practice formalized as written work descriptions to everyday tasks. The other orientation seeks to expand Scope-watch actions, assigning overall responsibility to the Scope-watch. To support this change, they suggest including basic information regarding the way in which electrodes are applied, through use of visual representations of the correct procedure performed by the patient-responsible nurse.

4.3. Representing a knowledge domain – Work descriptions as resource

In the two previous extracts, the participants talk of available resources points, although somewhat implicitly, to available scripts as being one of the regulating resources. In extract 3 (see Table 4), from the third project meeting, they explicitly include work descriptions as central cultural tools for the development of the learning resource. The excerpt is from the tail end of the meeting. Their talk around presentation of work descriptions began as a choice to either copy material from the work descriptions to the learning resource, or to include hyperlinks to direct the learners to the relevant work descriptions.

Table 4

Extract 3: Work descriptions as a resource for negotiations around meaning potential of the learning resource

1.	Mia:	Did you add the procedure, too, that has to do with:: about monitoring ((monitoring patients post PCI)) ?
2.	Amanda:	No, I haven't ((added)) the ones that have to do with principles for monitoring according to PCI.
3.	Ann:	But you have corrected this, but anyhow I think that we, this is what it should be all about.
4.	Mia:	Because it was this ((procedure)) . I suggested that we should add, because it's highly relevant, because we receive the patient directly from the emergency room, comes up to us, and then it's up to the Scope-watch what kind of mon:: ((itoring)) we choose in practice before ((the patient)) is seen by the physician.
5.	Amanda:	This is why we need to include this one as well.
6.	Marie:	This is important.
7.	Mia:	Often people are put on telemetry while they would be better off on 10-channel; it is arbitrary.
8.	Amanda:	What is it called?
9.	Mia:	It's called <i>procedure for monitoring according to PCI</i> . It is displayed at the hub (Scope), I think.
10.	Marie:	It's in as well ((digitalized and documented in the EQS, which is the hospital's knowledge management system)) .
11.	Mia:	Yes, it's in the EQS, too, I think so.
12.	Marie:	Yes, I'm the one responsible for:: but I think it's, it is still not approved.
13.	Mia:	This was the one we talked about going through, and then we said because of lack of time, no, that we concentrated on the ((4 procedures; a-d)) , but it should be included because it actually controls a part of it[...] because the Scope-watch decides in practice even if it's the physician that should decide type of monitoring.

In this interaction, Mia asks for a particular work description, “monitoring patients post-PCI”, in the URD (turn 1). Amanda confirms that this work description is not included (turn 2). Ann takes action to close the discussion by stating that the corrections have already been made in the URD, as they decided to drop “monitoring patients post-PCI” as a theme from the learning resource in an earlier meeting (turn 3). Mia holds them back with an example from everyday work in the cardiac unit to clarify why she again raised this particular work description, “monitoring according to PCI”. According to Mia, the Scope-watch frequently chooses type and level of monitoring when a patient is transferred to them after a PCI, before being seen by the attending physician (turn 4). She stresses the importance of the Scope-watch’s qualified decisions regarding type and level of monitoring for this patient group. Amanda and Marie support her justification (turns 5, 6). Mia follows up by exemplifying variability in the selection of monitoring strategy. She upholds the assertion that, without proper work descriptions, the selection remains arbitrary (turn 7). Amanda redirects the negotiations, asking for the exact name of this particular work description, in order to write it into the evolving URD (turn 8), and also discusses how to access the work descriptions in the learning resource (turns 9-11). Marie introduces the institution’s efforts to consolidate, update, and digitalize work descriptions at the hospital, and explains that the procedure in question is pending approval at local management level (turn 12). In concluding this interaction, Mia revisits their initial decision regarding how to use and include the work description in the learning resource, and uses current issues in the Scope-watch work to justify a revisit of this issue (turn 13).

The nurses’ interactions clearly exemplify how written work descriptions are used as resources for tension resolution. Day-to-day experiences in the cardiac unit, where the Scope-watch enters the domain of physicians, and actually selects the monitoring strategy for patients transferred directly to the cardiac unit, drive the interaction. Their solution is to suggest formalization of this in a work description. A work description could explain and regulate selection of monitoring strategy, and we see how they discuss ways of potentially changing current practice by formalizing new work descriptions.

4.4. *Summing up*

Three tensions are central in the presented data, and the excerpts of participants’ interactions exemplify how they are addressed. The first and second tensions are choosing whether content should align with institutionally approved knowledge in work descriptions explaining best-practice, or if the starting point should be problems in everyday situations. The third tension is tied to the newly introduced web-based learning resource’s tools for pedagogical design. The first tension deals with the envisioned use of the learning resource and crystallizes in the discussion of access to work descriptions; either as re-presented, integrated content in the resource or hyperlinked to the work description in the digital repository. This tension is resolved when the nurses agree that learners ought to be familiar with the work descriptions, and the suggestion for hyperlink is not contested. The learning resource should support use of work descriptions as guidelines, rather than proposing any actual work description. As such, the co-construction is directed toward the envisioned learner as end-user. The second tension surfaces as the interaction goes beyond discussion of how to represent ischemia-monitoring to focus on how practical work can be informed by written work descriptions and *vice versa*. This tension is illustrated in how they orient themselves differently to everyday work and written work descriptions. The technical affordances in the emerging learning resource mediate the talk and bridge different orientations. The third tension

deals with dilemmas between written work descriptions explaining best practice and everyday realities in the work as Scope-watch—a potential for expansion of knowledge domain of the work function. Specifically, the tension relates to Scope-watch responsibilities, elaborated in a critical example when the Scope-watch often selects a monitoring strategy before the patient is seen by the attending physician, and by doing so enters the physicians' formal responsibility, as monitoring strategy is an essential part of the medical treatment. Co-construction is directed to expansion of the end-users' professional role. An approved work description could explain, delegate, or regulate the selection of monitoring strategy.

5. Tensions in orientations and instrumentalities for the co-construction

The findings presented here illustrate how the group of nurses interacted to prepare the web-based learning resource for specialized practice as Scope-watch in a cardiac unit. The tensions traced in the data point to how central instrumentalities and orientations contribute to co-construction of a common, emerging object. These tensions illustrate interacting instrumentalities and orientations, and tension resolution is illuminated in different orientations. As shown empirically in the findings, and illustrated in Fig. 2, three central orientations are at play, two of which are mediated by tools tying in to *practice*, while the third is mediated by tools tying in to *project*. The three orientations intersect with current and new instrumentalities in the setting, as illustrated in Fig. 1.

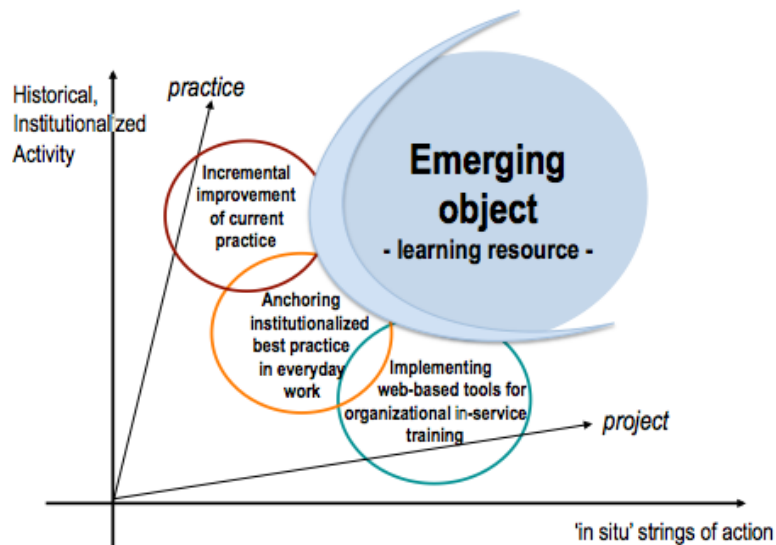


Fig. 2. Orientations in construction of the participating nurses' emerging object

In Fig. 2, the shared, emerging object, the learning resource, is depicted in how the participants position themselves, by their talk during co-construction of the web-based learning resource. We will discuss the three orientations and constructed instrumentalities in relation to the analytic concepts of *project* and *practice*. Our focus is on how affordances in the new knowledge tools in-use mediated planning, and how adaptation was mediated by discussions around written work descriptions.

5.1. Orientations

The three orientations we identified intersect and contribute to co-construction of the emerging object; the web-based learning resource. These orientations negotiate two parallel and intersecting practices; work practice and learning practice. In Fig. 2, the first orientation: I) *Incremental improvement of current practice* summarizes everyday work as Scope-watch. This focuses on typical problematic situations or deficiencies in the workflow. The second orientation: II) *Anchoring institutionalized best practice in everyday work* points toward desired institutionalized best practice, illustrated in how participants elaborate on work descriptions and the potential use of the learning resource. The third orientation: III) *Implementing web-based tools for in-service training in the organization* elaborates on institutional interests to implement web-based learning tools for organizational training and knowledge development. These orientations are manifestations of historical objects that interact and give direction to the co-construction of an emerging object (Miettinen & Virkkunen, 2005). The time dimensions, and their inherent temporalities, produce diversity that affects how the work in *project* unfolds, and how the nurses relate to Scope-watch as *practice* and target for intervention.

The interactions of these diverse orientations are mediated by current work tools, and are complemented by the new set of presentation tools available in the LMS to construct the emerging learning resource. Adaption of the learning resource involves introduction of new technical tools, and learning how to use these, as well as to specifically adapting these tools to a local domain and concurrently achieving best practice. The negotiations around the learning software's different representational modes exemplify attempts to interpret and use offered instrumentalities in this new technological tool to plan for the emerging object. The nurses' dialogue in extract 1 gives direction to the emerging object in line with orientation I, *incremental change to current practice* (see Fig. 2). Incremental change supports refinement of a shared repertoire of expertise, and relates to *stabilization knowledge* (Engeström, 2007). Positioning talk as orientation I strengthens current practice, reflecting on, and alleviating problems in, everyday work, but does not move beyond the established role of the Scope-watch. Orientation II, *anchoring institutional best practice in everyday work*, is promoted in talk around organizing content as intertwined strings of action. As this way of organizing knowledge is not in accordance with current, scripted practice, this orientation holds potential for transforming one aspect of practice. However, in the first extract, the arguments in accordance with position II are promoted, but are not followed through. When project members interact with a common instrumentality, such as the learning tool, talk goes beyond the current division of labour in the scripted practice that currently regulates the Scope-watch. The project members express different, individual orientations anchored in parallel scripted practices (Gutierrez, Rymes, & Larson, 1995). The individuals' orientations contribute to the pedagogical design in different ways during co-construction. Orientation III, *implementing web-based tools for in-service training in the organization*, illuminates destabilization of current knowledge practice and attempts to transform institutional practice. Institutional motives relates to general demands for cost-effective healthcare organizations (according to market value), along with an emphasis on research-based knowledge and evidence-based practice. This orientation strongly influences pedagogical design and future framing of the learning resource, explicitly discussing learning goals, representational modes, and general framing.

5.2. Instrumentalities

The orientations interact with new and current instrumentalities, mediating the implementation process. To change learning practice calls for new instrumentality, which consists of new tools in constellations with established resources and concepts. Institutional incentives surface in the interactions as regulating circumstances in co-construction. How these orientations intersected and how tensions in or between orientations were resolved during object construction were mediated by available cultural tools or instrumentalities in the setting. New instrumentalities were represented in the emerging learning resource and local, written work descriptions proved to be important assets and tension resolvers. A core concern is how to represent accumulated knowledge and make choices fostering change and facilitating transformation. In the findings section, we illustrated how they approached instrumentalities differently, exemplified in how written work descriptions and available templates for representation in the learning resource serve different and explicit roles. Interactions evolve from suggested use of the different representational modes available in the software, focusing on *how* meaning potential should be framed, but not *why* it is important to frame it in a certain way. Written work descriptions, as established cultural tools within the social practice, mediated discussions around how the learning resource could explain and support knowledge related to formalized best practice. For example, ischemia monitoring is currently regulated by two different work descriptions. The work description '*tasks and responsibilities as Scope-watch*' describes actions of the Scope-watch, emphasizing follow-up and correct application of technical equipment. The work description '*principles for monitoring in the cardiac unit*' recommends actions for the patient-responsible nurse and provides guidance on how to apply electrodes to a patient's torso for reliable monitoring. These local work descriptions represent formalized knowledge tied to ischemia monitoring, and seek to anchor institutional best practice (orientation II) in everyday work. The learning software mediates new ways of presenting and representing this knowledge, in line with orientation III.

Written work descriptions are cultural tools that represent the knowledge domain. They are scripts that inform the users of how to handle certain situations in a healthcare setting. Work descriptions also come with opportunities for constructing knowledge in the particular situation in which they are used (Nes & Moen, 2010; Timmermans & Berg, 1997). They can also be resources for transforming the object of activity. Work descriptions are situated when their contents are adapted to inform everyday work, and they evolve culturally to reflect or motivate improvements in the knowledge domain over time. This implies that written work descriptions carry instrumentality for constructing and stabilizing local situations to balance accumulated experiences and scientific knowledge in practical hospital work.

The work descriptions in the cardiac unit are shared representations of accumulated knowledge and expertise. Work descriptions are tools for local practice, providing common rules and guidelines for the Scope-watch function and resources for adaptation of the learning resource. These scripts for practice are not set rules, rather, they are subject to change and modification. The interaction in extract 3 illustrates how an orientation toward current practice (orientation I) unleashes talk that goes beyond existing formalized knowledge. This is illustrated in the discussion of adding a work description that is not formally approved (monitoring post PCI). We may see that locally adapted work descriptions are instrumental in development and at the same time exposed for constant change. This tension is resolved by an in-depth discussion of the everyday work of Scope-watch, and in relation to, not yet formally approved, work descriptions. The interaction illustrates the dialectical relationship between formal work descriptions

and everyday work. An important implication for future co-construction of new instructional activities is to explain detailed content of the new learning software and adapt to the local domain. This time-consuming, yet crucial, part of the adaptation is in constant tension with project members' ability to produce learning content within the given time frame.

5.3. "Project" – "Practice" in co-construction of the emerging object

As shown, planning for the learning resource was mediated by a new set of web-based learning tools, and how these could interact with current cultural tools and every-day practice in the cardiac unit. Our analysis demonstrated how interactions of, and tensions in and between orientations and instrumentalities mediated adaptation of the learning resource. To further elaborate on how the emerging object was co-constructed, we applied the analytic concepts of *practice* and *project*. These two concepts are dialectically related, and show how implementation of new cultural tools and knowledge intersect with every-day work-practice and current expertise in planning the learning environment.

In this study, *practice* points to two distinct and intersecting angles. The first of these relates to use of the set of tools and concepts available to develop the web-based learning resource for learning in introduction to the new practice. The second relates to how the participants orient themselves toward local work and current practice in the cardiac unit. Both aspects are mediated by formalized knowledge represented as written work descriptions. The angle of learning new practice and the angle of institutional practice mediate the interaction, and serve as instrumental in the planning of the learning environment. Fig. 2 illustrates how *practice* ties into orientation I, *incremental improvement of current practice*, when common problems in everyday work are raised as being important in co-construction. *Practice* expresses shared, normative patterns of interaction. Standards and formalized knowledge are resources for interpreting activity and guiding participation within the local social practice (Gutierrez, Rymes, & Larson, 1995). Stabilizing elements are core aspects of *practice*, important for maintaining and gradually improving current practices. To a certain extent, professional members of a practice require comparable levels of expertise and access to a shared repertoire to address conflicting input in terms of signs, symptoms, knowledge, or experience (Eklund, Mäkitalo, & Säljö, 2011). This is often referred to as standards for work. One way to understand standards is as "...material and discursive constructions that organize the world and our professional life" (Nes & Moen, 2010, p.377). Therefore, the repertoire of standardized knowledge expressed in *practice* is challenged when expansion requires transforming and externalizing knowledge and expertise. To adapt global standards to recommendations for local work involves relating and making them relevant for everyday work (Timmermans & Berg, 1997). In this study, the institution's formalized work descriptions served as standards and, as such, had a stabilizing impact on the emerging new learning tool. These work descriptions mediated discussions around how everyday work may be regulated. This is reflected in orientation II, *anchoring institutionalized best practice in everyday work*, emphasizing the realities of everyday activity. Discussion in accordance with this orientation centres on written work descriptions as being one of the tools for guiding improvements of concrete work situations, rather than as set rules. This is explained in elaborations on how to formalize support for the Scope-watch as an expert in heart monitoring and coordinator between bedside monitoring and central monitoring unit. This orientation focuses on support for learning instructional work. As such, it contributes to bridging the gap between current, everyday doing and future practice, using situations in everyday work that are not always supported by formalized work

descriptions as a start for change efforts. In such situations, the evolving learning resource becomes a possible tool for constructing knowledge based on everyday experience. As mediating means for future learners, the proposed solutions expand efforts to formalize more work descriptions that can regulate intended engagements with everyday situations.

In our findings, *project* refers to situations in which co-construction centres on change and possible transformation in the approach to future practice-related problems. Fig. 2 illustrates how orientation III, *implementing web-based tools for in-service training in the organization*, ties most in with *project*. This orientation illustrates potentials for transformation of institutional practice. An important aspect of *project* was how tensions arose and how these tensions were resolved in the interactions. The learning resource as an emerging object gave direction to *project*. *Project* points to zones in which individual orientations intersect and weave fragmented knowledge together to solve concrete problems or challenges by collective interactions among activities and professionals' individual "knowing in practice" (Bruni, Gherardi, & Parolin, 2007). This relates to optimized division of labour, specialization, and unscripted production, which comes with the potential for constructing and reconstructing knowledge (Kerosuo, 2006). Explanations of the envisioned role of users or learners enabled the project members to include instructional support, for example, an opening for future formalized work descriptions that would seek to regulate situations. Such situations occurred when the three orientations intersected in co-construction, and opens up the possibility of changing situations in which tasks are not formalized in a work description.

The learning resource is an emerging object directed at how to support such a transition to the future state. Interactions evolved as the nurses resolved tensions and gained knowledge of how to utilize the technical aspects of the emerging learning resource. This evokes talk around how the learning resource can mediate future Scope-watch practice by including new instrumentality in the form of not yet formalized work descriptions. The analysed tensions illustrate how co-construction of the object evolves over time, mediated by new and existing instrumentality given by affordances in the learning software and written work descriptions.

6. Conclusion

In this paper we have followed local adaptation of a learning resource. We discussed the process of co-construction as interaction between orientations and available (current and new) instrumentality. The findings empirically show how object co-construction is mediated by written work descriptions and everyday work in a specialized knowledge domain. Professionals from two departments in the institution brought diverse perspectives, in terms of knowledge of the learning tool, management policy, professional knowledge, and the local domain to create the web-based learning tool.

Local adaptation of generic software to a domain-specific resource presents end-users with opportunities and tasks related to pedagogical design and changing instructional practice, leading to new representation of a local knowledge domain. This means that users are expected to learn, and concurrently use, a new technical tool to mediate change in instructional practice. Although nursing has a long historical tradition of using technological tools in everyday work (Sandelowski, 1999), web-based learning resources represent a new technology with the potential to change knowledge practices in the organization. Our paper contributes to illustrating this change by providing an *in situ* analysis of the emerging object as a small, but invaluable, piece of a puzzle to grasp and

makes sense of resources for institutional change over time. The contribution points to how co-construction of an emerging object is mediated through cultural tools in processes to design for learning in work-life. The intermediate, analytic concepts of *project* and *practice* proved useful in illustrating the interplay and diversity in orientations to the emerging object. Furthermore, ways to take advantage of new instrumentalities were identified, drawing from different experiences represented by the project participants.

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