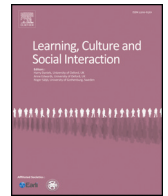




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Full length article

## Organizational learning in forensic fingerprint investigation: Solving critical challenges with organizational rule construction

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## ABSTRACT

The present study analyses data collected from a series of developmental seminars in a fingerprint laboratory during which fingerprint examiners jointly discussed and developed their work processes, analytical methods, decision-making criteria and rules of documentation. The analysed organizational development took place in the context of moving from paper to digital documentation and from individually to collectively mastered work process. The fingerprint examiners who participated in the seminar series jointly reflected on their existing professional rules and operational practices, improvement of which was called for to facilitate organizational learning. The analysed data set consists of 10 audio-recorded developmental seminars with written documents as well as notes and decisions that were made during the seminar. The results of the study will reveal the complex ways in which the fingerprint examiners share their practical professional knowledge and collectively create decision-making criteria and rules of investigative practices so as to adapt their work practices to the changing quality requirements, evolving international standards and digitalization of research documentation.

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## 1. Introduction

The purpose of the present study is to examine how challenges of digitalization of fingerprint investigation are addressed in the developmental seminars of fingerprint examiners in the Forensic Laboratory of the National Bureau of Investigation (NBI) in Finland. Traditionally, fingerprint examiners' work has relied on personal capabilities of analyzing and processing latents with actual physical evidence extracted from crime scenes in the form of paper, photos and tapes. The examiners' work process did not provide many possibilities for quality assessment, and the level of documentation during the investigative process remained minimal. Digitalisation, however, brought new technological means with the help of which the work could be further developed. In 2011, for instance, Laboratory Information Management System (LIMS) was adopted in NBI to mediate almost all of the laboratory's work processes and services, a change which made it possible to develop and transform the fingerprint investigation process from individual toward a novel, collective work process with higher quality requirements. The digitalized examination made the divergence of personal practices visible and

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elicited documentation of all stages of the examination. Additionally, it forced the fingerprint community to go beyond the former methodological criteria and interactively further develop the rules of its own practices.

In order to analyse the above-mentioned change, and the related organizational learning embedded in the social interactions of the studied expert community, this study will address following research questions:

1. What kinds of developmental challenges emerged from the digitalization of fingerprint-examination process?
2. What kinds of shared criteria and rules of fingerprint examination were co-constructed during the developmental seminar to address the developmental challenges?

In order to answer these questions, this study draws ideas from a diverse body of research on expert work and organizational learning as well as from literature, which addresses the use and recreation of rules in social interaction. The analysis will reveal the complex ways in which the fingerprint examiners shared their everyday knowledge and collectively created their decision-making criteria and rules of investigative practices so as to adapt their work processes to the changing contextual conditions, such as new quality requirements, evolving international standards and digitalization of the research instrumentation. The article will thus open up an avenue to better understand the complex ways in which technological change, professional expertise and local social interaction transform collective work practices and enhance organizational learning, especially with reference to rules that are important elements of organized human activities (Engeström, 2015).

## 2. Challenges for transforming practices in fingerprint examination

The forensic science community consists of practitioners and scientists coming from a broad range of disciplines with different sets of investigative methodologies and techniques. The nature of fingerprint analysis is also historically formed by diverse practices and knowledge, shaped by the values, motivations, emotions and purposes of the examiners and the institutions in which they work (Charlton, Frazer-Mackenzie, & Dror, 2010; Edwards & Daniels, 2012). It is thus a complex process in matching two fingerprints, an unidentified fingerprint (latent) found at the crime scene and one from the register. Because of lack of mandatory standardization (e.g., operational principles and procedures), the methods and practices of examination have been locally-developed. Although joint protocols are followed, standards are often not used in a meaningful way. Much criticism has been directed at discipline's lack of scientific validation, determination of error rates or reliability testing (NAS, 2009).

Nevertheless, fingerprint examiners are expected to state their conclusions according to standardized rules and produce accurate, well-justified, and adequately documented decisions. Examiners are also encouraged to adaptively develop their working methods, examination processes and documentation. Due to digitalization, fingerprint examiners have to cultivate new epistemic practices mediated by digitalized instruments and practices. Furthermore, examiners have to deal with tightening quality criteria and accountability requirements when they encounter fuzzy cases and conflicting interpretations (Mustonen, Hakkarainen, Tuunainen, & Pohjola, 2015).

In conjunction with digitalization of instruments, fingerprint examination is also becoming more international in nature; investigators collaborate with their international counterparts, and national efforts are mediated by various international standards and quality requirements. This is partially because the fingerprint domain has had challenging situations due to misidentifications, e.g., in the USA and UK (Saks & Koehler, 2005; U.S Department of Justice, 2006). International guidelines, norms, standards and scientific research have tried to push those in the forensic domain to develop their practices further, with little success. The norms that regulate the fingerprint examination are also subject to individual variation in judgments, decisions, working practices, and documentation. National examination systems are, moreover, being developed and refined according to accumulating international research and evidence revealing challenges and limitations related to transparency and criteria. Consequently, professional expert systems, including those in fingerprinting, are increasingly expected to incorporate scientific methods and practices. The fingerprint examination community may be seen as an example of a professional epistemic culture (Nerland, 2012; Nerland & Jensen, 2012, see also Jensen, Lahn, & Nerland, 2012), one that relies both on professional knowing and scientific knowledge. Digitalization make personal and collective work processes visible and durable, leading to new kinds of transparency and accountability requirements (Jensen et al., 2012; Nerland & Jensen, 2012).

Learning to do fingerprint analysis requires sophisticated expertise acquired through years of training and practical experience (Ericsson, 2006). Mustonen and Hakkarainen (2015) analysed the development of two apprentices' adaptive expertise in fingerprint examination across a two-year training program. Their study, alongside with that of Mustonen et al. (2015), confirmed that professional expertise is, to a large extent, based on tacit or implicit knowing; experts know more than they can tell (Polanyi, 1966) and often cannot provide reliable verbal descriptions of their reasoning process. Examiners' internalized professional knowledge provides psychological tools (Vygotsky, 1978) for separating significant cues and signs from non-significant background. Goodwin's (1994) theory of professional vision assists in understanding and explaining experts' sophisticated visual competencies in recognizing complex patterns when comparing target fingerprints (latents found at a crime scene) with filed prints. Such visual capabilities allow experts to make well-justified inferences based only on partial and limited information. Goodwin (1994) categorized professionals' visual activity according to three practices; coding, highlighting, and producing and articulating material representations. As illustrated by Mustonen et al. (2015), coding by marking minutiae in latents enables making Automated Fingerprint Identification System (AFIS) database searches and comparisons with the candidate's fingerprints. By highlighting disturbances and colour coding ridge flows (i.e. special details) or minutiae, the examiner makes his or her perceptions visible and shareable with other experts. Constructing external material representations involves manipulating fingerprint images in various ways by using AFIS and/or image manipulation programs (e.g., Photoshop) and by also producing written annotations which

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