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*Challenges of development work: Instrumentality and constellation of rules as conceptual resources**

*Desafíos en la investigación de desarrollo:
Instrumentalidad y constelación de reglas
como recursos conceptuales*

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DOI: 10.5944/reec.29.2017.17203

Recibido: 30 de septiembre de 2016

Aceptado: 9 de mayo de 2017

* The first version of this paper was presented in the Vocational Education & Training-Emerging Issues, voices from Research. V International Conference & Research Workshop. Conference, 9-10, May 2016, Stockholm, Sweden.

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Abstract

Professional and vocational institutions are facing challenges due to changes in working life: increase of knowledge work, digitalization, globalization and constant need for improvement of practices. The aim of this paper is to explore organizational change efforts in two educational institutions. First case introduces the vocational college, in which focus of development was new training for immigrant students. The second case presents development work done within training of dentists and oral-hygienists. Theoretical and methodological anchoring of both cases was cultural-historical activity theory and developmental work research, which is an approach evolved in the 1980s in Finland. It combines scientific research, practical development work and learning, called expansive learning. In developmental work research projects one of the theoretical tools is an activity-system model. My focus will be on two elements of the activity-system model: instruments or instrumentality and rules or constellation of rules. It seemed that, at least, partial failure of development work in two educational institutions was due to lack of taking into account the systemic whole of activities under development: activity of learning in multicultural context and in context of patient care.

Key Words: instrumentality; rules; developmental work research; cultural-historical activity theory; activity-system model

Resumen

Los profesionales y las instituciones de formación profesional se enfrentan a desafíos debido a los cambios en la vida laboral: aumento del trabajo del conocimiento, la digitalización, la globalización y la necesidad constante de mejora de las prácticas. El objetivo de este artículo es explorar los esfuerzos de cambio organizacional en dos instituciones educativas. El primer caso presenta la escuela de formación profesional en el que el foco del desarrollo era nueva formación para los estudiantes inmigrantes. El segundo caso se presenta el trabajo de desarrollo realizado dentro de la formación de los dentistas y los higienistas. El anclaje teórico y metodológico de los dos casos es la teoría de la actividad histórico-cultural y la investigación trabajo de desarrollo; el último un enfoque desarrollado en la década de 1980 en Finlandia. Se combina la investigación científica, el trabajo de desarrollo práctico y el aprendizaje, llamado aprendizaje expansivo. En los proyectos de investigación de trabajo de desarrollo una de las herramientas teóricas es un modelo de sistema de actividad. La atención del análisis presentado en este artículo se centra en dos elementos del modelo de sistema de actividad: los instrumentos o instrumentalidad y las reglas o constelación de reglas. Parecía que, al menos, el fracaso parcial del trabajo de desarrollo en dos instituciones educativas se debió a la falta de consideración y atención al todo sistémico de las actividades en el proceso de desarrollo, es decir, falta de atención a la actividad de aprendizaje en el contexto multicultural y de la atención al paciente.

Palabras clave: instrumentalidad; reglas; investigación de desarrollo; teoría de la actividad histórico-cultural; modelo de sistema de actividad

1. Introduction

One of the biggest challenges of working life is immense change and rapid development, as Cairns and Malloch (2011, p. 12) wrote when they outlined theories of work, place and learning. Engeström (2011, p. 88) continued on the same line by stating that the life cycles of entire product, production and business concepts are rapidly becoming shorter and the rhythm of concept-level transformation has accelerated. This paper deals with challenges of multi-organizational and multi-professional change efforts through the lens of an activity-system model (ASM). Cultural-historical activity theory (CHAT) and the developmental work research (DWR) approach were employed as theoretical and methodological anchoring in development work within organizations.

DWR is an interventionist approach, the aim of which is to study transformations and learning in work technology and organizations. Under the interventionist approach, practices are intentionally explored and changed to facilitate understanding and the transformation of those specific practices and social realities. DWR combines practical development, scientific research and expansive learning. The theoretical foundations of DWR are in CHAT, which was initiated by Russian scholars, such as Vygotsky, Leont'ev and Luria, in the early 1900s (cf. ENGESTRÖM & MIETTINEN, 1999; COLE & ENGESTRÖM, 2011). The origins of DWR lie in the work and research carried out in Finland since the early 1980s. In the last 30 years, the DWR approach has been used in various studies focused on the development of workplace practices and tools in industry, health care, technology, co-operation between work and education, vocational teacher education and multi- and intercultural education, to name a few (ENGESTRÖM & SANNINO, 2010). The theory of expansive learning, and the ASM introduced first by Engeström (1987/2015), has been foundational for these development endeavors, as well as analyses of them. He formulated his efforts as follows:

“First, activity must be pictured in its simplest, genetically original structural form, as the smallest unit that still preserves the essential unity and quality behind any complex activity. Second, activity must be analyzable in its dynamics and transformations, in its evolution and historical change. No static or eternal models will do. Third, activity must be analyzable as a contextual or ecological phenomenon. The models will have to concentrate on systemic relations between the individual and the outside world. Fourth, specifically human activity must be analyzable as culturally mediated phenomenon. No dyadic organism environment models will suffice. This requirement stems already from Hegel’s insistence on the culturally mediated, triadic or triangular structure of human activity.” (ENGESTRÖM, 1987/2015, pp. 32-33 italics in original)

The ASM consists of six elements in the form of a triangle: a subject, an object, instruments, rules, community and division of labor (Figure 1). The model was developed by Engeström (1987/2015) in his dissertation *Learning by Expanding*.

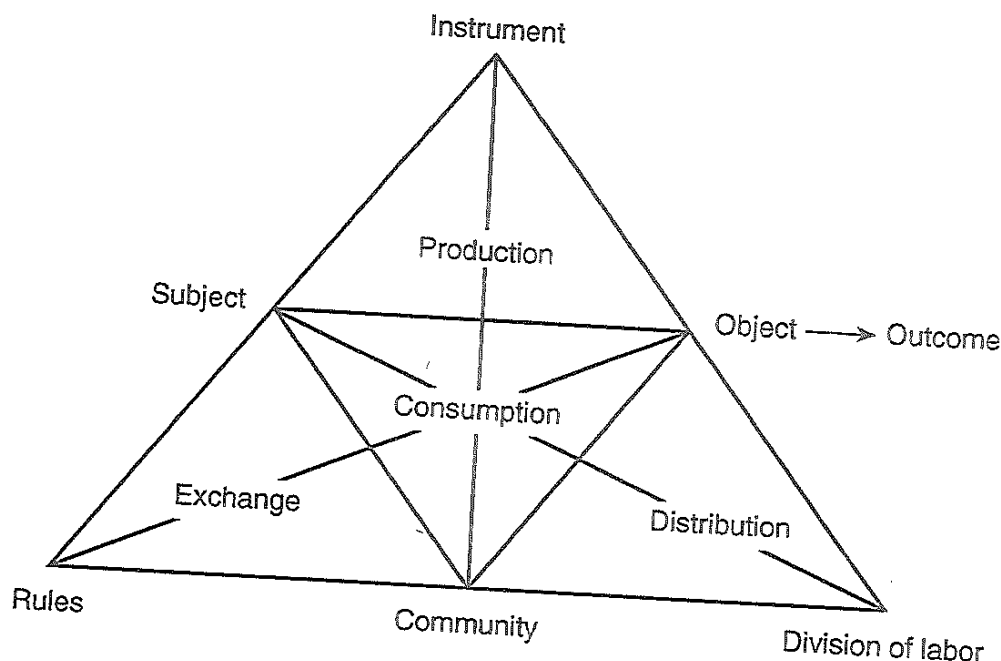


Figure 1. The Activity-System Model (ENGESTROM, 1987/2015, p. 63).

The ASM was inspired by Vygotsky's (1978) concept of mediated action, cultural mediation by tools and signs that Engeström called *instruments* of activity and *artifacts* referring to Wartofsky's (1979) primary, secondary and tertiary levels of artifacts. The model was further stimulated by Leont'ev's hierarchical structure of activity, and especially his understanding of extraction action, activity and operation levels. The meaning of *an object* in activities and *a subject's* relations to the object were of utmost importance. *Division of labor* and *community* were generated by Leont'ev's famous hunting example. *Rules* emerged as the cultural evolution of human forms of activity. Furthermore he stated that:

“The model suggests the possibility of analyzing a multitude of relations within the triangular structure of activity. However, the essential task is always to grasp the systemic whole, not just separate connections.” (ENGESTRÖM 1987/2015, p. 62)

This concern is relevant, as often, when the focus is on a single element of the ASM (whether the object, subject or instruments), the systemic whole is easily forgotten. This may have been the case in these two empirical examples. Instead of using the ASM to organize one's data, it needs to be used to capture the inner and outer contradictions and to produce a qualitatively new type of activity system, such as a new type of understanding of the systemic whole and of concepts such as instruments, rules and division of labor. Thus, the activity system depicts a theoretical generalization of a practical activity in focus. Today, the ASM is often depicted with at least two interconnected activity systems or a network of activity systems, what Engeström (2001) called the third generation of activity theory.

Another important concept for understanding development and change within DWR is contradiction. In DWR, contradictions are seen as tensions between two opposing forces

and dynamics that trigger learning and development (cf. ILJENKOV, 1977; LEONT'EV, 1978; ENGESTRÖM, 1987/2015). Thus, contradictions are not something that need to be got rid of; instead, they are explored and examined to reveal their potential, and they are used to create solutions to existing problems. Engeström (1987/2015, pp. 70-72) presented four levels of contradictions. The first level is a primary contradiction inside one element of the activity system, typically a contradiction between the use value and the exchange value. The second-level contradiction is identified between elements of the ASM, and the third level between old and new activity systems. Fourth-level contradictions are those identified between neighboring activity systems. In this paper, contradictions and levels of contradictions help the reader follow the second empirical example.

2. Instruments and instrumentality in developing immigrant training

The concept of instrument originated from Vygotsky's mediational means: tools and signs, as stated above. From the concept of instrumentality Engeström stated that there has been:

“a shift from utilizing well-bounded singular tools to designing and implementing tool constellations or instrumentalities. A tool constellation or instrumentality is literally the toolkit needed in an activity” (ENGESTRÖM, 2007, p. 33).

He (1990, p. 188) elaborates empirical tools of physicians as *why*, *how*, and *what* artifacts. For example, a '*why*' artifact is an explanatory model of illness, and *how* artifacts are procedures and methods medical doctors use in their work. In 2007, he presented a more elaborate model of instrumentality. He systemized different artifacts using a hierarchical structure and naming them six *epistemic levels of mediational artifacts*. At the bottom level, he finds *what* artifacts such as images or prototypes, in the middle there are *in which location* artifacts such as maps and classifications, and at the top, there are *where to* artifacts such as germ cells, models and visions (Ibid., p. 34). Naming artifacts as epistemic mediational means he wants to draw attention to technologically mediated learning, claiming that the technologies introduced to facilitate learning are themselves poorly analyzed and understood in the epistemic qualities and potential (Ibid., p. 35).

Now let me turn to the first empirical case. The empirical material comes from a study focusing on a preparatory vocational immigrant training (TERÄS, 2007). I will briefly explain the context to give the reader background. In 1999, new training for immigrant students was launched in Finland. The new training was started, because the number of immigrants increased during the 1990s in Finland. At the time, Finland changed from a country of emigration into a country of immigration. The biggest groups came from Russia, Estonia and Somalia. The new training was not regular vocational training but was oriented toward regular vocational training. Therefore, the aims of the training were that students learned sufficient Finnish language and cultural practices in Finland so that after this one-year training they could apply for regular vocational education and training (VET).

The new training began in a social and health care college located in Helsinki. The college was a secondary-level vocational school, and between 1,500 and 1,800 students were enrolled in vocational programs each year. The Practical Nursing diploma was the most popular choice among the students. Immigrant students were offered either vocational education or the new preparatory immigrant training (TERÄS, 2007, p. 46).

The empirical material was produced with immigrant students (17 students who were natives of eight different countries Estonia, Russia, Somalia, Iraq, Chile, Italy, Afghanistan, and Japan), their teachers, other personnel at the college and researchers during a change laboratory intervention called a culture laboratory. It was organized in 2001-2002 and included nine meetings lasting 2–3 hours with a total of 26 persons. The meetings were videotaped and transcribed for further analyses.

During the discussions, the participants identified and compared different cultural practices by questioning and negotiating the cultural tools used in the vocational college. For example, multiple uses of papers and written texts that mediated learning activity were discussed (see also TERÄS, 2012). In activity theoretical terms, the concept of the subject and the object had changed. In addition to mono-lingual and -cultural students, the college received multi-lingual and -cultural students; therefore, the concept of the student had expanded, and new students had new needs. Furthermore, the object of regular VET had shifted from educating skilled students for labor markets to educating skilled students for vocational colleges. One could argue that the object had narrowed instead of expanding.

In the analysis, I asked: What kinds of instruments of learning did the participants identify in the cultural practices of the vocational college (TERÄS, 2015). Instrumentality and the six epistemic levels of mediational artifacts were used as an analytical model (ENGESTRÖM, 2007). All six levels of artifacts were identified. For example, *what* tools such as papers and computers used in a learning activity were pointed out by the students as in the following example in which a student explains changes in tools “In my life, computers, IT lessons are changes, because when I studied in [name of the country omitted] in our school or institute there were no computers.” *How* artifacts, for example, were the rules and roles of the students and teachers, and how they differed from the students’ previous experiences. In the next example, the teacher reported discussions with the students and the differences the students stated:

“Well, then, in [name of the country, omitted] there are many more rules. There is, for example, a school uniform, no rings, no nail polish, no coloring your hair, no mobile phone, no drinks.”

In addition, one epistemic artifact was recognized at the second level: *where from*. When the students compared their previous cultural tools and practices, the students often mirrored practices between their previous and current experiences, as in the examples.

Taking into account and focusing on learning activity at the theoretical level as a systemic whole, what were the relations between different elements of the activity of learning in the empirical context of immigrant training from the students’ perspective? First, what was the relation between the new subject, immigrant students and instruments? The analyses showed that the texts and textbooks were written for native speakers; thus, these materials were far too difficult for the students, for whom Finnish was their second or third language. This also affected the subject’s relation to the object. In theoretical terms, new types of *what* instruments were needed. More specifically, *hybrid what and how* instruments that could integrate vocational vocabulary to target language, in this case Finnish, were needed. Second, what was the subject’s relation to the object? Most of the students were motivated by getting into vocational schools, but some wanted to go to work directly after the training; therefore, they also had individual goals. In theoretical terms, the object was divided between the new training aimed at VET and the regular VET aimed at the labor market. Third, what was the subject’s relation to the division of labor and rules? There were clearly differences between the rules and roles for teachers

and for students at the vocational college but also between the students' previous schools and the current one. In theoretical terms, temporal rules connecting the past and the present were needed, as well as making a division of labor between the teachers and the students visible. Fourth, what was the subject's relation to community of learners? In the students' previous schools, the students had tended to be members of the majority group; in their new school, the students were part of the minority, which changed the notion of community and caused ponderings about the division of labor, rules and the community. This brief reflection about the systemic whole of learning activity in the context of immigrant training has focused attention on three issues. First, the notion of instrumentality revealed the richness of the instruments the vocational students and teachers encountered. Second, the notion of instrumentality alone did not capture the systemic whole of the learning activity. Third, in the context of immigrant training, a temporal dimension of instrumentality and rules was needed that is a reflection of tools in the past and present activity of learning. Next, I bring the notion of rules into focus.

3. Rules and constellation of rules in education of health care professionals

Rules were recognized as part of the ASM in the evolution processes of human activity. Human societies, communities and groups need rules in order to function and to organize their collective activities. Engeström provided examples of rules such as “societal (state, law, religion), organizational and interpersonal rules” (1987/2015, p. 122). He then talks about “quantitative procedural rules” and “heuristic rules.” He (1990, p. 172) later described the ASM and rules as follows “the rules regulating the actions legitimately taken by the actors (typically rules pertaining to issues of time and money).” He (1990, p. 81) also described the ASM “as a whole also represents some historically identifiable ideal-typical qualitative pattern or constellation of its components and inner relations.” He described inner contradictions of the work activity of general practitioners at a health center in which rules represented a primary contradiction in the “categorization of patient visits and rapid processing vs. prevention” (Ibid., p. 93). Rules “refer to the explicit and implicit regulations, norms and conventions that constrain actions and interactions within the activity system” (Ibid., p. 79). Engeström (1999, p. 66) described ‘the bottom’ of activity system model – rules, community and division of labor – as the less visible social mediators of activity. He recognized that if development work emphasizes instrumental re-mediation, which focuses on developing new instruments, then socio-organizational re-mediation of the activity system is often dismissed. This was what happened with the first case I introduced: We focused on the instrumentality of immigrant training and forgot other elements of the ASM.

When *how* rules had been used as an element of the ASM was examined, three types of analyses were found. First, the inner contradictions of the rules were identified as similar to the inner contradictions of the work activity of general practitioners at a health care center. Second, contradictions in and between activity systems, for example, between rules and tools, were identified. In addition, displacement and ambiguity between tools and rules were common. The physicians saw medical records more as a bureaucratic rule than as a tool (ENGESTRÖM, 1999, p. 179). Third, what rules are used in the activity (cf. ENGESTRÖM, ENGESTRÖM, & VÄHÄÄHO, 1999)? However, rules were not focused

on or analyzed more deeply. To further analyze and theorize about rules, we used Elinor Ostrom's (2007) and her colleagues' long-term studies, evolution of rules and rule systems in the context of developing irrigation systems in Nepal (TERÄS & MIETTINEN, forthcoming).

Instrumentality has an interesting counterpart in Ostrom's (2007) rule constellation or rule configuration. Ostrom emphasized the configurational nature of rules:

“One needs to know the basic contents of a *full* rule configuration, rather than a single rule, to infer both the structure of the resulting situation and the likely outcome of any particular rule change” (Ostrom, 2007, p. 18 italics in original)

For an examination of the transformation of rules, she made a distinction between seven clusters of rules according to the element of action and the decision-making situation they directly affect (Ibid., p. 11). The seven types of rules were boundary, position, choice, aggregation, information, payoff and scope rules, reflecting different aspects of rules in action situations. For example, boundary rules regulate who can enter or leave the situation, position rules create a certain status and scope rules state outcomes that need to be reached or avoided in the situation. Together, these rules form a set of instructions and a structure for a working situation (Ibid., pp. 11–12). Furthermore, her main argument was that when the users have autonomy to develop and tinker with the rules, better outcomes result than if external experts impose their rules on practitioners. Ostrom aptly pointed out that formal rules may be written, but a researcher in the field needs to determine “rules-in-use,” as she called them, when trying to understand the behavior and outcomes in any situation (OSTROM, 2007, p. 13).

Next, I provide examples from the second empirical case, which was part of a larger project called “Co-operation between a university, a university of applied sciences and working life: New teaching experiments” (cf. TERÄS & NUUTINEN, 2010; TERÄS, 2016). The project was organized in Helsinki in 2008–2010, because gum diseases were identified as a new and aggravating oral health problem in the adult population in Finland. Thus, the societal need in this case shifted from caring for caries to caring for periodontal diseases. For periodontal care patients' self-care activities at home are of vital importance.

The data involved two periodontal patient trajectories, about 25 hours of video recordings, collected during dental and oral hygienist students' clinical practice periods. Three organizations (a university dental clinic, an oral hygiene clinic at the University of Applied Sciences and a city dental care clinic) created a new model for oral-health work, called “health-centered teamwork.” In activity theoretical terms, the practitioners expanded their object of work from disease-centeredness to health-centeredness and from individual-based work to team-based work.

From the perspective of instrumentality, the new model is a *where to* artifact aimed at the future of dentists' and oral hygienists' work. Other instruments identified in these professionals' work included instructions and manuals that define a good practice: one for dental students (Paro-Manual) and one for oral hygienist students (instruction for the care of adult patients). Diagnostic means such as x-ray images and an instrument for measuring the depth of gingival pockets were used to evaluate the illness. A care plan was an important instrument, in which the goals and measures of care were documented. Instruments for caring for the teeth and gums were the practical tools the professionals employed. Thus, the instrumentality of oral health care involved what, where to and how tools, among others. In particular, two mediational means seemed to be important for the practice of periodontal patients' care: manuals and the patient database, including

the care plan. The means acted in practice as rules and as tools. For example, the manuals included direct instructions for how to diagnose a patient's oral health, as well as an evaluation of the periodontal disease stage.

The challenge was how the new model affected actual care practices. In the analyses, we found that the new model was manifested only partially in the care practice of periodontal patients: The health-centeredness embedded in the model had not changed the actual care practices, which still followed the traditional disease-centeredness model and focused on caring for the disease and not on emphasizing patients' health-care activities at home. The data showed that only 7 % of the time was invested in health-related issues and almost 70 % of the time was invested in treatment of the disease (TERÄS & NUUTINEN, 2010).

We found that there were two reasons for that. First, the strategic instruments (the manuals and the care plan) were named health education as one of professionals' tasks, but it was not clearly stated what the term actually meant, for example, how, when and what kinds of topics health education was supposed to include. Second, no time invested was in the script for a treatment session on health issues. Thus, it seemed that health education was assumed to be self-evident practice in the care of periodontal patients. In activity theoretical terms, the new object of health-centeredness had not affected other elements of the ASM (TERÄS & NUUTINEN, 2010).

In relation to the teamwork embedded in the new model, the manuals recognized teamwork as part of the professionals' task. The manuals gave explicit instructions for the responsibilities between the two student groups. In the next example from the dental students' manual the rule for the division of labor was explicated as follows:

“After showing that a dentist candidate has needed knowledge and skills (at least 2 middle large treatments) he or she can implement, starting from the H42 course, periodontal care together with an oral-hygienist student. The oral-hygienist student's task is not to clean gingival pockets that are more than 5 millimeters deep (CPI 4). Every student must care for at least three co-operation patients during her or his studies.” (Paro-Manual, p. 21)

In this example, the manual clearly recognized teamwork and provided rules for the division of labor: the depth of the gingival pockets. In Ostrom's perspective, this would indicate a position rule. The dental student's position was different from that of the oral-hygienist student and was supposed to implement different actions compared to the oral-hygienist student. However, Ostrom (2007) pointed out that to understand actions in a specific situation, rules-in-use must be followed. In the next example, the students discussed the division of labor:

Dental student: Well, surely some treatment sessions with you [the oral-hygienist student] and then with me, and then we take care together the second evaluation when we have cleaned. (...) Last time, we did so that you took care of the lower jaw, and I the upper jaw.

Oral-hygienist student: Yeah, and I cleaned with an ultrasound for the whole mouth.

Dental student: Maybe we can do the same kind of division of labor, if that is ok for you.

Oral-hygienist student: Yes, whatever, it's the same for me.

Dental student: Yeah, let's do so that you take care of first a basic cleaning with the ultrasound, and then you'll clean the lower jaw, and I'll do the upper one.”

In this situation, the students decided to act as they had previously, which is called a “previous rule.” Furthermore, the anatomy of the jaw affected their actions and division of labor. Ostrom called this “a biophysical condition” of a situation, which interacts with the rules. Thus, instead of using the measured gingival pockets (the previous example), the formal rule, to divide the tasks, the students took a practical stance. If they had followed the written rule, it could have resulted in the dental student taking care of some teeth in the upper and lower jaws and the oral hygienist student taking care of the rest. It seemed more practical to divide the tasks according to the anatomy: the upper and lower jaws.

From the activity theoretical point of view, there are two interesting observations. First, an explicit rule was replaced by the students with a more practical rule; thus, they had tinkered with the rules-in-use and navigated through multiple rules. Instead of using one static rule, the activities involved multiple rules and a constellation of rules. Second, the creation of a new model or concept for an activity is not sufficient if all elements of the activity system are not evaluated, tinkered with and re-mediated.

4. Discussion

The aim of this paper was to reflect and explore organizational change efforts in two educational institutions in light of the ASM and especially through the lenses of instruments or instrumentality and rules or a constellation of rules.

Instrumentality was beneficial in revealing the richness and the interconnectedness of cultural tools and practices in VET. There was not one “culture, instrument or practice” but a fruitful repertoire and constellation of cultural instruments used in different cultural practices. In providing education for immigrants, VET teachers face different expectations, conceptions, methods and instruments of learning. However, when looking at the instrumentality of immigrant training, models or visions, as *where to* artifacts, were missing

Constellation of rules, in the second case, offered a broader conceptualization and a tool to analyze and navigate through practices of oral-health care. The challenge in this case was that the new model, as *where to artifact*, seemed not to have affected other elements of the ASM.

Thus, instrumentality, as well as a constellation of rules, provided a solid background for analyzing the efforts and challenges in organizational development work. However, it seemed that the development work in these cases partly failed, because the systemic whole was not taken into account during the development work. In the first case, a clear new model or vision that combined all development efforts was lacking; instead, the focus was on the development of instrumentality in immigrant training. In the second case, a new model was created, but its relation to instruments, and especially rules, was missing. Thus, in development work the systemic whole of the activity should be taken seriously. This is a challenge for researchers within DWR. If researchers do not take the systemic whole into account, practitioners need to navigate through the systemic whole in their everyday practices.

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