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Multi-Level Expansive Learning in Work-Life Networks: Developmental Work Research Perspective

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It is no coincidence that when inter-organizational networks arose as a focus of research notably in the 1990s the perspective taken was that of learning. It was learning that mediated understanding of (industrial) networks' potential in innovation cooperation, profit making, and management. The use of the concept 'learning' varied from loosely, if at all, defined metaphors to elaborated equations of behavioral models. The critical notion in the field of organizational learning stated, 'learning tends to be identified with whatever features and activities managers deem or expect to be functionally beneficial' (Contu & Willmot, 2000, p. 269). The economic orientation seems to have emphasized the outcomes of collaboration, as Gustavsen (2011, p. 475) points out, in favor of structural approaches rather than 'looking at the fairly rich, but often dispersed, literature on change and development'.

Even though the early conceptualizations of network-level learning did not directly speak to educational research, the findings were interesting and invited further elaboration. In networks of innovation, argued Powell, Koput and Smith-Doerr (1996, p. 143), two processes of learning occurred simultaneously and recursively: 'First, firms are increasingly using ties to enhance the inflow of specific information, resources, and products. Second, firms are becoming much more adept at and reputed for the general practice of collaboration with diverse partners.' This resonated with and could be rephrased in the cultural-historical activity framework by using the socio-material definition of the object of activity (Kaptelinin & Miettinen, 2005; Leontiev, 2005). The two processes of learning set networks a twofold object of learning activity, learning-through-networks for the production of goods, services and innovations, and learning-to-network for instrumenting and retooling the dispersed multi-organizational collaborative practices (Toiviainen, 2003). These processes are intertwined in networks' practical actions, but analytically separable and would have to be separated in order to make the understanding of learning richer and the insight in developmental implications more precise.

This chapter introduces the approach of Developmental Work Research (DWR) and the theory of expansive learning, known from the foundational work of Yrjö Engeström (2015). The theoretical basis lies in the cultural-historical activity theory ('CHAT'), in brief, activity theory (Vygotsky, 1978; Leont'ev, 1978; see Roth & Lee, 2007). For a socio-cultural-

historically oriented research the CHAT approach represents an inspiring approach to apply to the studies of work-related learning (Engeström, 2011). In the framework of the DWR the theory is applied to learning partnerships among researchers, practitioners and developers. This takes place typically in and through public-private-funded projects with a society-level expectation to produce models and practices that answer acute challenges of work life (in Finland, see Alasoini et al., 2011).

The next section opens up some of the diversity of the work-life networks and their learning-related challenges. The recognition of work as increasingly dispersed, multi-professional, and interdisciplinary activity changes our conceptions of a workplace and workplace learning. The contribution of Developmental Work Research and three conceptual notions as an analytical CHAT-based resource are discussed in a separate section. Examples of theory development and modeling from three empirical learning network studies in different contexts of work life are given. Reflections on the future research challenges concerning learning in work-life networks closes the chapter.

WORK-LIFE NETWORKS AS PLACES OF

LEARNING

Research of learning in work-life networks started from studies of entrepreneurial learning drawing on the theories of industrial districts and small-firm networking (Deakins & Freel, 1998) and innovation networks in novel and fast-developing technologies such as biotechnology in the 1990s (Powell et al., 1996). Emerging partnerships were recognized as networks of learning and innovation. This contrasted with traditional cooperation in supply chains where the question was rather about combining special capabilities and functions in an optimal way. The studies made a strong argument for the need to learn through networks when organizations are striving for knowledge that they cannot achieve alone. Because of the underlying business logic, learning outcomes were scrutinized from the point of view of single firms (e.g., Powell et al., 1996). In addition, often learning was treated as a by-product of such collaborative processes that turned out to be successful, as Contu and Wilmott (2000) in their critique point out.

The recognition of two other types of networks offered a possibility to expand the learning analysis in two ways. Besides the inter-firm networking, public-private-funded development programs have supported multi-sectoral learning networks particularly formed for work-life innovation where learning is the main motive, not just a by-product of activity (Alasoini, 2008). In addition, the current emphasis on vocational and professional learning at work and simultaneous digitalization of society call for new pedagogical and partnership solutions by the actors of education and work life (e.g., Hattinger et al., 2018). In this chapter all the examples with various backgrounds fall into the category of 'learning networks' in a sense that they have been formed for the special purpose of workplace innovation and development.

The emergence of work-life networks and inter-organizational collaboration added a 'new level' of analysis (Brass et al., 2004; Gittel & Weiss, 2004; Kekäle & Viitala, 2003; Easterby-Smith et al., 2000) and created attempts to conceptualize the links between the levels of learning (e.g. Casey, 2005; Knight, 2000). For some researchers the new level was unproblematic, but the studies also brought out that the theories of organizational learning do not easily lend themselves to the challenges of inter-organizational knowledge creation and development of practices. Besides, like organizational learning, also the studies of network-level learning were criticized for still being 'underpinned by individual cognitivist metaphors' (Araujo, 1998, p. 317). These were the starting points to develop the

methodology of inter-organizational learning within the frame of the Developmental Work Research.

CONTRIBUTION OF DEVELOPMENTAL WORK

RESEARCH

Among the analytical frameworks of the cultural-historical activity theory (Holzman, 2006) DWR is a learning approach (Engeström, 2015). The cycle of expansive learning outlines the steps of the DWR processes (see 'Expansive learning cycles in networks' below). The interventionist methodology draws on dialogue and mutual commitment of academic researchers, developers and practitioners (Engeström, 2005). For developmental work researchers having access to concrete activities in transformation is necessary in order to analyze the emerging learning challenges in the past, present and future, and experiment with the learning possibilities. From the practitioners' point of view the data collected and the analytical tools used offer the means to become researchers of their own work and to act as developers and change agents in their work environments.

Developmental Work Research (DWR) was designed in the 1980s in the context of the Finnish working life as an alternative to the growing industry of staff training and human resource development. According to critical voices heard from both work and development organizations, the training programs and courses often remained detached from the needs of work. The solution was to strengthen the research basis of development, not only by bringing the newest knowledge into the development, but also by turning development into research activity. Developmental Work Research refers to developing through research and researching through developing. The practical applications of the DWR methodology range from the workshop series (e.g., Kerosuo & Toiviainen, 2011) to the Change Laboratory framework (e.g., Virkkunen & Newnham, 2013). New applications to answer the challenges of work and learning in different cultural contexts are being published globally (e.g., de Gouveia Vilela et al., 2020; Mukute, 2015).

In order to develop the analysis of learning in networks I first discuss the activity theoretical concepts as analytic resources of the DWR. When doing so I draw attention to the notions on networks and network research that resonate with the basic concepts making the DWR an attractive approach. The concepts discussed are: the object orientation as the basis of motivation of activity, the concept of expansive learning, and the socio-material mediation of activity.

Object Orientation – Why Networks Learn?

The first notion is that networks combine different kinds of actors and stakeholders representing multiple activities with their own objects of activity (Toiviainen 2003; Toiviainen & Vetoshkina, 2018). Thus, when studying networks as multi-organizational, cross-disciplinary, and multi-professional collaboration we need to address the question of what this collaboration has emerged for, and beyond that, what actually is created in collaboration. Even when addressing established organizations and institutions, developmental research rather questions the object of activity investigated than takes it as given; even more so in the case of hybrid and temporary network organizations where the object of activity appears to be much less self-evident. For example, we can presume that a school is for the education of students, but the purpose of a development network of schools forms a research question and the topic of investigation (e.g., Townsend, 2019).

Defining the object of activity as the motive is the fundamental idea of cultural-historical activity theory (Leont'ev, 1978). The object defines why and to what pupose a given activity emerges in society. Analytically we may make a distinction between the generalized object of the historically evolving activity system (societal meaning) and the specific situational instantiations of the object for a particular subject at a specific time and place (personal sense; Engeström, 2011, p. 91).

The object-oriented activity is the methodological unit of analysis, which implies that the 'learning task' is not separated from the 'basic task' of an organization or a network of organizations. In the Developmental Work Research framework, the object/motive of learning is investigated by going deep into the object/motive of collective activity. The analysis of expansive learning proceeds through the analysis of participants' actions for transforming and expanding activity (Engeström, 2015).

What is not often demonstrated in network studies is that networks by nature create multiple objects of collaboration. Networks are fields of collaboration that give ground for new sub-networks and partnerships when participants learn to know about each other's expertise, find synergy and end up imagining expansive possibilities of activity. If networks are expected to follow the goal-rationality of organizations this diversity will be overlooked. In other words, a network that does not achieve the goal set for cooperation is deemed unsuccessful; therefore learning has not taken place and the network has failed (Miles & Snow, 1992). The object-oriented activity theoretical approach shows that expansive learning in collaboration networks is multi-layered (Toiviainen, 2003). Even if some of the elements of the network activity break down or the efforts to construct the object fall apart, the activity and learning may continue on other levels and oriented to other objects of activity still meaningfully related to the motives of the network actors (Toiviainen, 2003, p. 209). I will continue elaborating on the meaning of the object in the discussion on expansive learning in networks.

Expansive Learning Cycles in Networks

The second notion is that networks emerge for the creation of novelty and innovation – besides industrial and technological lines of business this is recognized even in public service production (Kallio & Lappalainen, 2015). The co-production and knowledge creation are scattered among multiple stakeholders; coordination is decentralized and horizontal. This makes work and its outcomes open and uncertain to a greater degree than in the intra-organizational activities. The concise definition of expansive learning is that communities are learning 'what is not yet there' (Engeström, 2016). Characteristic of expansive learning is collective knowledge creation for future activity rather than knowledge transfer as a competitive asset (lately, Sohi & Matthews, 2019); it is learning through 'exploration of new possibilities' much more than learning through 'exploitation of old certainties' (March, 1991, p. 71). This is an interesting starting point to learning in networks.

Expansive learning proceeds through learning actions modeled as the subsequent steps of dialectic cycles. The steps are named: questioning, analyzing, modeling, applying, and consolidating and reflecting (the exact terms have been enriched and modified in various studies). Expansive learning is a dialectic process that proceeds through emerging developmental contradictions and their creative solutions. The model will be presented in the first example below. The completed conceptual analysis is beyond the purposes of this chapter; therefore I refer to detailed introductions of the theory of expansive learning (e.g., Engeström, 2011, 2015).

The members join networks to contribute with their knowledge and expertise and to learn from others through knowledge transfer, but learning in a network extends beyond a combination of its members' specialized fields. When carrying out expansive learning actions

members develop insight and relate themselves to the partners' knowledge areas to learn 'what matters' to themselves and others in a shared object construction, as Anne Edwards (2017) puts it. Edwards proposes that this type of service production in multi-professional networks takes place through relational expertise, with an implication that the object and the outcome of activity is not fixed and given, but rather constructed through the process of collaboration. An expansive learning approach to the network processes reveals that the knowledge and the object created are at best partially shared, disputed, tension-laden and multivoiced, as Engeström's (2011) review of a variety of empirical studies demonstrates. The sustainability and sustainable development of the object that is partly unknown and unpredictable is an issue of members' commitment, even moral-ethical volition, much more so in networks than within the frames of (juristically and economically) accountable organizations.

Socio-Material Mediation of Learning

The third notion is that network approaches have given rise to the notion of material mediation and the role of artifacts in cross-disciplinary collaboration. Nicolini, Mengis and Swan (2012) find three significant roles of objects in the practice-based approaches: 'they motivate collaboration, they allow participants to work across different types of boundaries, and they constitute the fundamental infrastructure of the activity' (p. 612). Based on the former discussion of the object orientation it may be added that not only the role of objects, but also the conceptual notion of the object is different. Objects that motivate are of a different quality, answering the question 'why collaboration and learning?', whereas the two latter roles refer to objects as material artifacts and infrastructures, in activity-theoretical terms to tools, instruments, and 'instrumentalities' (Engeström & Toiviainen, 2010).

In the cultural-historical activity theory framework, the concept of cultural mediation by means of tools and signs is fundamental (Vygotsky, 1978). 'Vygotsky was arguing that humans master themselves through external symbolic, cultural systems rather than being subjugated by and in them', as Daniels (2008, p. 9) puts it. This opens up the research field even in the collective development of networks discussed here. Participants collaborate, overcome problems and learn by implementing, modifying, and creating tools for their network practices. Integrating socio-material mediation into research settings materializes and makes visible learning in networks otherwise difficult to trace and see.

The three notions discussed in this section – object orientation, expansive learning and socio-material mediation – are resources of cultural-historical activity theory, which have inspired the studies of multi-organizational and cross-sectoral settings of collaboration. The studies of developmental work research are a special field of application, where the research interest essentially entails development of the activities by enhancing communities' expansive learning.

DEVELOPMENTAL WORK RESEARCH AT THE SERVICE OF LEARNING NETWORKS: THREE PROJECTS

Three examples from three decades (the 1990s to the 2010s) demonstrate the author's applications of DWR on learning networks. The first case started as a field research of university-funded doctoral studies. Part of that project and the two other examples entirely

belonged to the long-term Finnish Workplace Development Programme (Alasoini, 2015), financed by the Finnish Funding Agency for Innovation (TEKES, until 2018). The projects were planned in cooperation between the university researchers of DWR and work-life practitioners, thus combining the academic interest in learning networks with the developmental needs of inter-organizational collaboration in a certain industry or region.

In the following, each of the three examples is presented in two parts, the 'Case description' followed by the 'DWR conceptualization'. First, I model the evolutionary phases of an inter-firm network of the metal industry by means of the multi-level cycle of expansive learning (Toiviainen, 2003, 2007). The second example demonstrates the application of the multi-level cycle of expansive learning to design a development tool for the use of a multi-sector regional learning network (Toiviainen et al., 2009). The third application of the levels of learning is an analysis of an innovation network connecting education and the industry of digital printing (Toiviainen & Vetoshkina, 2018).

Multi-Level Expansive Learning in an Inter-Firm

Network

This case represents the growing interest in collaborative networks as a new form of organization during the 1990s, which was discussed earlier in this chapter. The research and development project was carried out during 1995–2000; in the first three years by observing the evolution of the small-firm network of metal industry, and in the following two years by participating in the double role of developer and researcher (Toiviainen, 2003).

Case Description

Phase 1. Inspired by international cases of interfirm cooperation operating predominantly in Scandinavia and Northern Italy, some academic researchers from the Finnish University of Business presented the idea of an 'excellence club' in the metal and electronic industries in the early 1990s. The national industrial federation (currently 'Technology Industries of Finland') contacted some active members of subcontracting companies who agreed to join the initiative. For many, the main driver was the exceptionally deep economic depression that affected subcontractors who were dependent on big companies.

Phase 2. The Club was organized in the form of a registered association managed independently by the member firms. Financial support from the national industrial federation and 'sparring' by the business researchers were helping the firms to get started. The group of 13 firms grew to 22 during the first years. The idea was to offer a forum for collaborative practices and innovation in the Finnish metal industry subcontracting area. The member companies were located in the Helsinki district and in other parts of Southern Finland representing typically small firms of 10–100 employees.

Phase 3. The members started to model the Club's activity. One failed effort to create business around a product design provided a learning experience for those involved (firms and academics), helping them to clarify the rules and the division of labor of the future activities. It became clear that it was not possible to find an ideal product area combining the technologies of all member firms. The Club model designed on the basis of early experiences and comprised of a

heterogeneous combination of activities, and developed from the initial network ideals towards realizing the actual collaborative potentials of the network.

Phase 4. Critical discussion on the philosophy and model of the Club continued and the possibility of carrying out 'The Club Project' and introducing the concept to big customers was debated. The diversity of ideas developed, and the members seemed generally to accept the heterogeneity of collaboration, as one of them articulated: '... I would say that our activity has stabilized in such a way that we have given up the product projects. [--] Firms can collaborate even without the coordinator being aware of it. It is all right' (Toiviainen, 2003, p. 99). Multiple cooperative projects were initiated among two or three member firms at a time engaging already large groups of personnel. The emphasis of the Club's organizational activity was on training and material supply, which embraced new groups and created a need to expand networking to all levels in the companies.

Phase 5. Some of the leading member companies intensified collaboration and finally merged into one business organization. To the business-based process they wanted to combine development and inclusion of all personnel groups, not only those in charge of strategic planning. In this phase the author's field researcher role changed from an observer to that of an interventionist-developer. The researchers' (the author together with a colleague) intervention concerned the developmental dialogue groups that cut across the partner firms and staff positions. The developmental dialogue is a systematically guided proceeding based on the dynamics of peer-to-peer small groups, in which professionals analyze and reflect upon their career and work, and generate personal development projects (Heikkilä & Seppänen, 2014). In the context of the merger, the developmental dialogue procedure was used to facilitate inter-firm boundary-crossing and mutual learning (Toiviainen, 2003, 165–93). Today (2020), the merged company is one of the 18 members of the Club partnership organization.

DWR Conceptualization

The analysis of this brief but productive history of collaboration (Phases 1–5) resulted in a hypothesis as to the Club's expansive learning (Toiviainen, 2003). Each phase appeared as a step, a learning action, in the cycle of expansive learning. The interpretation was that the collective learning actions gave rise to new levels of collaboration and learning.

1. Questioning that triggers the learning cycle appeared in subcontracting firms' general concern about and overt dissatisfaction with the current collaboration practices. Their need for improvement to survive reflected the economic depression of the time and simultaneous reorganizing of the Finnish subcontracting system in the face of globalization and 'the rise of networks' (Castells, 1996). The activity was developed in this field of multiple social challenges, the needs of firms and interests of other stakeholders, for example, which molded the inner contradiction of the shared object: planning activity with long-term goals of creating innovative collaboration, or short-term operations for gaining economic profit. This discussion was led on an *ideological level of learning* and networking (Figure 6.1, bold line).

2. Analyzing the present activity and the need for change took place in the negotiations and planning meetings that resulted in the foundation of the Club association. The missions formulated represented the network-ideological search

for the development of a shared and major project. In this phase, however, the members started to work on alternative objects of network activity. Contradictions emerged between different conceptions of networks, which was echoed in the debates as to whether the Club was seen as an ideal type network or as a heterogeneous forum for collaboration.

3. Modeling entails working on the contradictions and searching for new activity to answer the challenges. The Club members dealt with the inner contradiction (long-term vs. short-term outcomes) and the competing network conceptions (shared object vs. heterogeneity). They created a model for the Club's project activity, by means of which they introduced the new network to their significant customers. The new model gave rise to the *project level of learning* of the Club (Figure 6.1, medium-bold line). It created discussion around potential future projects and generated a contradiction between the interests of a single firm, its project ownership and established customer relationships, and the interests of a network with shared duties, profits and customers.

4. Applying a new model leads to the implementation of a new activity, often starting with small-scale pilots and experiments. People who carry out new actions deal with contradictions stemming from the resistance of the old activity, in the Club the firm-based collaboration, and the contradictions between the created new network activity and the original given model of activity ('the excellence club'). The model included the notion of the heterogeneity of collaboration, encouraging the member firms to start with concrete projects. This opened up the *production level learning* (Figure 6.1, thin line).

5. Consolidating and reflecting are learning actions to decentralize the new activity and to create a social infrastructure for it (Engeström, 2015). The need for expanding the Club activities to personnel groups other than managers, and rooting the infrastructure within the firms, reflected these actions. Consolidation and critical reflection of the new activity brought about new kinds of contradictions between the new Club activity, and its neighbor activities, both within the member firms and in customer companies. A new level on the expansive cycle emerged, the *worker level learning* (Figure 6.1, dashed line), which anticipated the start of a new cycle of expansive learning towards deeper partnerships (*the partnership level learning*) than those offered by the heterogeneity of the Club.
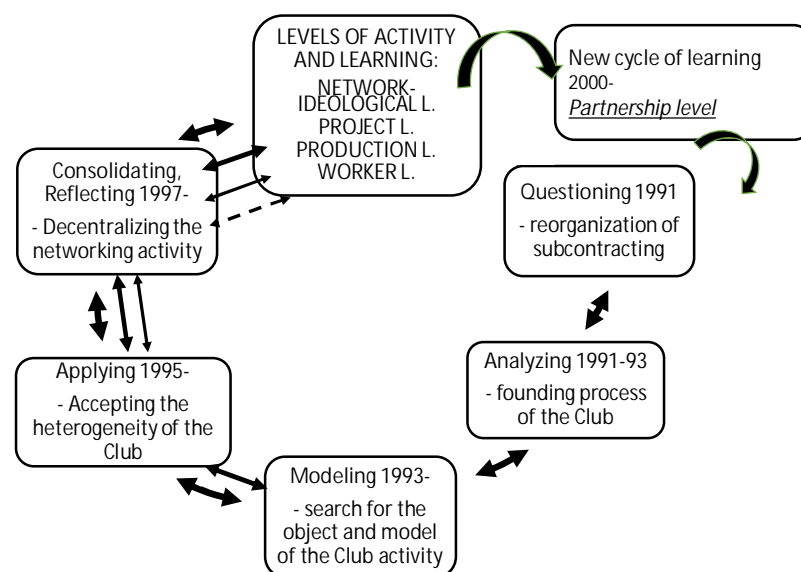
Figure 6.1 The multi-level cycle of expansive learning of an inter-firm network (cf. Toiviainen, 2003)

Radar Tool for a Network of Developers

The second case is a learning network (2007–2009) that was set up as a pilot to enhance inter-organizational learning and in-house development of workplaces in an economically slowly developing region in Finland (Alasoini et al., 2011). The participants in the Forum of In-House Development were predominantly from public service organizations ranging from the administration of employment, occupational health and safety, and environment, to care units in mental health rehabilitation, elderly nursing and reformatory youth work. Two subsequent groups engaged a total of 24 in-house developer trainees and seven local tutors. The participants were professionals and developers who became interested in training that would equip the trainees for in-house developers' tasks alongside or as a part of their basic professional tasks. The whole 'curriculum' of this learning network is presented elsewhere (Toiviainen & Kerosuo, 2013); here, I focus on how the notion of the multi-level expansive learning cycle was used in the design and implementation of a development tool (Toiviainen et al., 2009).

Case Description

Phase 1. The team of researchers and local development experts planned and held a series of workshops with two network groups. The learning goals involved DWR-based training to become a qualified in-house developer, acquiring new work development methods, applying and disseminating the methods in workplaces, and learning from other developers with different organizational contexts and challenges.

Phase 2. When planning the workshops the researchers sketched a tool to help themselves and the in-house developers manage the complex setting of multiple learning forums and the steps of expansive learning. The participants needed a tool to deal with both the regional project and the individual in-house developer's workplace projects planned in the Forum. The core of the model was composed of the cycle of DWR (based on expansive learning) already introduced to the participants of the Forum (Figure 6.2). To identify the levels of learning the researchers analyzed which parallel development activities were going on in the project and added to the model the levels of (1) workplace, (2) local tutoring, (3) workshop, named 'networkshop', and (4) extended 'networkshop' (Figure 6.2).

Phase 3. When presenting the development tool in the workshop a discussion ensued in which the participants gave their comments and reflected on various use possibilities of the model. The tool was named 'Development Radar' (Figure 6.2); it could be used at workplaces to show the management 'what's going on' in the Forum; the participants might use it as a development calendar by marking important dates and milestones on the Radar. The most inspiring finding concerned the dynamics of in-house development: the parallel cycles at different levels are not proceeding simultaneously and in harmony. In addition, proceeding from one step to the following step is not one-way movement; rather a developer needs to oscillate between the steps and return to the earlier phases when new participants join workplace development (Toiviainen et al., 2009).

Phase 4. In the last workshop the participants had an opportunity to reflect on their personal and professional learning. Some of the in-house developers admitted that the introduction of Development Radar had meant a turning point in how they conceived development work. The idea of development work and own learning as a pendulum motion that proceeds to return to previous phases allowed them to step back, learn more and look for alternative strategies.

DWR Conceptualization

A learning tool named 'Development Radar' was a local innovation developed during the process of the Forum of In-House Developers. It is a graphical model that combines the steps of developmental work research based on the theory of expansive learning and the levels of learning specific to each network (Figure 6.2). It has been used as an instrument of in-house development in the network project for regional workplaces, as described above. The Radar tool is composed of the following conceptual elements (Figure 6.2):

1. Six steps of the cycle of DWR are presented in the center of the Development Radar in a form of a pizza diagram (Figure 6.2): (1) charting, (2) analyzing, (3) modeling, (4) experimenting, (5) implementing, and (6) reflecting (cf. Engeström, 2015; compare to the 5 steps of the expansive learning cycle above). The steps of the cycle were used in the Forum of In-House Development in two powerful ways: the researchers planned the training workshops to proceed step by step, while, at the same time, the participants studied the steps by implementing them in their workplace projects and sharing the experiences in the workshops.
2. There are four levels of development and learning specific to the activity of the Forum of In-House Development designed around the core of the diagram. (1) Workplace level: the in-house developer trainees planned and implemented workplace development projects dealing with topical issues of their/their management's choice. (2) Level of local tutoring: between the workshops the participants worked on their workplace projects and met in small groups of two workplaces under the local developer-tutors' guidance. (3) Networkshop level: the main study of the in-house development methods and horizontal learning from each other's workplace projects happened in the Forum's workshops led by the researchers. (4) Level of extended networkshop: the participants and the researchers planned together additional workshops at certain points of the process where the in-house developers presented their projects to the managers of the workplaces inviting them to comment on the progress of the workplace development. The levels offered the in-house developers, as well as the tutors, the project coordinator and the researchers, the framework to orientate themselves to parallel learning processes and make sense of the complexity of the development activity (Toiviainen & Kerosuo, 2013).
3. Intermediate reports marked with long arrows on the Development Radar set the rhythm for the development work. The participants and researchers produced development plans, analyses and models, summaries of pilots and implementations, and final reports. These were the socio-materially mediating artifacts that were concretely discussed in the networkshops.

For example, in the phase of 'charting', the task was to identify the developmental challenges at work. The participants' 'homework' included specifying the object of development and writing a draft of a plan for an in-house development project on the 'workplace level'. While drafting the plan they received support in the small groups supervised by the tutors on the 'level of local tutoring'. The plans were collectively discussed

in the networkshop under the researchers' guidance and instruction on the 'networkshop level'. The next step from 'charting' to 'analyzing' was prepared and a new assignment given asking the participants to think what data they would collect from the work activity to analyze the developmental challenges (Toiviainen & Kerosuo, 2013).

While still rudimentary in its graphical design, the case of Development Radar suggests that the joint creation of artifacts is the key to collective learning at work (Miettinen & Virkkunen, 2005) and to relational work in networks of professionals (Seppänen & Toiviainen, 2017). The implementation of innovations and tools is an instrumentalization process during which an artifact transforms into an instrument to be used by a community (Béguin & Rabardel, 2000). Participants of learning networks contribute actively to the modification of the practices and tools introduced.

Figure 6.2 The Radar tool

Sustainable Object Creation in a Network of Digital

Work

The third case is that of a network of digital printing in the textile, clothing and interior printing industry to develop cooperation between vocational education and work life by using the possibilities of digitalization on an ecologically, economically and socially sustainable basis. The project was coordinated by a University of Applied Sciences and the members represented product design, printing business, material production, higher vocational education, and university research of design and education. Students, teachers and consumer-customers contributed to the concept development. The DWR researchers' task was to analyze the network learning process and contribute to the knowledge creation in the workshops, but the project as a whole did not apply the methods of DWR. This example shows how researchers analyzed the data in the framework of DWR/cultural-

historical activity theory by drawing on their preconceptions of object-orientation and multi-level expansive learning in the working-life networks that have been formed to enhance innovative future work practices (Toiviainen & Vetoshkina, 2018).

Case Description

The object of the project was to create a customer-centric digitalized service concept in the school-working life interface by considering the sustainability of the digital printing business. During the series of workshops led by the researchers of design and the researchers of education, the network members developed a concept of a cooperative as a platform to enhance sustainable digital printing activity (product design, production, marketing) in the interface of school and work. The materialized implementation was a digital platform where students could learn professional design activity in a real-life collaboration with other network partners. The role of the students and their specialized teachers was crucial in the concept development. The project was carried out in close collaboration between the project coordination, vocational education, and the business units.

DWR Conceptualization

The researchers analyzed the data from the workshop discussion in the early phase of the project in order to produce knowledge of the multi-level learning challenges of the digital printing network (Toiviainen & Vetoshkina, 2018). The findings of the empirical analysis of the complex object of the network's activity (Table 6.1, columns a and b) and the theoretical conceptualization of the levels (Table 6.1, columns c and d) formed the framework that was applied to cover the analysis of the whole design process up to the end of the project (Vetoshkina & Toiviainen, in press). The elements a–d of Table 6.1 outline the analysis process:

1. Instantiations and features of the object. Learning networks by definition share the object of development activity; it is the assumed motivating force to join collaboration. For the digital printing network the object was defined in a project plan as a *customer-centric digitalized service concept.* However, instead of taking the main object as given and evaluating its realization during the project, the multi-level framework directs attention to the multiple partial instantiations of the object. They are anything from material artifacts to ideal concepts that the participants relate with, debate on, and modify though collaborative actions. For example, when they discuss the products that the *service concept* might make possible to produce, they deal with tangible products and prototypes, specific ready products and product ideas (Table 6.1). By analyzing the workshop discussions and extracting all verbal and non-verbal (showing, touching, etc.) expressions of the object-instantiations we get a rich and varying list of the topics. Then, we may further analyze the discourse to find out what features, in other words, qualities, requirements, etc., the participants attach to each of these topics. For example, in the case of products, the features discussed may be prototyping, productability, marketability, variation, appearance, prize, and durability, to name a few (Table 6.1).

2. Leading activity. The instantiations and features of the object are empirical findings that in the next phase of analysis are categorized by analyzing their qualitative differences (Table 6.1, a and b) and defining the activities (leading activity) each category of object-instantiations represents (Table 6.1, c). Defining the leading activity is the first step of generalization. For example, the researchers

interpreted the (discussion on) products to represent design activity. Designing was the leading activity in the creation of new products in the context of this network.

3. Levels of learning. Proceeding from the leading activities to the naming of the levels of learning is another step of generalizing (Table 6.1, d). The researchers identified four levels, named the project, the product, the process and the concept level. Expansive learning in this framework means, first, generating the levels in the process of creating the object of collaboration and, finally, proceeding to the concept level where the co-configuration of the main object (the service concept) takes shape.

The framework of the levels of learning functioned as a working hypothesis that oriented the researchers to the nuanced forms of learning when analyzing the discursive data of the subsequent workshops (Vetoshkina & Toiviainen, in press). The risk of frameworks resides in overlooking some essential but unanticipated evidence; when used cautiously they may as well direct attention to new phenomena that do not 'fit into the picture'. The levels are open to modifications and additional components. Knowledge of the interaction and gaps between the levels of learning (different activities and objects) as they manifest in the network partners' collaborative actions is instrumental in facilitating the development work of learning networks.

Table 6.1 The levels of network learning of the digital printing network (modified from Toiviainen & Vetoshkina, 2018)

Empirical analysis		Theoretical framework	
(a) Instantiations of object	(b) Features of object (examples)	(c) Leading activity + the object of development	(d) Level of learning
– project plan, schedule and future agenda – digital service as a network	Project coordination Educational requirements Benefits to firms Continuity	Project activity + creation of the digital printing network	1 Project level
– tangible product – prototype – specific ready product – product idea	Prototyping Productability Marketability Variation Appearance Prize Durability	Design activity + products to consumer market	2 Product level
– process model as an operational scheme – process model as a product development process	Design-production interface Product development vs. production development Gatekeeper Educational perspective	Production activity + production development product development	3 Process level
– customer concept – digital service as service concept – digital service as business concept – ecological and local digital printing	Sustainability Added value Ownership Customization	Development activity for conceptualizing: + customer/consumer + customized product and service concepts + business concept for network	4 Concept level

CONCLUSIONS

Conceptual resources of Developmental Work Research in the broader context of cultural-historical activity theory offer interesting vantage points to study expansive learning in work-life networks. The notions of object-orientation, the cycle of expansive learning, and socio-material mediation of learning were presented and elaborated on in the research of networks' innovation and development activity. Three learning network projects were examples of how the DWR resources have been applied in formulating and modifying the framework of multi-level expansive learning. The three DWR concepts and the network examples are connected and summarized in Table 6.2.

Table 6.2 Developmental Work Research perspective on the studies of work-life learning networks

DWR perspective	Study: Multi-level expansive learning in an inter-firm network	Study: Radar tool for a network of developers	Study: Sustainable object creation in a network of digital work
1. How did object-orientation guide analysis?	Analysis of historical phases by focusing on object creation	Analyzing the object of in-house development on the levels identified	Analyzing the main object and the instantiations and features of the object
2. How was the cycle of expansive learning (EL) applied?	Modelling historical phases of the network as the cycle of EL Exploring the levels of learning emerging through the learning actions of the cycle	Modelling a development tool by combining the cycle of EL/DWR and the levels of learning of the network	Cycle of EL was not analyzed. Modelling the object-oriented levels of learning of the network for further analysis
3. What are examples of socio-material mediation of learning?	Model of the Club activity created by the network members Outcomes of inter-firm projects Outcomes of Developmental Dialogues guided by researchers	Development Radar: graphical illustration of nonsynchronous and oscillating phases of in-house development, which gave professionals insight into workplace learning	Instantiations of the object, such as prototypes of the online service facilitating the creation of the final service concept

The examples discussed in this chapter represent a cross-section of learning networks in Finnish working life. The first example was an inter-firm business-oriented network of the 1990s that started as an ideal 'excellence club' but expanded to challenge the collaborative practices at workplaces. The second example from the 2000s was a regional cross-sectoral learning network for the training of in-house developers; the aim was to enhance workplace development and networking in a geographical area of slow economic development. The third example was a network that addressed the themes of digitalization, sustainability, and strengthening vocational education in a work-life context – all topical themes of the 2010s.

The working-life networks from different times represent different generations. Spekman et al. (2000) in the late 1990s suggested that it is time for a 'second generation' discussion on partnering by moving on from *alliance formation* to *alliance management and competence*. The idea of generations can be elaborated on in the research and development of learning networks. The first-generation research investigated *network formation*, such as the case of the 'excellence club', where analyzing the evolution and outcomes of collaboration was informative for the development of network activities. 'Evolution' and 'success' of networking were keywords. The second-generation research was directed at partnership networks with more defined learning purposes and requirements concerning network management and competence. The keyword for this phase was 'partnership'.

Research was thus following the trend that was also visible in the Club's development from alliance formation to actual implementation of partnerships. In addition, the second-generation management and competence perspectives were clearly linked to the second example, the Forum for In-House Development, aiming at the competence building of in-house developers and supporting local management of the learning network as a means to enhance regional economic activity.

To conclude, the suggestion for the third-generation research on learning networks setting challenges for the DWR approach is *alliance mobilization* by users, consumers, citizens, and experts by experience. New cross-disciplinary as well as nonprofessional members join partnerships mediated by digitalized systems and actively contribute to the creation of knowledge. Learning networks are complex and cross-sectoral, and oriented to open problems and innovations that bear both global and local consequences in terms of sustainable development, universal human rights and active citizenship (e.g., Kenny et al., 2016). Our third example of the digital printing network anticipates some of these features. The discussion of the 'quadruple helix' model of innovation networks captures this wave of cooperation with new key words of 'learning ecosystems' and 'smart technologies' (Borkowska & Osborne, 2018). However, the research of the third generation learning networks is rare to date.

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