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The practice of supervision for professional learning: the example of future forensic specialists

Susanne Köpsén and Sofia Nyström

Supervision intended to support learning is of great interest in professional knowledge development. No single definition governs the implementation and enactment of supervision because of different conditions, intentions, and pedagogical approaches. Uncertainty exists at a time when knowledge and methods are undergoing constant development. This situation affects professions with high demands on precision and safety, and thus supervision and learning. The aim of this article is to explore the practice of supervision for learning professional knowledge of forensic specialists. The context is the Swedish National Laboratory of Forensic Science internal training program, which focuses on learning in daily work when the forensic trainee is assigned a supervisor. Ethnographic studies of supervisors and trainees in different forensic specialties were conducted. Practice theory is used to understand how supervision is planned and implemented to support professional development. Findings show that supervision by seasoned professional forensic specialists is significant for trainee learning. However, supervision is arranged, and performed differently, indicating various conditions for learning. Furthermore, the material set-ups of the professional practice prefigure the practice of supervision. Supervision is an area of expertise that needs to be cultivated and learned to maintain highly specialized professional knowledge in current time of change and uncertainty.

Keywords: supervision; professional learning; practice theory; ethnographic study; forensic specialists

Introduction

Supervision intended to support learning is of great interest in the development of professional knowledge. However, no single definition governs the implementation or the process of supervision. Supervision may be conducted under different conditions – for example, as part of an educational program or workplace learning – with different intentions, goals, and pedagogical approaches, and it may be based on different ideas about what supervision entails. Supervision requirements vary depending on the profession and the type of professional knowledge involved. Uncertainty exists at a time when knowledge and methods are undergoing constant development. Thus, demands on professions and professional knowledge are changing. This situation affects professions that demand high levels of precision, safety, and professional knowledge development. The aim of this article is to explore the practice of supervision for learning professional knowledge of forensic specialists. Forensic knowledge is a field that involves high standards of legal certainty, scientific knowledge, and professional skill, by considering an internal training program in the Swedish National Laboratory of Forensic Science (SKL). We offer an alternative perspective on supervision by drawing on recent research and theory in studies that describe how professional learning is embodied, relational, and situated in social-material relations (Fenwick 2010). A sociomaterial perspective, especially drawing on the thoughts of Schatzki (2002) and Kemmis (2009), makes visible that supervision is arranged, and performed differently, indicating various conditions for professional learning. It is shown that the relations between supervisors and trainees, the objects and the material set-ups prefigure the practice of supervision.

Learning at work is a large part of both professional development and the development of specific professional knowledge. Prior research in this area concerns the social aspect of learning and the situated character of knowledge; learning is integrated in daily work (Hodkinson and Hodkinson 2003). Furthermore, studies consider the ways that newcomers learn the practice of work (Lave and Wenger 1991; Köpsén 2008; Köpsén and Nyström 2012a, 2012b; Nyström 2009a, 2009b) and develop professional identities (e.g., Billett and Somerville 2004; Salling Olesen 2001). Learning from coworkers is an essential aspect of workplace learning, although being a learner at work is not always accepted and is potentially problematic (Boud and Middleton 2003; Ellström 2006). Learning from others can be referred to differently according to its purpose, distribution of responsibility, and the type of relationship (Lauvås and Handal 2001). Workplace learning can consist of learning in which the inexperienced (e.g., forensic trainee) learns with and from others (Doak and Assimakopoulos 2007) or of learning in which the newcomer is assigned a supervisor (Köpsén and Nyström 2012a; Owen 2009; Teperi and Leppänen 2010). This article focuses on learning from others in terms of supervision. Furthermore, the use of practice theory situates our study in Hager's (2011) third and contemporary trace of workplace learning theories where learning is embedded in practices.

Prior research on supervision emphasizes that different types of supervision can be detected depending on the intention, goals, pedagogical approach, and ideas about the nature of supervision. First, research shows that supervision comprises different activities and relationships that are meant to support learning. Learning from others indicates that supervising could focus on a close relationship between a master and a trainee in a centered relationship or be distributed to others in the form of decentered supervision (Nielsen and Kvale 2000). Second, individuals designated as responsible for transmitting professional knowledge adopt various strategies to support learning as a result of their different ideas about the nature and enactment of supervision (Manathunga 2007; Owen 2009; Tyler and McKenzie 2011; Wright, Murray, and Geale 2007). Third, studies of supervision show different supervisor approaches to learning, including unreflective (Tyler and McKenzie 2011), instructive (Koskela and Palukka 2011) or reflective in terms of pedagogical strategies (Owen 2009). Similarly, Lauvås and Handal (2001) have identified two main strategies of supervision for the development of professional knowledge: the traditional master-apprentice relationship (Nielsen and Kvale 2000), in which the supervisor is pictured as a skilled professional and the apprentice's objective is to copy and master the skills through reproductive acting, or in which the supervisor is characterized as a reflective practitioner (Dewey 1998; Schön 1983) who focuses on the apprentice's understanding. Research stresses the importance of investigating supervision and learning in professions that are complex and require high levels of reliability and trustworthiness, such as police officers, forensic specialists, and traffic control officers (Campbell and Nyström 2011; Koskela and Palukka 2011; Köpsén and Nyström 2012b; Tyler and McKenzie 2011). This study focuses on the professional learning of future forensic specialists.

According to research, a profession is defined as a specific field of knowledge involving particular skills, expertise, and language (Abbot 1988; Goodwin 1994). Hence, professional knowledge comprises part of a specific profession and contains several elements (Goodwin 1994). Some elements explicitly relate to theoretical knowledge (Eraut 2000), while other elements, including skills and knowledge, relate to practical knowledge (Polanyi 1983). A skill is the practical proficiency to carry out a task. Knowledge is inseparable from action and is learned through experience. Thus, a type of embodied practical knowledge is expressed in a work practice. Polanyi argues that this type of knowledge is tacit because we do not know how to articulate our knowledge or do not possess a professional language that can describe the complexity of this element of knowledge. An additional element of practical knowledge relates to a person's virtuous intention to act rightly, termed 'phronesis' (Kemmis and Grootenboer 2008). Doak and Assimakopoulos (2007, 2010) indicate that forensic trainees first rely on more explicit knowledge, such as facts, systems, and procedures; only later do they develop the more complex and tacit knowledge necessary to become fully competent forensic professionals. The authors

argue that the more explicit elements of professional knowledge are taught through formal education, while tacit knowledge is learned through participation in work practice. Notably, Köpsén and Nyström (2012b) have found that an essential part of forensic professional knowledge is the ability to describe the investigative process, the reasons behind one's analysis, and the judgments one has made. Thus, how does one manage supervision so as to develop professional knowledge, especially in the context of high demands on reliability and trustworthiness in a complex profession?

In many European countries, professional forensic knowledge is available through forensic science degree programs in universities (Welsh and Hannis 2011). In a study conducted by Welsh and Hannis (2011), employers were critical of course inconsistency and the course's lack of relevance to the professional practice of forensics; they emphasized the need to invest in initial training programs so that new employees learn basic forensic science principles. This article is based on an ethnographic study (Köpsén and Nyström 2012b) of an internal training program at the SKL. The definition of a profession indicates that a professional with forensic knowledge, called a forensic specialist in the Swedish context, understands a well-defined body of professional knowledge, including explicit tasks, responsibilities, and language. SKL stresses that the ability to make wise and legally valid judgments within the judicial system is an essential element of a forensic specialist's professional knowledge. The study showed that daily work supervision is critical to learning the complex professional knowledge of forensics.

The aim

The aim of the article is to explore the practice of supervision for learning professional knowledge of forensic specialists. More specifically, we investigate the SKL internal training program, which focuses on learning in daily work settings in which a trainee is assigned a supervisor.

The Swedish National Laboratory of Forensic Science

SKL is an independent public authority under the National Police Board in Sweden. SKL works in close collaboration with the Swedish judicial system and provides the system with official specialists (SKL 2012). This study focuses on the forensic specialists who work in the laboratory and analyze material gathered by crime scene investigators.

SKL is organized into different departments and units according to forensic specialties, such as serious crimes, forensic IT, doping and pharmaceuticals, and firearms. SKL operates according to the principle of independent assessment. In practice, independent assessment requires that each working team appoint one person to be responsible for each case, and one peer reviewer. These two individuals are not supposed to communicate about the case until the double examination and assessment are complete and the evidence evaluation and witness statements are ready for discussion.

SKL training comprises a two-year program that consists of general courses, forensicspecific introductory courses, and more comprehensive learning at work in the unit where the future forensic specialist is employed. An extensive quality-assurance system exists and is intended to guarantee that forensic specialists in training develop the competencies necessary for their work (SKL 2012). A degree in a field such as chemistry, biology, or engineering is required for employment as a forensic trainee, but other disciplines, such as political science, are also represented. The recruitment process emphasizes specific personal traits and abilities, including the abilities to notice details and to think logically. There are three levels of qualification in the becoming a forensic specialist. A newly employed forensic trainee (level A) is not allowed to work independently and is assigned a supervisor, who is responsible for the trainee's learning as well

as the cases used for learning. A trainee who has reached the next level (level B) of professional competence is permitted to work independently, however, managed by the supervisor (or another forensic specialist) responsible for the case. The assigned supervisor is still responsible for the trainee's learning. Finally, after passing an examination, the trainee becomes a forensic specialist (level C) and is considered proficient enough to be held formally responsible for cases in a specific field of expertise (SKL 2010). This article focuses on the part of the internal training program in which the trainee is supposed to learn from daily work experiences – that is, the article focuses on the practice of supervision.

Theoretical framework

A professional practice presupposes a certain arrangement of human actions expressed through language, actions, and relations between individuals – ‘sayings,’ ‘doings,’ (Schatzki 2002) and ‘relatings’ (Kemmis 2009). The sayings concern different ways of thinking and discussing what a professional practice is and means. The forensic profession, for example, has its own language or specialist discourse. The doings concern the different types of activities and work performed by the professionals and the way these doings influence others in the same practice. In addition, every practice has its own relatings, certain arrangements of people, roles, and relations (Kemmis and Grootenboer 2008). This article focuses on a specific part of the professional practice of forensics – the practice of supervision, which is characterized by its own arrangements. Together, these arrangements create a practice that is linked through practical understandings, rules that govern and form specific actions, and teleoaffective structures that determine normality, acceptability, and general understandings of the meaning and significance of each action (Kemmis 2009).

Each practice occurs in a material world in which the arrangements of objects, artifacts, and technology (e.g., computers, microscopes, and examination tables) are essential to the formation of a professional practice and the enactment of different actions (Kemmis 2009; Schatzki 2002, 2012). Therefore, it is possible to argue that the material set-ups precondition certain individual actions. Thus, individual actions always relate to a certain activity, which is enacted in and adapted to the material world. Changes in the material set-up – for instance, the development of new computer programs – will change the professional practice and alter the way individuals do their work, as well as which actions need to be performed.

The internal training program at the SKL, including supervision, can be viewed as practice architectures ‘which are complex bundlings of arrangements of mediating preconditions of practice – ways of saying, doing and relating, and objects and set-ups with which people in the setting interact’ (Kemmis 2009, 34). Our study describes and analyzes supervision in its cultural-discursive sayings, the social-material activities, and the relatings between trainee, supervisor, and others in the specific professional practice as supervision always is shaped and maintained by the architectures. Features of general and practical understandings, rules, and normative structures are used to analyze the way all the actions are linked – in other words, how supervision for becoming a professional forensic specialist is actually implemented and performed. A study of supervision for learning professional knowledge must relate to professional practice, which influences the way the practice of supervision is constructed, enabled, and constrained.

Method

This article is based on a study (Köpsén and Nyström 2012b) that takes an ethnographic approach (Hammersley and Atkinson 1995). The characteristic of this approach is extended periods of participation in order to get to know the ‘unknown’ context. Following ethnographic research strategies, we used various methods, such as watching what happened, listening to what was said,

asking questions, reading documents, and so on, in order to acquire an all-around understanding of the practice of supervision in the professional learning of forensic specialists at the SKL. During a period of 15 months we visited SKL approximately 70 times (two to eight hours at a time; usually about four hours). The study focused on five forensic trainees at different stages in their training (three in level A and two in level B) and on their supervisors in the work units, representing five different forensic specialties. Further, four supervisors from other work units were interviewed at the end of the study. In total, the sample includes nine supervisors and five trainees. We spent about the same amount of time on each work unit.

Each substudy of a trainee-and-supervisor pair was planned according to their work situations and preferences so that our presence would not disturb or affect the work. Field notes were taken to document our observations of daily work and supervisor–trainee collaboration, including their routines, informal conversations, and special meetings discussing case assessments and witness statements. At each visit, in addition to making observations, we conducted informal conversations and follow-ups. We also studied documents such as standard procedures, competence criteria, work sheets, and workroutine manuals.

Furthermore, each substudy ended with planned individual interviews of the trainee and the supervisor to discuss events and various aspects of supervision that had aroused our interest. According to Larsson (2009) and Hammersley and Atkinson (1995), such

interviews can be viewed as a type of respondent validation to verify our interpretations of the observations. Interviews with the other four supervisors sought to broaden as well as deepen our understanding of the practice of supervision. All (14) planned interviews, which lasted between 45 and 90 minutes, were recorded and transcribed verbatim.

In line with the ethnographic approach, the data analysis was not a distinct stage of research (Hammersley and Atkinson 1995). It was, rather, in an ongoing and stepwise analysis that our understanding and interpretation of the practice of supervision were gradually clarified and deepened.

In accordance with ethical research practices, the informants provided their consent to participate after they had been informed of the study's aim and of how the research material would be used and handled. The critical aspect of this study is the requirement of confidentiality. Participant confidentiality cannot be guaranteed because SKL is the only organization of its type in Sweden. The management selected the trainees and supervisors, and it is almost impossible to maintain confidentiality in such a small organization. Despite this challenge, various techniques were used to protect the participants. The participants had the opportunity to read and comment on the initial results and analysis. Furthermore, the confidentiality requirement affected the presentation of the results. The statements used have been carefully considered, and the names of the informants have been changed. Supervisors are denoted with names beginning with S; trainees, with names beginning with T.

Findings

This section examines the practice of supervision for professional learning. The majority of forensic trainee learning is through supervision conducted in the work units. Various ways of how to implement and conduct supervision have been identified. The types of supervision observed are presented in Table 1 using four practices architectures of supervision. The findings indicate a change in the way the practice of supervision is enacted, which could be related to a transitional movement of learning. Furthermore, the findings show that the practice of supervision is also shaped and formed by materialeconomic, cultural-discursive, and socio-political preconditions.

Architectures of supervision to learn professional forensic practice

A central finding indicates that the practice of supervision at the SKL differs from case to case. Supervision is identified as the main strategy for learning and should be a component of professional practice (SKL 2012). However, the way this goal translates into the actions that comprise the practice of supervision in practical understandings can vary; the findings show variations depending on forensic specialties and the relationship between a trainee and the assigned supervisor. It is possible to argue that the different traditions associated with specific forensic professional practices prefigure different conditions for supervision and learning. Following Schatzki (2002), it is possible to argue that the practice of supervision is a space of multiplicity. To capture this multiplicity, the model in Table 1 describes four practices architecture that are enacted in the practice of supervision. Use of the term 'practice architecture' (Kemmis and Grootenboer 2008) facilitates a discussion of how supervision and learning are structured in the organization's overall work.

Table 1. Patterns of relations and activities for supervision and learning.

Patterns for social relationships	Patterns for activities for learning	
	Explicit in supervision	Implicit in daily work
Centered	1	2
Decentered	3	4

Four practices architectures

According to the study findings, it is possible to identify several architectures for supervision and learning within the work units studied. These architectures, presented in Table 1, describe different arrangements of activities and relationships used in the practice of supervision for professional learning. These arrangements prefigure the varied actions of the assigned supervisors and their trainees. However, model construction requires simplification in order to determine where emphasis is needed in order to reach the desired conclusion. None of the cases studied exhibits a pure arrangement of work and social connections according to the four architectures. However, each specific professional practice has formed and structured the practice of trainee supervision in patterns of activities and relationships that align with the patterns in the model. According to how the forensic trainee learns to talk with, work with, and relate to others in professional practice, the arrangements of supervision within a specific practice may change. In other words, transitional movements (elaborated on later) may change the particular supervision arrangement; a shift may occur between one type and another.

First, the patterns of activities for learning relate to the prominence of the aim of learning in professional practice activities and to the supervisory relations between forensic specialists and trainees. The findings exhibit generally distinctive arrangements and patterns of activities and work: different doings and sayings according to learning. Either activities and interactions explicitly focus on learning – that is, on the intention of or situation for supervision – and thus learning is explicit and obvious (1, 3) or the activities and interactions between specialists and trainees are part of the trainee's normal work, in which case the supervision and learning processes are embedded and implicit in the daily work activities (2, 4). In other words, the two patterns of activities for learning are explicit sayings and doings in a pattern of supervision or implicit patterns of sayings and doings embedded in daily work.

Second, the patterns of social relationships refer to the significant relations present in the trainee's learning. The findings show that the practical understanding of supervision could be either centered on the assigned supervisor (1, 2) or distributed among others within the professional practice (3, 4). Thus, the arrangements of supervision are either centered or decentered. These social patterns are likely to change during the trainee's learning progression.

Explicit supervision and learning in a centered relationship (1). The training arrangement for Thomas follows a pattern of activities of explicit supervision and learning (1). When Thomas interacts with his supervisor, the activities primarily focus on learning. Every day, Thomas independently works on cases that his supervisor has given him; he has started his training to become a forensic specialist. Thomas concentrates mainly on solving any problems that arise by looking at similar but closed cases because he is trying to be as independent as possible. However, he sometimes asks his supervisor for advice. Supervision occurs when Thomas and his supervisor discuss the preliminary work sheets for the evaluation of evidence, which they independently draw up. This is a situation in which the supervisor comments on Thomas's proposals, explains why there are varying assessments, and instructs Thomas on proper evaluation. Thomas and his supervisor thoroughly discuss specific words and phrases in witness statements. Supervision frequently occurs on specific occasions in which the supervisor's obvious intention is to instruct and explain. Using practice theory (Kemmis 2009; Schatzki 2002), it is possible to argue that the arrangement of Thomas's professional learning includes explicit doings: looking at old cases, asking for advice, and discussing the evaluative activities with his supervisor. In addition, explicit sayings are apparent in the interaction with his supervisor – namely, using proper words and phrasing when discussing and writing the results of the evaluation.

The relationship between Thomas and his supervisor is a centered one. This relationship between a forensic specialist and a trainee exhibits similarities to a traditional relationship between a master and an apprentice learning a handicraft or a practical profession (Gamble 2001; Nielsen and Kvale 2000). Individually centered and emphasizing reproductive action, the relationship focuses on the transfer of professional knowledge from a seasoned professional to a new practitioner. Another supervisor in a centered relationship argued that he wanted to 'be in control' of the examination and report writing. However, this supervisor also stated that he would change these arrangements once his trainee was more experienced, noting, 'Then she can work more independently and with other forensic specialists.'

There are some objections to centered relationships. Although Thomas is content with his supervisor relationship, he identified a shortcoming: 'We are usually very consistent. I almost feel that it is uncomfortable. Sometimes we are so consistent.'

Explicit supervision and learning in a decentered relationship (3). A decentered relationship is the other arrangement between trainees and forensic specialists. The practice of supervision includes both the assigned supervisor and other forensic specialists in the professional practice of a particular forensic specialty. Supervisor Sara has a close relationship with her trainee, Tara, and her activities of supervision are explicit for professional learning. However, Sara has established networks of relationships so that Tara can work with other forensic specialists. Sara argued in favor of such arrangements:

It is better, I think, for a trainee to work together with other forensic specialists, as many as possible, as then it's not only two-way communication. It's valuable to benefit from others' experiences.

Another example is Tamara, Stefan's trainee, who emphasized the value of observing other forensic specialists investigating a case. She said,

... Stefan and I were working on the case, and then Sophie came in, and I listened to the discussion between Stefan and Sophie. Then, Scott also had to be involved, so they [forensic specialists] were all there, – it was

very good!.../It was great to see and hear that they had different approaches. They had slightly different ways of working, and they came to conclusions in different ways. Then, they discussed, changed their minds a bit.../and what was the argument behind that change? This situation was so valuable, even if it wasn't specifically supervision.

This statement shows that a decentered practice of supervision is constituted by certain sayings and doings. Thus, the precondition for learning is different when relating to only one assigned supervisor. This example shows that practice architectures of supervision are influenced by professional practice. Another example occurs when the forensic peer reviewer actively participates as members of the decentered team collectively reexamine their independent investigations and assessments. This situation, specifically staged for explicit learning, is an additional part of ordinary current casework. These two examples identify supervision distributed within the community of practice and highlight a decentered learning process (Nielsen and Kvale 2000). Such supervision is especially emphasized in the initial encounter with a given professional practice and provides a resource to help the newcomer understand the arrangements of work activities and learn how to reflect on and talk about work (e.g., Kemmis 2009). A decentralized supervision arrangement implies learning as a collective process that includes various skills, experiences, and perspectives (Lave and Wenger 1991). However, the decentered relationship has shortcomings. Tara said, 'It's not easy; it's a kind of double command ... sometimes I think everyone has their own agendas.'

Implicit supervision and learning in a centered relationship (2). Another type of arrangement in the practice of supervision is characterized by a central relationship and implicit sayings and doings for learning (2). Tess indicated that she initially performed exercises in close connection with her supervisor. However, this situation has changed. Now, she independently works on segments of current cases that she shows to her supervisor before she proceeds. The flow of the professional practice of forensics is picked apart, almost like exercises. Because she is not part of the ordinary work practice that Tamara described (above), Tess works alone and expressed a feeling of loneliness and isolation. She noted:

... After a while he [supervisor] was doing his own cases, and I had to go and ask if there was something more I could do.../ and if I am to be critical, I miss the feedback that I believe is so important for learning.

Despite the exercise-based activities during supervision, the trainee's statement expresses an experience of being left alone and lacking feedback. Tess did not identify her situation as an arrangement of explicit supervision and learning. The arrangement of Tess's supervision has changed from explicit patterns of activities to implicit patterns. The change is the result of material and economic preconditions because her supervisor no longer has the time to actually supervise. In Tess's case, then, the practice of supervision is constrained by material and economic preconditions in the professional practice. Therefore, the arrangements of the practice of supervision do not provide Tess access to professional practice because she is not an active participant. In some ways, she is outside daily professional practice. Based on these observations, it is possible to argue that a centered relationship between a supervisor and a trainee is fragile. Such a relationship always implies a power relation (Manathunga 2007) because the supervisor has the professional knowledge and controls trainee learning and introduction to the professional community. In many ways, the supervisor is viewed as a gatekeeper (Räsänen and Korpiaho 2011).

Implicit supervision and learning in a decentered relationship (4). Tim's arrangement is an example of implicit learning, which is embedded in his participation in the professional practice of ordinary work activities without any specific arrangement of supervising and learning activities (4). Sybil, his assigned supervisor, said:

I don't specifically supervise. We work together. He [the trainee] sometimes knows more about this [the case] than I do, although it was different in the beginning.

With the exception of Tim's first trainee workdays, he has worked independently and participated in the professional practice almost as if he were a qualified forensic specialist capable of performing daily forensic practice tasks. Collaboration and responsibility for tasks are decided on within the group according to individuals' knowledge and skills and their appropriateness in the current case. The forensic area of this work unit is based on another professional discipline in which forensic specialists and trainees are well educated in direct relation to their work. However, Sybil argued that specific forensic knowledge (e.g., mastering the activities of investigating, assessing, and communicating cases) is best learned while conducting professional practice tasks. She stated that she was aware of her responsibility as a supervisor, although that admission does not mean that she interacts differently with Tim than she does with other forensic specialists in the work unit. In other words, the specific forensic practice in which Tim and Sybil collaborate does not include any indicated arrangements for supervision activities and interactions. Instead, the regular professional practice of their specific forensic specialty is the precondition for Tim's learning. It is therefore possible to argue that the architectures of supervision are constrained by professional practice since supervision and learning are not a part of daily work.

Transitional movement in the practice of supervision

The findings show the potential for a change, related to a transitional movement of learning, in the practice of supervision. Stefan, a supervisor, stated:

I try to work side by side at the beginning so the trainee sees me in action I see supervision as very close and practical in the beginning, and then we let go; we become more distant as time passes.

Sam, another supervisor, said, 'I choose among the cases that are appropriate, the size ... how complicated they are.' These supervisors' statements are examples confirming that the supervisor-trainee relationship and supervision's enactment and content may change. This alteration in the practice of supervision, a change from one pattern to another according to Table 1, could be related to a transitional movement in learning. Changes in the practice of supervision depend on trainee experience. First, they are determined by the time elapsed since the start of training. In the beginning, the trainee appears to require a closer relationship with the supervisor, and the two conduct forensic work side by side (e.g., Gamble 2001). In some cases, the activities of supervision changed to support a more reflective and decentralized form of learning once the trainee had developed an increased knowledge and understanding of professional practices (Lave and Wenger 1991). Thus, the practice of supervision is a composite of characteristic sayings, doings, and relatings (e.g., Kemmis 2009) that can shift between the particular architectures described in Table 1.

Second, the transitional movement is complex. The apprenticeship period and the trainee's entry-level knowledge of his or her forensic specialization affect supervision. In some special areas, the employed trainees have an educational background relevant to their work as forensic specialists; for instance, trainees in video forensics have professional knowledge that can be used immediately. These trainees know some of the professional language and specialist discourse and understand how to handle the work activities and actions. Trainees in other areas, however, such as handwriting and fingerprint analysis, have a university degree but were employed because of specific personal traits.

Material and economical preconditions for the practice of supervision

According to Kemmis (2009), a professional practice is always formed in a world of objects and things. This is also the case with the practice of supervision at the SKL, for the findings emphasize that supervision is formed through physical, material, and economic preconditions by different arrangements of special objects, such as tools and resources, in relation to various activities. The following section describes examples of such materials, including databases, the material being examined, work sites, the materialization of knowledge, and artifacts designed for supervision and learning.

The findings exhibit different patterns of relations and activities for supervision and learning. These patterns can be analyzed further. Here, we emphasize that the findings show that the material and economical conditions provide different affordances for the centered and decentered relations between the supervisor and the trainee, in turn affecting different activities for learning. Therefore, it is possible to argue that material and economical preconditions provide the basis for the practices architectures of supervision as presented in Table 1. After analyzing these patterns, it is possible to argue that material arrangements change and redirect doings and sayings in the practice of supervision (e.g., Schatzki 2012, 2002). Some work units use special rooms for collaborating and assessing critical findings. Such a room may have computer screens surrounded by chairs or a large examination table where many individuals can simultaneously examine evidence. This is one example of how the arrangement of a material set-up invites collaborative work in a specific professional practice. These set-ups enable specific sayings and doings and provide specific arrangements for supervision, which is common in a decentered learning relationship. Other units have similar material preconditions for collaborative work, although these materials are not actively included in the professional practice. Instead, forensic specialists and trainees in these units communicate via email and meet only when necessary to discuss a case or witness statement. Our observations indicate that these meetings occur in offices, where the supervisors and trainees sit very close together with no space to spread out their papers or the material to be examined. This practice is primarily observed in a centered supervisory relation where the focus is the transfer of professional knowledge from supervisor to trainee. In this case, it is possible to argue that the material set-up both enables and constrains the supervision. In line with Schatzki (2012), one central finding is that material arrangements prefigure the perpetuation of the practice of supervision affecting the way learning and collaboration are formed and enabled. However, we observed a change within one work unit; the forensic specialists used to hold their supervisory meetings in an ordinary office, and they later moved to another room with a large table. Based on these observations, one might argue that the possibility of spreading out all the material moved the practice of supervision toward a more reflective process. This supports the importance of the material set-up for staging and enacting practice.

The practice of supervision becomes even more complex because the material conditions and set-ups both enable and constrain the conclusions that forensic specialists can draw from their cases. Above, we described a relationship between a forensic specialist and a trainee that exhibits similarities to a traditional relationship between a master and an apprentice (Gamble 2001) – namely, a centered relationship. This kind of relationship is a typical way to learn mastery of material elements; the trainee can observe as the supervisor cuts a plastic bag in a certain way, appropriately adjusts a microscope, or makes a cast of a screwdriver. The trainee attempts to copy the supervisor's actions.

The findings show that the practice of supervision must be examined in relation to economic preconditions (Kemmis and Grootenboer 2008; Schatzki 2002). Supervisors are responsible for trainee learning but are simultaneously expected to examine cases on their own, handle projects,

and perform administrative work. These tasks do not always go hand in hand. Supervisors noted that these expectations complicate the supervisory assignment. One example is Sigmund:

/... /The trainee has been left alone because I have had a lot to do, and honestly, I have had a bad my conscience bothers me sometimes because..., well, I haven't had time. I've have had many cases by myself, and often it is urgent, and then I have different projects as well./... / the training was prioritized a bit lower. That's how it is.

Trainees also expressed a sense of being a low priority: 'It is hard if I think about the time. It makes me feel, – well, I become her [supervisor's] bad conscience because she doesn't really have the time for me.' These two quotes exemplify the way the practice of supervision is shaped by economic preconditions. If the supervisors do not have sufficient time and resources to implement and conduct supervision, there is a risk that trainees will be left on their own. The findings indicate that economic and material preconditions arrange the particular tasks and activities that influence trainee learning.

Furthermore, the findings show that the professional practice of forensic specialists is largely shaped in the world of objects and things (Kemmis and Grootenboer 2008). For example, forensics employ tools, equipment, and machines to examine material evidence, or they rely on databases and systems to assist in investigations. Practice theory helps one understand that materials precondition professional practice (Kemmis and Grootenboer 2008) and enable and constrain the work that people can do. Following Doak and Assimakopoulos (2007, 2010), standardized procedures, such as those governing the management of data systems or databases and administrative routines, have a significant impact on the professional practice and on the practice of supervision. Forum, the overarching data system used by forensic professionals in Sweden, is the administrative system that records all the information pertaining to a case. Forensic specialists cannot work without knowledge of this system. Supervisors, however, generally do not acknowledge the need to learn about these systems and their significance. One supervisor identified the standardized procedures as mere background for the work: 'These things, how to write a work sheet and how different systems work, – to me, that doesn't really have to do with being a forensic specialist.' One trainee elaborated on the lack of organized training in essential elements of professional practice – namely, the use of a certain database. The trainee said:

Rather quickly I got to sit down and play around with xxx [a the data base], trying to learn about it but not working with real cases/... /we worked from old cases and tried to get a hit./... /This was something that I sat alone working with, so it felt like "What happens if?" and "What if I erase something?" It felt unsafe and uncertain./... /It had a "trialanderror" feeling to it.

Another example is a situation in which two trainees in a work unit must share access to a particular database; such a situation has implications for their work because each must wait to complete the task at hand. These three examples demonstrate how the arrangement of objects – in this case, an overarching data system, databases, and the set-ups of a professional practice – is not included in the practice of supervision. Our findings indicate that these set-ups can enable or hinder trainees' learning processes. Material infrastructure, such as databases and computer systems, prefigure changes in professional practice. But supervisors see these infrastructural elements as background, not as learning necessities (Fenwick 2010; Schatzki 2012).

Finally, the supervisors in some work units developed their own written exercises, case simulations, and specific tests to examine trainees' knowledge. These work units have their own traditions; therefore, it is possible to argue that exercises, case simulations and tests embody specific, local professional knowledge and practice (Fenwick 2010). These tests not only examine the knowledge of the trainee but also materialize an overlap between the practice of supervision and professional practice in terms of how learning should be performed and shown, as well as in terms of which professional knowledge is emphasized and valued.

Discussion

The aim of this article is to explore the practice of supervision for learning professional knowledge using the example of the SKL internal training program for forensic specialists. The general finding is that the practice of supervision has a crucial influence on professional learning. The study demonstrates that supervision by professional forensic specialists in daily work is significant for trainees' learning their forensic specialty. This finding aligns with previous research emphasizing the value of learning through participating in work practice (Hughes 2004). However, supervision arrangements and performances differ within SKL. In accordance to Billett (2011) it appears that there is one intended curriculum for supervision and learning, while another curriculum is enacted in practice. Therefore, we argue that the practice of supervision constitutes a space of multiplicity (Schatzki 2002) characterized by different intentions, goals, ideas, and pedagogical approaches. This space of multiplicity is also influenced by the social– political, cultural– discursive, and material–economical conditions since it provides different types of affordances for the practice of supervision.

Learning and developing professionally by participating in work practices can be accomplished in different ways (Doak and Assimakopoulos 2007, 2010; Köpsén and Nyström 2012a, 2012b). This study shows that a newcomer's learning in the forensic profession can be visualized in various arrangements of supervision and learning in the work units. The relationship between the supervisor and the trainee and the focus of learning are two significant aspects of supervision for the professional development of forensic specialists. Our model depicts four practices architectures of supervision that are discursively formed in arrangements of ideas and sayings as well as socially formed in specific relationships between people. Hence, supervision and learning can be either

explicit or implicit in daily work, and relations between supervisor and trainee can be either centralized focusing on the pair, or decentralized involving multiple relationships within the work unit. Hence, a varying focus on learning and the influence of different kinds of relationships implies that various practices of supervision are employed. Thus, various conditions may obtain for in learning the professional knowledge of forensic science. Moreover, the study shows that the practice of supervision also is characterized by a transitional movement in which the supervision changes according to the trainee's development. Given that supervision is significant in the learning process, we argue for an awareness of different ways to implement supervision.

Furthermore, a key finding is that the practice of supervision is formed and structured within specific material and economic conditions. Previous studies have described material set-ups as the background against which learning occurs, but concurring with Fenwick (2010), we maintain that the material set-up of a professional practice – including data systems, microscope, and room design – is entangled with the social, and co-constitutes the knowledge, identities, and activities that are performed through this entanglement. This entanglement both enables and hinders trainees' learning processes. The study shows that material arrangements in a room precondition the way supervision is enacted and staged. Therefore, we emphasize the need to thoroughly consider how a room is set up. Does set-up invite collaborative work? Where will the supervisor and the trainee sit? In addition, it is important to consider the material artifacts and technology that are used daily and decide whether these objects should be part of the practice of supervision. The practice of supervision is additionally prefigured by economical conditions. The study shows the importance of a supervisor's availability to the trainee and of the trainee's access to material resources needed to supervise.

Thus, one finding is that practice of supervision comprises complex socially and discursive arrangements that determine certain ways of sayings, doings, and relating, coupled with the objects and the physical set-ups with which the trainee-and-supervisor interact. As already

mentioned, there are patterns of activities that focus on how prominent the aim of learning is, and there are patterns of social relationships referring to the significant relations that support a trainee's learning. In addition, the material and economical conditions provide different types of affordances for the practice of supervision. The findings show that practices of supervision – and thus the activities and relations that facilitate learning – differ at the SKL. One possible reason for this is that the professional forensic practice comprises a set of local forensic practices, or forensic specialties, each with its own cultural, discursive, economic, material, and social arrangements. Each work unit has different ways of thinking and talking about how to become a forensic specialist, different ideas of what that profession actually entails and the professional knowledge involved, and different understandings of what it means to be a supervisor and how supervision should be performed or enacted (Billett 2011). These local variations and practices prefigure different possibilities for and constraints on becoming a forensic specialist. This should be recognized, considered, and discussed on an overall organizational level, as well as within the specific work unit.

In line with Kemmis and Grootenboer (2008), we see that SKL has created institutional learning architectures in the form of an internal training program intended to prepare new professionals for forensic practice. However, these architectures potentially constrain the local arrangements for supervision and professional learning. The institutional supervision and learning architectures do not consider or acknowledge the many sets of professional practices, each with its own traditions, which could be used more actively in training. However, these different local practices potentially constrain the management's intentions of creating a common and overarching training program. The internal training program requires that a supervisor within a particular forensic specialty be assigned to each trainee in that specialty, but the specific meaning of the supervisory assignment is barely defined. No instructions, guidelines, or training set out ways to actually arrange and conduct supervision for learning. Thus, the meaning of being a supervisor is not obvious (Manathunga 2007; Wright et al. 2007). Drawing on Schatzki (2002), we find a general institutional understanding that the main part of the forensic trainee training occurs during daily work supervision, but there is no general practical understanding of supervision in terms of sayings, doings, and relating. Each work unit and supervisor determines the organization and performance of supervision. Thus, the development of a trainee's practical professional knowledge of the forensic specialty is realized through variable patterns of activities for learning and social relationships.

To conclude, the practice of supervision for learning professional knowledge has an important influence on and contributes to the professional development of future forensic specialists. There is a need to acknowledge that supervision is a space of multiplicity that is shaped, conducted, and enabled in relation to the history, traditions, ideas, and principles of professional practice, as well as by material-economic preconditions. This study calls for the problematization of and reflection on ways to arrange supervision concerning who will be responsible for supervising and how supervision will be planned and implemented. Moreover, it is important to rethink how the material set-up of a professional practice is entangled with social aspects of that practice, given that it coconstitutes the knowledge and activities that are performed through that entanglement. The study shows that such entanglement both enables and hinders the processes for professional learning. It also raises questions for future studies regarding how supervision is enacted through various doings and sayings in order for development of professional knowledge and skills. If supervision is put forward as a crucial aspect of professional development and learning these issues are important to take into consideration since this is a way to ensure the quality. Thus, supervision is an area of expertise that needs to be cultivated and learned to maintain highly specialized professional knowledge in current time of change and uncertainty.

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