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Abstract

The study explores the professional development of future forensic experts. Specifically, it investigates how the forensic expert trainees learn through the internal training program at the Swedish National Laboratory of Forensic Science with a focus on the supervision at work. The findings are drawn from an ethnographical study where five trainees and their supervisors have been observed and interviewed. By drawing on a socio cultural perspective on learning, the results show that supervision is crucial for professional development. Two types of activities and relations define how supervision is implemented. There is a “transitional movement” in how supervision is staged depending on the trainees’ gradual changes in participation in the work practice and increased experience. Forensic experts need skills and know-how to make wise and impartial judgments, i.e. a kind of tacit professional practical knowledge, as well as the skill to communicate with other professionals. However, the development of a professional language is somewhat unspoken or planned. Becoming a forensic expert is a learning process in practice where supervision plays a decisive role in maintaining the professional knowledge in the judicial system. Therefore, supervision for supervising might be a valuable support for supervisors.

Keywords: Forensic expert Professional development Supervision, Trainee, Professional knowledge

“We spend an enormous amount of time discussing the language, it is very important! We discuss the meaning of words, how they can be interpreted, and that the statement of witnesses should have a linguistic tone in line with to the strength of the statement. . . so that it becomes a number. We use a scale of nine points, so the wording has to be in a kind of harmony / . . . / It requires a lot of energy.” (Thomas, a forensic expert trainee at the Swedish National Laboratory of Forensic Science)

1. Introduction

The profession of a forensic expert is highly specialized and in a narrow professional area with high quality demands from the judicial system. Thomas describes, in the quote above, the day-today work of being a forensic expert trainee. It describes the complex task of case assessment where the professional knowledge of a forensic expert is put to the test by combining theoretical forensic knowledge and the practical knowledge performed and expressed in action. How do you learn such knowledge? And furthermore, how do you become a forensic expert? In this article, we present the findings from an ethnographical study [1] of the only formal way to become a forensic expert in Sweden – an internal training program at the Swedish National Laboratory of Forensic Science (SKL).

The understanding of how a profession/vocation is learned has changed. In the past, the apprentice learned the skills and knowledge by following and copying the master’s work [2–4]. The master was the possessor of knowledge and responsible for the apprentice’s learning. In recent decades, there has been a shift towards formalization of professional education with a focus on theory, thus making the work practice subordinate. The downside of this shift is a gap

between formal and theoretical training/ education, and professional practice, implying that when the newcomer encounters the work practice, he/she lacks practical professional knowledge [5,6].

Learning a profession is not only about how to “design” for learning, it is also a specific content, the professional knowledge. Professional knowledge contains both explicit and tacit aspects; the latter are expressed in practice through action and thus hard to verbalize [5,7,8]. Forensic experts, as well as police officers, lawyers and judges, work in the judicial system, which make their education and training and how to learn the more tacit aspects of the professional knowledge important for research. In their actions, the assessment of critical findings and their statement of witness, the forensic experts have to make explicit what they base their judgments on and be able to argue for the case in question. In this interaction, the professional language and the ability to verbalize one’s knowledge plays a decisive role since forensic experts have to justify their actions and judgments with words [e.g. 8, 9]. Despite these complexities, there has been little previous research on the professional development of forensic experts and the development of forensic knowledge. Some studies focus on the importance of the educational design [10,11] while a further study focuses on the development of forensic professional knowledge [10]. These studies stress a need for more studies concerning professional practice, i.e. the work the professional do and the context in which the work is carried out, and how forensic knowledge is learned at work [10].

The aim of this article is thus to explore the professional development of future forensic experts. Specifically, the article investigates how the forensic expert trainees learn through the internal training program at SKL with a focus on the supervision at work.

1.1. The context – the Swedish National Laboratory of Forensic Science

SKL is an independent public authority under the National Police Board (NPB) in Sweden. This makes SKL the formal expert organization, working in close collaboration with the Swedish judicial system [12]. This study focuses on the forensic experts who work in the laboratory, performing analyses of the material gathered by the crime scene investigators. They are supposed to have the ability to make wise judgments in line with the rule of law, and according to the SKL management that is what constitutes a professional forensic expert compared with a skilled analyst. At SKL, they work according to the principle of independent assessment. In practice, this means that the working team appoints a person responsible for the case and one peer reviewer. These two individuals are not supposed to communicate about the case until the “double” examination and assessment have been completed, and the evaluation of evidence and the draft of the statement of witness, are to be discussed.

In Europe there are Forensic Science degree programmes within universities [13] but in Sweden the professional knowledge of the forensic experts is developed and maintained in an internal training program at SKL. The two-year program consists of general courses and more forensic-specific introductory courses as well as learning integrated in work practice. An extensive quality assurance system (CDA: competence, development and authority) is supposed to guarantee that the future forensic experts acquire the right competence for their work [12]. To be employed as a forensic expert trainee, you need a degree in e.g. chemistry, biology and engineering, but also other educational programs are represented such as political science. In the recruitment process, specific personal traits and abilities, e.g. to see details and logical thinking, are emphasized. There are three levels of qualifications before the trainee becomes a forensic expert. A newly employed forensic expert trainee is not allowed to work independently and is assigned a supervisor. When the trainee has reached the second level of professional knowledge, she/he is permitted to work independently. Finally, after having passed the examination, the trainee becomes a forensic expert with the competence to be formally responsible for cases in a specific field of expertise [14].

1.2. Previous research and theory

Previous research concerning how to “become” a forensic expert or how the individual should learn forensic knowledge is scarce. Some studies problematise the importance of educational design when it comes to individual learning, e.g. innovative laboratory programs [9,10] and ICT solutions [11]. Other studies emphasize the work of forensic experts by discussing the complex relationship between explicit knowledge (codified and standardized procedures) and tacit knowledge that are learned and developed in work practice. Doak and Assimakopoulos [7] have,

from a socio cultural perspective, studied how forensic expert trainees develop their professional knowledge. The findings indicate that trainees firstly rely on more explicit knowledge such as facts, systems and procedures, and secondly, develop the more complex and tacit knowledge needed to become a skilled forensic expert. The authors argue that the more explicit parts of the professional knowledge are taught in formal education, while the tacit knowledge is learnt through participation in work practice. Doak and Assimakopoulos [7] emphasize the need for more research focusing on forensic experts’ work practice and its importance for professional development. This article contributes with such research.

The development of forensic professional knowledge also relates to the debate about professionalization. Research on professions is a large research field concerning the characteristics of a profession and how professional knowledge is developed. A specific field of knowledge with particular skill, expertise and language defines a profession [15,16]. Based on their knowledge and professional responsibility, a professional group can claim legitimacy over certain work tasks [e.g. 17]. In this text, a forensic expert is defined as a profession based on a well-defined field of professional knowledge with explicit tasks, responsibilities and language. The term professional knowledge also needs to be scrutinized and defined since it contains different aspects. First are the more explicit aspects often related to theoretical knowledge, i.e. book knowledge, codified and propositional knowledge [5,15]. Secondly there is practical knowledge, which, according to Polanyi [8], can be divided into skill and know-how. Skill concerns the practical proficiency to carry out/perform the tasks. Skill is individual in nature but it is not self-evident it could be articulated and explained since skill is developed through work practice. The other aspect of practical knowledge, the “know-how”, is learned through experience and is thus inseparable from the action [8]. The “know-how” is a kind of embodied practical knowledge expressed in a work practice. Polanyi argues that this knowledge is tacit since we do not know how to articulate our knowledge or we do not have a professional language that can describe the complexity of our knowledge.

Becoming a forensic expert is also a process of professional development. Such development in working life often stresses a combination of learning as a part of day-to-day work and learning through participating in formal training/education [18–20]. In recent decades, there has been a debate concerning professional development in the transition between education and work [21]. The research has emphasized the role of the training/education in which educational design [10,22] and the relation between theoretical studies and work practice [6] and between experienced and inexperienced workers [23] have been central. Many studies have a socio cultural perspective on such learning processes. Studies show that newcomers’ learning processes are complex and dependent on whether individuals have access to or are allowed into the professional practice [23–25].

In order to analyze forensic expert trainees’ professionalization, this paper applies a socio cultural perspective on learning. Thus, learning is seen as processes of social activities changing through interaction and participation in a social practice, a community of practice as discussed by Lave and Wenger [26,27]. Professional development, i.e. identity formation, is the advanced increasing ability to understand and handle the tasks of the practice – how they are carried out and which of

them are more important and relevant than others. The individual also learns how to relate to and communicate with others and develops the ability to understand and use the community of practice's repertoire of resources (both intellectual and physical) such as artefacts, values, traditions, language and other symbols. The practice's repertoire is seen as socio-cultural knowledge, built up over time in mutual interaction between practice and the individual. Gamble [2] relates to Lave and Wenger [26] by emphasizing the need for apprenticeship when learning the tacit knowledge of work.

Furthermore, to analyze the processes of the trainees' professionalization, Rogoff's [28] theory of analyzing learning processes on three different, but intertwined levels is used. The individual level relates to the professional development of the trainees and changes in their participation. Another level is the interpersonal one and concerns activities such as communication and coordination between people who are jointly engaged in the social practice. Rogoff sees these interpersonal activities as "guidance", which we understand as either clearly and explicitly focusing on learning, or being embedded and implicit in everyday activities. In this article, we use the term supervision for the explicit kind of guidance, and the forensic expert having the formal responsibility for this is called a supervisor. The implicit guidance embedded in the everyday interrelations, not specifically focusing on learning, between the trainee and other members of the workgroup, including the supervisor, is named guidance. We also make another distinction in line with Nielsen and Kvale [3], the guidance/supervision can either be centered, meaning that it is related to one supervisor or decentred, e.g. distributed within the work practice. The third level, "apprenticeship" relates to a system of activities aimed at supporting individual learning processes as well as changes in interpersonal interactions and relations [28]. Investigations of this level focus on e.g. institutional structures, financial conditions, rules and regulations as well as specific arrangements for learning such as courses, access to teachers and supervisors.

Studies show that supervisors have different ways of supervising as they have different understandings of what supervision is about and how it should be done [22]. Lauva's and Handal [4] have identified two approaches, which reflect different traditions of learning. The first is based on a traditional master-apprentice relationship where the supervisor instructs by showing while the apprentice observes. The supervisor is pictured as a skilled professional and the objective of the apprentice is to copy and master through reproductive acting. The second approach to learning focuses on the apprentice acquiring an understanding by reasoning and reflecting about the supervisor's constructive questions. Thus, the supervisor is characterized as a conversational partner and a skilled interpreter and analyst.

2. Materials and methods

This article is based on a study [1] with an ethnographical approach [29]. Such a research strategy is appropriate for getting to know and understand what is happening, and why, in "unknown" contexts and practices. Characteristics of the strategy are longer periods of participation in the context of research, the use of different research instruments and a stepwise and ongoing analysis.

The study, which took place over a period of 15 months (including about 70 visits), focused on five forensic expert trainees, at different stages in their training, and their supervisors in different work units, i.e. forensic specialties at SKL. The selection was based on the trainees' stage of development and forensic specialty. Observations of everyday work including special meetings for discussing case assessments and constructions of statement of witness were carried out. Also informal conversations and document studies, e.g. standard procedures, competence criteria, work sheets, and manuals for work routines were used. In order to document the study, field notes were taken. The trainee and the supervisor were also individual interviewed (recorded and transcribed) when the period of observations ended. The interviews intended to deepen our understanding of the forensic work and the training to forensic expert. According to Larsson [30]

and Hammersley and Atkinson [29] this could be seen as a kind of respondent validation since it verifies our interpretations of the observations.

According to the ethical aspects associated with research the informants gave their consent to participate after we had informed them about the aim of the research and how the research material was to be used and handled. To keep the confidentiality of our informants we have changed their names, supervisors are named with an S and trainees with a T.

3. Results and analysis

The study investigates how the forensic expert trainees learn through the internal training program at SKL with a focus on the supervision at work. This part focuses on the main results divided into “supervision and learning” and “professional language”.

3.1. Supervision and learning

Sara, a supervisor states “... the most obvious [supervision] is to investigate cases together.” This statement indicates that the process of professionalization of forensic trainees are integrated into practice of work. The process of learning is thus situated in a particular social practice [7,26]. Sara’s statement also expresses a perspective that points to learning as an activity and the value of joint activities. However, a central finding in the study is that the subject-related supervision for professional learning is approached and staged differently at SKL.

There are no specified instructions or common routines for the supervision of future forensic experts. However, there is a joint understanding that supervision and learning should be part of the work practice. What this means when it comes to activities and relations between supervisor and trainee – and between a trainee and other forensic experts in the work unit differs according to the work practice and forensic specialty. The specific socio cultural structures and routines fort how the tasks are organized, the interactions between the forensic experts in everyday work, and the traditions about how the tasks are performed determine the content of supervision as well as how supervision and guidance in everyday work is performed. Moreover, the level of development of the forensic trainee influences the interrelations between the supervisor and other forensic experts in terms of independence in everyday work. In addition to the differences that have been discovered, it is possible to identify aspects that help to understand more about supervision for professionalization of future forensic experts.

3.1.1. Systems for supervision and learning

According to the findings, it is possible to speak about different kinds of apprenticeship [28], e.g. systems for supervision and learning within the work units studied. The differences can be seen as related to the specific forensic socio culture and the trainee’s level of qualifications. Two main types of activities and relations define how the apprenticeship is shaped; focus on learning and the relation between the trainee and the experienced forensic experts.

The first type, focus on learning, relates to how prominent the aim of learning is in the interrelation between the forensic expert and the trainee. The activities and the relation are either explicitly focused on learning, i.e. the intention of and situation for supervision and learning are explicit and obvious, or the activities and interrelations between expert and trainee are part of the tasks, routines and structure, i.e. the ability to participate in the practice of forensics is developed through activities involving guidance that are embedded and implicit in the workday activities. In other words, we can talk about learning as either *explicit in supervision or implicit through everyday guidance*. The apprenticeship for Thomas is an example of explicit learning and

supervision. When Thomas interacts with his supervisor the activities are mainly focused on learning. Thomas works on his own everyday with cases given to him by his supervisor and has done so since he started his training as a forensic expert trainee. Thomas mainly tries to solve the problems that come up by looking at similar but closed cases, as he is trying to be as independent as possible. However, he sometimes asks for advice from his supervisor. Supervision takes place when Thomas and his supervisor discuss the preliminary worksheets for evaluation of evidence, which they have drawn up independently of each other. This is the situation when the supervisor comments on Thomas' proposals and when the supervisor explains why there are varying assessments and instructs Thomas about what the proper evaluation is. This is also the situation when they thoroughly discuss specific words and the phrasing in the statement of witness. Thus, the supervision mostly takes place on specific occasions and with the supervisor's obvious intention to instruct and explain.

The apprenticeship for Theodor is an example of implicit learning, i.e. guidance embedded in the trainee's participation in workday activities and without any specific unspoken situations or activities for learning. His supervisor Sybil says:

I don't specifically supervise. We work together. He [Theodore] sometimes knows more about this [the case] than me, though it was different at the beginning.

Except for the very first time when Theodor was a newcomer as a forensic trainee, he works independently as a legitimate member [26] of the team, capable of performing the everyday tasks. The forensic area for this work unit is based on another professional discipline in which the forensic experts as well as the trainee are well educated in direct relation to their work. But the specific forensic knowledge, i.e. to investigate, assess and communicate cases is, according to Sybil, best learnt while participating in the work practice. However, she states that she is aware of her responsibility as a supervisor, although that does not mean that she interacts differently with Theodor compared to the other members of the work unit.

The second type of apprenticeship, relation to the forensic experts, concerns which relations that are significant to the trainee's learning. The explicit supervision, or embedded guidance in everyday work, is either related to one supervisor or distributed within the work practice, i.e. it is either centered or decentered.

An example of a centered relation for supervision is the relation between Thomas and his supervisor described above. This kind of relation between a forensic expert and a trainee has similarities with a traditional relation between a master and an apprentice when learning a handicraft or a practical profession [2,3]. This is a relation for supervision that is individually centered, emphasizing reproduction as it focuses on the transfer of professional knowledge from an experienced person to a newcomer. Another example is Stefan, who supervises Tamara who recently started as a trainee. He emphasizes that he so far needs to "have the control" but that he will change when Tamara has become a little more experienced, "then she can work together with other forensics experts". However, there are some objections to the centered relation. Although Thomas is content with the centered relation of supervision he argues there is a shortcoming:

*We are usually very consistent, I almost feel that it is uncomfortable, sometimes we are so consistent /.../
There is not much friction /.../ we have become so synchronized. . .*

Stefan's trainee says, after having had the opportunity to observe other forensic experts investigating a case:

... both Stefan and me were working on the case and then Sophie came in and I heard the discussion between Stefan and Sophie. Then Steve also had to be involved so they [forensic experts] were all there and it was very good. Researcher: What was good about that? 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 together, changed their minds a bit/. . ./and what was the argument behind that change. This situation was so valuable, even if it wasn't supervision specifically.

A decentered relation is the other kind of relation for supervision. Sara argues in favor of such arrangements:

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

Although Sara has a close relationship with her trainee and clearly takes the responsibility for supervising, she has established routines for her to work together with other forensic experts. An example of realizing such arrangement of supervision is when the peer-reviewer actively participates in a situation where they are discussing all together the investigation and assessments each of them has done independently. The example concerns supervision that is distributed within the team, the processes of learning is decentered [3]. It is an approach of supervision that points to learning as a collective process including various skills, experiences and perspectives [26]. The collective process involves a mutual exchange of perspectives and ways of understanding and interpreting a task e.g. various understandings of the case and which proper and wise judgments should be made. Thus, it is also possible to interpret the example as showing that even the supervisor may benefit from by working together with a trainee. Another example of a decentered relation is when the trainee is permitted to work independently and participates in the team almost as if he/she is a qualified forensic expert. In this example who is responsible for the work tasks is decided within the group according to whom has the appropriate knowledge and skill for the current case. The relation between Sybil and Theodor, described above, is of such kind. However, also the decentered relation of supervision has shortcomings. Tara says:

"It's not easy, it's a kind of double command...sometimes I think that everyone has their own wills".

3.1.2. Perspectives of supervision and learning

Another finding in the study concerns the supervisor's perspective of supervision in terms of learning. Learning is a complex phenomenon and one supervisor can express multiple and varied perspectives, which do not necessarily harmonize with each other. However, some supervisors do not express any opinion at all about learning [see also 22]. The finding concerning views of learning can be described as focusing on *support, understanding, instructions* and/or *flexibility*.

When supervisors describe how they act as a supervisor they focus on *support*. The expressions they use to describe the meaning of support are e.g. being a sounding-board, lean in pinch, just being there, and answering questions. Two statements depict how different views of learning influence how support is performed and how it is experienced by trainees. Sara says:

I try to be a kind of supportive supervisor, not pointing to the way to go; "here it is, it's like this". The trainee has to figure it out herself. . . by reflecting, reading and learning

Talking about her experience of being supervised and what attitude she prefers, a trainee (Tara) says:

. . . a sounding board if you feel you've stagnated /. . ./ you may need to be coached and if you get stuck you need some good advice such as "read this" or "think about it in this way. . .

This trainee confirms the positive value of a supportive attitude, although when she describes the meaning of getting advice, she points to the value of being instructed and told how to proceed.

However, the statements display a different understanding of being supportive. The trainee talks about suggestions and proposals, but the supervisor highlights the value of not pointing to the way to go.

Other statements about supervision and learning emphasize *the importance of understanding*. Asked to describe the characteristic of “good” supervision, Sara says:

If you consider the situation when we jointly discuss the assessment that has been made. . . I think it's best if the trainee first says how she has been reasoning on her own. Then I can say how I've been thinking and we can have a discussion. It's better this way instead of the one who is more experienced saying how it should be. . . it would perhaps stop . . . put an end to the discussion.

When Tara is asked the same question she says:

Last week, we had a case / . . . / it was an interesting discussion / . . . / I reasoned and gave my thoughts and X [the supervisor] didn't say much, but it was good. I had to think and to reason my way of how it could be. . . to find an answer.

In these examples of supervision, understanding is an essential aspect of learning. Learning is not just how to act properly; both the supervisor and the trainee point to the need to understand why one acts in a certain way. This view of learning is also expressed by Stefan who says that he appreciates it when his trainee asks “why?” The goal is to develop the trainees’ understanding and thus enable them to reflect on and discuss the specific forensic phenomenon. This goal is a fundamental aspect in professional development emphasizing the change in participation in a community of practice, including the ability to understand and to know how to handle the tasks [26]. Likewise, Lauva° s and Handal [4] argue that understanding is a major aspect of supervising professionals. By reflecting, discussing and questioning an understanding is developed, which means that there are opportunities for interpretation and analysis other than supervision focused on observation, demonstration and instruction.

The latter attitude of supervision, e.g. *observation, demonstration and instruction*, is also found in the study. Above, in the example of the arrangement of Thomas’ supervision, it appears that his supervisor instructs, comments and explains to Thomas how to do things. This could be explained as a socio cultural tradition pointing to traditional learning of handicraft [3]. Stefan also instructs and demonstrates when supervising, although he says it is because his trainee is a newcomer. “I try to work side by side at the beginning so the trainee sees me in action”. Thus the starting-point for Stefan’s attitude is the progression of learning rather than socio cultural traditions. This is also an example of the need for *flexibility* that supervisors as well as trainees bring up, although some of them focus on this view of learning more than others. The main arguments for flexibility are the progression of learning and individual differences. Sam says that “during the first phase, one is the more. . . you check more step by step, how it works”. The argument for flexibility concerns the trainees’ gradual changes in participating in the work practice of the specific forensic subject. The more experience, the more understanding of the tasks and an increasing ability to handle the material to be assessed and make the proper assessments and evaluations. These gradual changes in the development of forensic knowledge, skill and “know-how” imply different and varying needs for supervision for learning. Thus, the progression of the trainees’ learning implies the need for the supervisors’ ability to vary how they supervise. Furthermore, another argument supporting flexibility concerns the individual and is expressed by Sam as follows:

. . . it's important that you see that trainees are individual and that they learn at different speeds and in their own way. Some of them learn better by doing it in one way, others in another way. It's important to be aware of this! It's also a question f how fast you work and how easily you learn this kind of knowledge. There are individual variations, you could say. . .

However, the findings show that the supervisors' approaches to supervision and learning are not always the same but differ in relation to the actual situation and the level of qualification of the trainee.

3.1.3. Content of supervision

In the study, different starting-points for supervision appear in the meaning of what the supervision should be about, i.e. the content. Although there are formalized specifications of requirements in CDA, findings show that these documents are not always the main principle when choosing the content of supervision. There are principles such as *specification of requirements*, *professional experience*, *workload* and *progression in learning*. These principles to some extent overlap, although one of them has a large influence on what the supervisor means is the goal of the supervision and what is brought up for supervision. Sara refers to the formal documents:

My main role is to supervise in the subject-specific area, and of course there are documents that specify the requirement of competence in the subject-specific area.

Sam, who has many years of professional experience, does not pay much attention to the formal competence criteria.

No, I don't really read the specifications of requirements. I don't think I need that / / I think I've learned over the years what you have to know and what you need to master until you become a forensic expert. I am not a supervisor that marks off in the specification exactly what the trainee has performed, but rather one who teaches the professional skills.

Sam's statement highlights the relation between master and apprentice [2,3] where the master defines what to learn in the process of professionalization. Nor does Sybil let the formal competence criteria guide her supervision of Theodor. It is the cases that are to be investigated that determine what Theodor works with and what issues are brought up. This is in line with the apprenticeship for Theodor emphasizing the implicit and gradual learning by participating in everyday work together with more experienced participants [26,27]. Stefan is ambivalent about the formal competence criteria such as the curriculum for supervision: "I don't know if all that a forensic trainee needs to learn is covered by the specifications. . .".

Furthermore, there is one more principle for what is guiding the content of supervision, e.g. expressed by Sam who says "I choose among the cases that are appropriate, the size. . . how complicated they are". Supervisors select the appropriate case for their trainee based on the trainee's experience and capacity. The supervisors' decisions concern *the progression of professionalization* and recognition that learning should be a challenge that the trainee can master. This approach reveals that the decisions about content and learning are integrated and interdependent [22] and that professionalization through gradual learning mean increasingly more complex tasks and greater independence [26].

3.2. Professional language

The findings show that an essential part of the forensic expert profession is the skill of describing how the investigation has been

conducted and its results in different contexts, both internal and external. Development of a professional language is thus a central part of becoming a professional forensic expert. You have to develop a general forensic professional language as well as subjectspecific one. When participating in the practice of everyday work as well as in the practice of general courses including quality assurance system and steering documents, the trainees adopt the general

forensic professional language, which is the meaning and use of concepts such as e.g. statement of witness and evaluation of evidence. However, the subject-specific professional language is mainly learned in everyday activities and supervision, although the trainees also become acquainted with the subject-specific language by studying theories and texts related to a specific forensic area. In this study, we have identified two significant challenges of learning a professional forensic language; the tacit aspect of forensic practical knowledge and the demands for a functional and stringent language for communicating the results to other professionals. These two aspects are related and hard to discuss separately.

The statement by a forensic trainee presented in the introduction of the article demonstrates the complexity of a professional language. Thomas says that he and his supervisor spend a lot of time discussing the meaning of words, the demands for stringency in the statement of witness and the need to use words in “harmony” with the 9-point scale. In the interview, Thomas also reflects on the challenge of using words that can be compared with a specific point on the scale. How can you express a specific degree in words? This is not just a challenge concerning how to write the statement of witness, but also how to communicate in the group of forensic experts. For example, what does the value +2 mean when comparing pictures, and what does one degree higher (+3) mean? This is the challenge of expressing the forensic “know-how” that is learnt through experience and is, as Polyani [8] says, inseparable from action, it is through long experience that you can e.g. distinguish different quality of heroin at a glance. Polyani [8] argues that this knowledge is tacit since we do not know how to articulate our knowledge. To learn how to use words and symbols, and trying to articulate and visualize such knowledge is part of becoming a forensic expert. The findings show that communications about assessments and evaluations are essential parts of the daily forensic work, albeit a discreet one. Special meetings and even new work routines are devoted to developing a joint understanding and a common language, but also to trying to make the assessments and evaluations transparent to others, in the forensic group as well as other professionals. The subject-specific professional language relates to the concepts and symbols used in communicating the examination of a case and the assessment of the results, i.e. the repertoire of the specific social cultural practice [26]. The findings indicate that each work unit, i.e. forensic specialization, has its own ways and words it uses to describe and clarify what is analyzed and assessed, and how – as well as why. Some of the words used are related to the basic discipline, e.g. analytical chemistry and video forensic, while others are related to the specific forensic profession, or as Sam says, “the specific craftsmanship”. The study shows that the subject-specific professional language sometimes includes a set of metaphors to express a tacit part of the professional forensic knowledge [8] e.g. “sails”, “eyes”. Thus, a challenge in the team and hence for the supervisor and the trainee is to calibrate their interpretations so the concepts are understood in similar ways. The findings indicate that this challenge occupied a large part of the process of supervision but was also part of the implicit learning in the trainee’s daily work.

In the interview, Thomas also reflects on the demands on clearly communicating the findings of an investigation so that judges, prosecutors, defense lawyers and even the person being charged understand the statement of witness. The study gives many

examples of how the supervisor and trainee intensely debate which words and phrasings they should use. Communicating with other professional groups, that is, converting professional language, and thus professional knowledge, so that it is understood by others, such as a client, is an important part of professionalization [8,17].

Having a professional language and the ability to use it properly in different contexts is crucial for a skilled forensic expert. However, the findings show that supervision and training in how to develop a professional language is not comprehensive. The trainees are thoroughly trained in communicating the final findings of an investigation, mainly because this task is so important in the work of forensic experts. They are trained to master a kind of transformed professional

language using specific expressions in the statement of witness to make them understandable to different clients in and outside the judicial system. Nevertheless, the development of a professional language between forensic experts is not part of the internal training program and therefore not purposely trained; it is implicit in everyday work. This is vital considering how the learning processes for a becoming forensic expert are staged. Furthermore, it is crucial as a significant part of the professional forensic knowledge is the skill and knowhow needed to make wise judgments. This knowledge is often based on experience carried out in action and of a tacit kind [2,8,9].

4. Discussion

This article is based on a study focusing on a key part of the professionalization of forensic expert trainees – the supervision by forensic experts. In the Swedish National Laboratory of Forensic Science (SKL), there is a structured internal training system for forensic expert trainees that combines general courses with introductory courses for forensic experts as well as supervised learning in practice. The results of the study emphasize that supervision and learning in practice are crucial for the professional development of future forensic experts.

However, the findings show that despite the internal training program, the system of apprenticeship, according to Rogoff [28], does not include any guidance for those involved in supervision, i.e. how supervision should or could be implemented and carried out. Nor is supervision something specifically discussed in the team or between supervisors. The findings, rather, indicate that supervision of trainees is shaped by individual interpretations and socio cultural knowledge and traditions in the subject-specific area and team. The different arrangements and approaches of supervision have a significant impact on how the learning processes in different forensic subjects are shaped. To our knowledge, it is necessary to acknowledge that forensic disciplines are different and that individuals learn in different ways. There is no single model of supervision. On the other hand, it is important to give support and make visible how supervision can be performed and why. Supervision for supervising might be a valuable support for supervisors.

Learning and developing by participating in the work practice can be done in different ways [7,21,23,24]. In line with Nielsen and Kvale [3], this study has shown that the newcomer's learning and gradual pathway into the forensic profession can be pictured in two ways. The first is a centered relationship between a master and an apprentice. The master has the knowledge and through close collaboration, the inexperienced apprentice learns to do as the master. The second way is decentralized learning [3] where the trainee learns together with other forensic experts in work practice by performing the tasks with gradually increasing difficulties and demands. The trainees emphasized the need for a decentralized relation for learning since it gave them access to different individuals' experience and perspectives, which not only stimulate learning but also further develop professional knowledge.

Another aspect of professional development is how important the aim of learning is in the interrelation between the supervisor and the trainee. The results show different apprenticeship where learning is either explicit in supervision or implicit through everyday guidance. In the first, the focal point is learning through supervision in which all activities are intended to further professional development. In the second, the focal point is on the work practice with its tasks, routines and structure where the activities and interactions between the trainee and the supervisor are a part of the everyday work. Professional development is carried out together with guidance that is embedded and implicit in work practice. These different ways of supervision are characterized by two logics, learning and production [31]. The results indicate that becoming a forensic expert can more or less be governed by both the logics and no clear cut case has been studied.

The results show that supervision for professionalization of forensic experts can have a different focus on learning and different relations to experienced forensic experts. We see a “transitional movement” in how supervision is staged depending on the trainees’ experience, i.e. how long she/he has been a trainee as well as educational background. In the beginning, it seems that the trainee needs more of a close relationship with his/her supervisor working side by side doing the forensic work [e.g. 2]. With increased knowledge and understanding of the work practice [26] we can see that the relationship changes to a more reflective and decentralized form of learning. This transitional movement is more complex since it also depends on entry knowledge in relation to the forensic specialization the trainee will work in. In some special areas, i.e. video forensic, the employed trainees have an educational background relevant for their work as a forensic expert, but in others, e.g. handwriting and fingerprints, the trainee has a university degree but is employed according to suitability and special personal traits. Another factor that also influences supervision is the access to resources, that is, colleagues who are forensic experts. Furthermore, it is important to emphasize, in line with Wenger [27] that rules, routines and established structures in the group influence how supervision is staged.

In the study, it is shown that professional forensic work to a large extent includes assessments and evaluations based on practical knowledge that include the skill expressed in action and the tacit embedded know-how that is hard to articulate [2,8,9]. Furthermore, a professional language is a significant part of the forensic profession. Thus, to become a forensic expert the trainees have to develop the professional knowledge for conducting investigations and making wise judgments including a professional language to be able to communicate the investigation and its results to other forensic professionals as well as other groups of professionals in the judicial system. However, the findings show that training and supervision in developing such a professional language is not comprehensively unspoken or being planned for. This is significant since SKL argue that the ability to make wise judgments in line with the rule of law is what constitutes a professional forensic expert compared with a skilled analyst in the field. If forensic knowledge is made explicit [7], it can become a crucial part of forensic expert trainees’ learning process. Furthermore, since the professional language is essential for the professionalization of forensics, it is important that the trainee gets the opportunities and support to develop a professional language that he/she appropriately and skillfully can use for different purposes in diverse contexts. Making such learning a part of both the general training and the subject-specific supervision could be discussed by SKL.

4.1. Conclusions

This study explores the professional development of future forensic experts. Specifically, the article investigates how the forensic expert trainees learn through the internal training program at SKL focusing on the supervision at work. The findings are drawn from an ethnographical study where five trainees and their supervisors have been observed and interviewed over a period of 15 months. The following conclusions can be drawn:

- Supervision in work practice is crucial for the professional development of forensic expert trainees. Despite this, there is no system (instructions, guidelines, training, etc.) in the internal training program supporting those involved as regards how supervision should or could be implemented. It is open to individual interpretation and socio cultural knowledge and traditions.
- There are two types of activities and relations defining how supervision is implemented.
 - a. Focus on learning relates to the importance of learning; explicit in supervision or implicit, embedded, in everyday work.
 - b. The trainee’s relation to the forensic experts; centered on one forensic expert or decentered so that the trainee can learn together with other forensic experts. Here, the trainees emphasize the need for a more decentralized relation.

- There is a “transitional movement” in how supervision is staged depending on the trainees’ gradual changes in participation in the work practice and increasing experience. How the transitional movement is played out is complex and dependent on the educational background of the trainee as well as access to resources, i.e. other experienced colleagues.
- One crucial part of becoming a forensic expert is the development of a professional language. Two significant challenges when learning a professional forensic language have been identified; the tacit aspect of forensic practical knowledge and the demands of a functional and stringent language for communicating the results to other professionals. The findings show that training and supervision in developing such a professional language are not being planned for and therefore important to include in the program.

The implications: The work of forensic experts is complex and involves professional knowledge, both theoretical and practical knowledge expressed in skills and know-how. The tacit aspect of the forensic know-how needs to be verbalized since the forensic experts should make wise judgments in line with the rule of law. This study has shown that becoming a forensic expert are learning processes in practice where supervision has a decisive role to play in maintaining professional knowledge in the judicial system. The supervision is implemented and performed based on individual and socio cultural traditions and knowledge and it is suggested that the internal training program for professional forensic experts is developed with guidance and training for supervisors. Therefore, this study contributes with new research concerning the complex and highly specialized profession of forensics.

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