THE KNOWLEDGE ECONOMY AND EDUCATION

Professional Learning in the Knowledge Society

Karen Jensen, Leif Chr. Lahn
and Monika Nerland (Eds.)

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PROFESSIONAL LEARNING IN THE KNOWLEDGE SOCIETY

The Knowledge Economy and Education

Volume 6

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PREFACE

The knowledge society constitutes an inescapable framework: “Not all people are included, but everybody is affected.” This book explores how this new age is experienced and dealt with by the professions. There are very good reasons for studying the professions in this way. Modern societies are increasingly dependent on them and their growing importance is reflected in both quantitative terms and in the vital tasks with which they are entrusted. As Abbott (1988) puts it, the professions have come to “dominate our world. They heal our bodies, measure our profits and save our souls.” Their knowledge and decisions influence all facets of modern life and provide a framework for most of what we do. At the same time, however, the knowledge society significantly challenges the professions’ classical modes of operation and requires them to reconstruct themselves in a manner which is more powerful in the emergent epistemic landscapes. One core challenge discussed in this book is how to construct cultures for knowledge and learning which take into account both the “unfolding” character of professional expertise in a complex world and the need to stabilise knowledge for responsible use. Thus to investigate how these groups transform and recreate is to study the knowledge society in the making, as its inherent tensions demand institutional resolve.

The book has been prepared over a three-year period. During this time many people have been involved and we are pleased to have the chance now to thank them for their efforts. First, Anne Edwards has read much of the manuscript and has been generous in her support and reactions to different chapters. We appreciate all the contributions she has made to this project and acknowledge that her (parallel) work on professional expertise has provided particular inspiration. During the process of writing, many seminars and conferences have been attended. These events have provided an intellectually stimulating environment and enabled us to meet colleagues working on similar themes. In particular, the research communities affiliated with the special interest groups for professional development and workplace learning in the EARLI and AERA associations have provided important opportunities for engagement. Special thanks go to David Guile and Michael Young who were among the first to “spot” our work and have also paved the way for this publication. Critical discussions with these scholars have been extremely helpful, as our analysis both diverges from and complements their perspectives on knowledge and the role of epistemic communities respectively.

The Prolearn project, on which this book is based, has been funded by the Research Council of Norway and is a collaboration between researchers from the Institute for Educational Research, University of Oslo and the Centre for the Studies of Professions, Oslo University College. We are grateful to these three

institutions for their extensive support and to the many individuals and teams required to get a project of this size up and running.

There are many other people and groups to thank, including our informants. In a longitudinal project like ours, it takes stamina to be an informant and without people willing to participate, there would have been no research. Many individuals have contributed extensively by writing logs, participating in interviews and focus groups, filling out questionnaires, amongst other things. Since our work is still ongoing, we look forward to their continued participation in the future.

We would also like to thank Carol Eckmann for the helpful corrections and language improvements that were invaluable as the work has moved into its final stages. Having a native English speaker scrutinise our manuscripts helped us to clarify our thoughts and little red comments in the margin saying “this is unclear” encouraged many a re-write.

Finally, the editors are indebted to all the authors and are confident that the end product has been improved as a result of the extensive discussions and consequential revision of some of the materials. Since the commencement of the project the literature has expanded considerably and we hope that this book will make a contribution to the debates that are currently ensuing.

KAREN JENSEN, LEIF CHR. LAHN & MONIKA NERLAND

INTRODUCTION

Professional Learning in New Knowledge Landscapes: A Cultural Perspective

> The most pressing need confronting the study of professions is for an adequate method of conceptualizing knowledge itself.
> (Elliott Freidson, 1994)

Our times are characterised by a prevalent interest in knowledge. In all branches of social life, people are turning to experts to provide answers and solutions to their problems. At the same time the rapid pace of knowledge production generates confusion as it leads to a wide array of conflicting evidence that lives and circulates simultaneously. Professionals are positioned at the heart of this complex situation, obliged as they are to operate as "intermediaries" who, in the face of multiple kinds of knowledge and the stamp of uncertainty, are charged with solving problems and safeguarding collective and individual interests. Never has their potential access to knowledge and information been richer, and – paradoxically – never has their collective knowledge been subject to greater challenge or been scrutinised with greater scepticism.

What are the implications of this for professional learning and practice? What kinds of opportunities and challenges does this lead to and how are they met in different spheres of professional life? What role do professionals play in securing knowledge as a public good and on what basis can we trust their knowledge? This book explores these questions from a cultural perspective by focusing on the ways in which knowledge is produced, circulated and engaged within four professions: nursing, teaching, accountancy and computer engineering. With the activities carried out under the Norwegian research project *Professional Learning in a Changing Society* as an empirical basis, we explore and discuss the variegated relationships between epistemic cultures in modern societies and the knowledge practices and knowledge relations of early career professionals. What emerges repeatedly from the chapters here is that it is necessary to understand the dynamic interplay of epistemic cultures and practices to understand contemporary conditions for professional learning.

In this chapter we provide a conceptual framework for exploring these relationships, and outline the empirical basis for the chapters that follow. Let us start, however, by elaborating on the statements above: how the emerging knowledge turn in society has altered the context for professional work.

K. Jensen et al. (eds.), Professional Learning in the Knowledge Society, 1–24.

NEW CONTEXTS FOR PROFESSIONAL WORK AND LEARNING

Being a professional is a complex mission. As practitioners who carry out their services based on expertise in a certain field of knowledge, professionals are expected to perform their work in accordance with their professions' collective knowledge and values. Thus, keeping up with developments in their field and engaging actively with knowledge is a core issue. Legitimacy and trust rest on the capacity to apply professional judgment in ways that are informed, guided by, and validated against a shared knowledge base.

Today however, the basis for professional work is challenged in many ways. In the context of cultural and institutional shifts, the certainties and assumptions that were constitutive for social life throughout most of last century, it is maintained, have lost their integrative power (Giddens, 1990; Dent & Whitehead, 2002). This situation has been met with different analytical responses. Some social scientists describe these shifts in terms of parallel moves towards deinstitutionalisation and individualisation, in which tasks and responsibilities previously allocated to institutions are being placed upon individuals (Beck & Beck-Gernsheim, 2002, Lash 2003). Others focus on the emergence of new organisational types and community structures, and point to the way in which work is increasingly constituted by collaboration as organising principle (Adler, Kwon, & Heckscher, 2008; Engeström, 2004; Edwards, 2010). Both accounts illustrate how the basis for professional work is no longer a given but rather is in transition in ways that call for continuous and critical awareness.

In the wake of these developments, expert knowledge is generally contested and branded with uncertainty. This is partly related to the emergence of the information society, which paves the way for extensive distribution of knowledge and information that is open to all without necessarily having gained the endorsement of professional or institutional authorities. In a society that operates on the principle of direct and unfettered access to knowledge (Chisholm, 2000), professional jurisdiction comes under challenge and the myriad of expressions and inputs available makes it difficult to identify valid knowledge and safeguard the quality of work. Paradoxically, the uncertainty characteristic of our times also springs from an increased emphasis on science-generated knowledge in professional as well as everyday life. As asserted in the discourse of the knowledge society, expert systems spread and their presence in personal and institutional life contributes to an overall epistemification in society (Giddens, 1990; Lash & Urry, 1994; Stutt & Motta, 1998; Jensen, 2007). The pace of knowledge production increases. New advancements arise from a plethora of sources and travel across wide areas within short periods of time. However, rather than providing reliable answers to social problems, the production of knowledge generates risk and insecurity by constantly constructing new social realities and bringing to light new options for action (Bechmann et al., 2009). As a result, professionals are exposed to multiple and contradictory demands that need to be handled at an institutional level in order to be productive.

At the general level, the notion of professionalism is being reconfigured and infused by discourses of managerialism, which paves the way for new regimes of accountability and their related allocation of responsibilities. A culture of performativity comes to the fore, in which professionals are entrusted with tasks on the basis of their ability to perform to a set of performance indicators audited by external actors and systems (Lyotard, 1984; Brint, 2001; Dent & Whitehead, 2002). This development is deeply at odds with the values of autonomy and independence historically associated with professionalism[1] (Freidson, 2001; Evetts, 2002). What are the implications of this when it comes to opportunities for learning? In a strict version it may lead to a sense of deskilling, if the indicators give rise to direct regulation of work which decreases the space for professional judgement (Forrester, 2000; Carey, 2007; Broom et al., 2009).

We follow another course, however, and explore the idea that epistemification processes may serve as a counterforce to managerialism by bringing new knowledge and their related practices to work, hence providing new opportunities for professional work and learning. As observed by sociologist Karin Knorr Cetina (2001, 2002, 2007), the prevalence of science-generated knowledge in social life brings with it a diffusion not only of knowledge as such, but of the whole set of practices and mentalities that comes with its existence. She describes this development in terms of a "spill-over" of epistemic cultures – that is, cultures usually found in universities or research institutions – to other areas of social life. People in many different areas of work are increasingly engaging with knowledge in ways that historically have been associated with science communities, for instance by exploring knowledge issues beyond what is already known, by questioning the validity of accepted knowledge and testing out its feasibility, and by systematically investigating and describing the environments in which they operate. The emergence of the knowledge society thus involves "more than the presence of more experts, more technological gadgets, more specialist rather than participant interpretations. It involves the presence of knowledge processes themselves (…), it involves the presence of epistemic practice" (Knorr Cetina 2001, p. 177). Understanding these processes and practices is at the core of understanding contemporary societies.

To uncover the mechanisms involved here, Knorr Cetina (2001) discusses how current epistemification processes are intrinsically related to the development and circulation of epistemic objects, which are created through the mobilisation of expertise to handle emergent and complex problems in society. These objects pave the way for a set of epistemic practices, as they typically invite further exploration

[1] We are aware that the theory and history of the professions vary in different parts of the world, for instance between the Anglo-American emphasis on the "freedom of self-employed professionals to control working conditions" and the Continental model where professions traditionally are related to "elite administrators possessing their offices by virtue of academic credentials" (Collins, 1990, p. 15). In the Scandinavian context, the professions have been closely linked to the state, and only a small minority of the professionals have been self-employed (Burrage & Thorstendahl, 1990; Svensson, 2001). The values of professional jurisdiction and collegial control of work have nevertheless been central in all these models.

and at the same time give directions for use. Examples of such objects in the context of professions are models for medical treatment, computer programs, and standards for auditing the potential value of and risks associated with firms and organisations. As these examples show, we are not talking about stand-alone material objects, but rather of a complex amalgam of material and symbolic resources that constitute a problem area and that, through their inherent complexity, activate a set of opportunities when they are approached, thus allowing for multiple interpretations and use.

In relation to professional work, this new context implies that the well known definition provided by Abbott (1988, p. 8) of professions as "exclusive occupational groups applying somewhat abstract knowledge to particular cases" is overly simplistic. Practitioners of today are invited to engage in knowledge practices in ways that go beyond contexts of application. They participate in activities related to exploring, testing, validating, archiving and sharing knowledge. For instance, professionals are increasingly involved in documenting practices to safeguard the continuity and quality of work (Callon, 2002; Eklund, Mäkitalo, & Säljö, 2010). This undertaking is often not a straightforward process but requires a critical focus as well as analysis of recently performed tasks. It typically involves the intellectual and analytical practices and engagement characteristic of knowledge-intensive work (Alvesson, 2004).

This in turn means that the tasks of practitioners go beyond the application of predefined knowledge to handle a particular case or client's needs. Also included are responsibilities for selecting, validating and in other ways safeguarding knowledge in the context of everyday work, for keeping issues open to investigation, and for taking active steps to explore opportunities for improvement. Rather than leading to a sense of subjugation or deskilling, the requests for performativity and accountability described above may facilitate active engagement with knowledge, thus providing the grounds for a contemporary form of professionalism. As sociologist Julia Evetts (2002) argues, professionalism is no longer related to full autonomy and jurisdiction in a field of expertise but rather to the possibilities for discretionary decision-making. To keep this space for judgements open and to be able to participate in active and critical ways however, practitioners need to be sufficiently embedded in the circuits of knowledge so as to be empowered by these circuits, not constrained by them (Tobias, 2005). In this sense, knowledge becomes a capacity to act (Bechmann et al., 2009).

Following this line of thought, two features emerge: First, the enrolment of practitioners in a profession-specific knowledge culture becomes a critical condition for engagement. Familiarity with collective knowledge as well as with the professions' specific modes of work and development provides a basis for active participation. This is not just a task for pre-service education. In the light of the abovementioned trends this is to be seen in a continual perspective, as "staying enrolled" becomes a critical issue throughout working life.

Second, active and critical engagement requires an awareness of circuits of knowledge that exceed the boundaries of local work practices. Increasingly, there is a need for practitioners to see their role and work in relation to extended contexts

for knowledge development and use. For instance, nurses will need some understanding of science-generated knowledge if they are to contest or critically validate procedures related to evidence-based practice, and auditors need to explore the relationship between different sets of audit standards and their conceptual premises in their efforts to make professional judgements in work with specific clients. As a consequence, the ideal of the "reflective practitioner" proposed by Schön in the 1980s is not sufficient. Skilful participation in today's working life requires a form of an extended "epistemic reflexivity" (Bourdieu & Waquant, 1992) which accounts for profession-specific arrangements and the epistemic origins of the acknowledged ways of thinking and behaving. By and large, learning is about mastering the dominant discourses in a given field (Säljo, 1999), and in professional work these discourses are increasingly related to ways of handling and engaging with knowledge.

The aim of this book is to explore and discuss these issues by examining the cultural conditions for knowledge engagement and learning in the four professions mentioned: nursing, teaching, accountancy and computer engineering. We do so primarily through the lenses of novice practitioners. Although their ways of engaging with knowledge are likely to differ from their more experienced colleagues, this choice allows us to identify core features of their knowledge environments as they manifest themselves in a learning-intensive phase of life, in which enrolment is at stake and more enduring relations to knowledge are likely to be established. Moreover, it allows us to account for professional cultures across the education-work divide. The questions we raise are: How do early career professionals of today engage in efforts to explore knowledge and renew their competencies? In what ways are their forms of engagement shaped by the knowledge cultures in their respective professional fields? And, what characterises these cultures when it comes to how the production and circulation of professional knowledge is organised?

To explore these questions, we draw further on the work of Karin Knorr Cetina (1999, 2001, 2006, 2007). Having carried out concerted efforts to examine and conceptualise contemporary knowledge societies and the associated spread of knowledge cultures and practices, Knorr Cetina offers a conceptual framework that allows us to investigate and explore the ways in which contemporary dynamics of knowledge play themselves out in professional work, as well as what these processes may imply for practice and learning.

Her perspective supplements existing perspectives and approaches to the conceptualisation of professional learning by focusing explicitly on the constitutive role of knowledge cultures on practitioners' relations to knowledge and identity formation, and by describing this as a relational rather than a performative idiom. The larger backdrop for her discussion is the emergence of the knowledge society and how its related cultural transformations produce new opportunities for, as well as pose challenges to, professional learning and self conduct.

In the next section we outline the theoretical framework and concepts underlying the explorations undertaken in this book.

THE FORMATIVE ROLE OF EPISTEMIC CULTURES

The concept of epistemic culture spans across levels of social practice and knowledge processes and provides the underlying framework for the chapters that follow. Delineated as "cultures that create and warrant knowledge" (Knorr Cetina, 1999), this concept highlights the logics and arrangements through which knowledge comes into being and is circulated, approached and recognised as a "public good" (Callon, 1993). On the one hand, these incorporate common characteristics of how knowledge is produced and recognised in contemporary society; for instance, today there are general expectations about making processes of knowledge production transparent, and about including user value as one criterion for recognising valuable knowledge (Gibbons et al., 1994; Knorr Cetina, 2002; Bechmann et al., 2009). On the other hand, these logics and arrangements carry features that are distinctive for the knowledge domain in question and thus provide analytical means for distinguishing between different domains and disciplines. An epistemic culture is constituted by its distinct heuristic practices and knowledge relations - including instruments, configurations of people and things, strategies, ways of envisioning knowledge, and the ways in which these factors come together to constitute a certain knowledge world. There is a mutually constituting relationship between these arrangements and mechanisms, at the same time as they work together as "machineries of knowledge construction" which "make up how we know what we know" (Knorr Cetina, 1999).

Knorr Cetina (1999) has developed this perspective through a comparative, ethnographic study of the cultures of high-energy physics (HEP) and molecular biology, which illustrates how two research teams' strategies and arrangements for knowledge production take fundamentally different forms. The institutional context of the high energy physics laboratory is portrayed in terms of horizontal circuits between tasks directed towards technical objects. A characteristic feature is to create new knowledge by way of "negative knowledge"; the ruling out and delimiting of knowledge. This was based upon a culture of "management by content" centered around principles of responsibility and shared criteria for decision making. The "ordering frameworks" are shared theoretical knowledge, models, simulations and statistical procedures that guide the process of discovery and the establishment of the "truth-like character of the results" (Knorr Cetina 1999, p. 179). In contrast, molecular biology thrives in more conventional laboratory conditions because experiments in this field are carried out in environments where researchers work according to a set of protocols issued by the head of the laboratory. The primary objective is to generate experimental knowledge about known molecular structures. To accomplish this, molecular biologists respond to a problem by trying different variations of their laboratory procedures in a context of competition, with the expectation that it will result in the discovery of new evidence.

Thus, by comparing these cultures, Knorr Cetina uncovers different ordering patterns and construction principles that "create and warrant knowledge." Moreover, she finds that these also incorporate different placements of the knower

– resting on communitarian mechanisms in the first case and individuation in the second. Although the constitutive elements of the two epistemic cultures are not unchangeable, she shows how they interrelate and support each other, thus producing a firm logic through which knowledge-related activities are guided and carried out.

Building further on this work, Kastenhofer (2007) suggests five cultural traits that distinctively identify epistemic cultures; the temporal and spatial scale of their research efforts, the ways in which they de- and recontextualise knowledge, their ways of dealing with complexity and uncertainty, their ways of handling the unforeseen, and their degree of inter- and transdisciplinary reflexivity. Moreover, she distinguishes between three kinds of epistemic orientations; an orientation towards control, complexity and experience respectively. Although these categories are used for the purpose of science studies, they are also productive for considering the epistemic machineries encompassing professional work. For instance, what is the spatial outreach of the machineries of knowledge construction in a given profession? To what extent is knowledge represented in universal and "global forms" with a "capacity for decontextualisation and recontextualisation, abstractability and movement, across diverse social and cultural situations and spheres of life" (Collier, 2005, p. 400) To what extent is its validity and use more experience-oriented and generated from below in locally bounded communities? And, to what extent are ways of employing knowledge geared towards unification or towards differentiation?

Additionally, a core premise in Knorr Cetina's work is that the structural forms identified in scientific cultures are becoming more relevant in contemporary society, as they characterise expert cultures more broadly. In the context of this book, we note that a common feature of scientists and professionals is that their cultures have developed through institutionalisation of expertise in modern societies (Evetts *et al*, 2006), and, moreover, they are both characterised by object-centred relationships. In line with this way of thinking, Knorr Cetina has in later years expanded the use of her concepts and arguments to other areas in society, such as the work context of financial traders (2005) and to more general discussions of knowledge relations in professional contexts (2001, 2006). In these efforts she describes and analyses how knowledge is developed and approached across levels of practice, in ways that are not only constitutive of knowledge but also of the knower.

The notion of epistemic cultures thus both resembles and provides an extension to socio-cultural research on professional work and learning. Whilst sharing the notion of human learning as mediated by cultural tools and as taking place in the interface between individual and collective actions, this strand of research comprises different analytical approaches. Some have focused on the social and organisational arrangements of the "communities of practice" underpinning professional work and learning (e.g. Chaiklin & Lave, 1996, Wenger, 1998, and, for critical discussions about the limitations of this perspective, Hughes et al., 1984). Others have employed perspectives and principles from activity theory to explore how institutional practices can be viewed as activity systems constituted by

the "object of activity" in question, with an increasing interest in how new practices emerge in the interface of two or more activity systems as well as how organisational change can be facilitated in researcher-practitioner collaborations around joint creation of artefacts and objects (e.g. Engeström, Miettinen and Punamäki, 1999; Engeström, 2007; Edwards, 2010; Guile and Okumoto, 2007). Others again have occupied themselves with aspects of individuals' participation and sense-making, and analysed how social practices are accomplished by individuals' agency or ways of exercising communicative work (e.g. Billett, Smith, & Barker, 2005; Mäkitalo & Säljö, 2009). In all cases, however, the relationship between the organisation of activities, cultural resources and logics of participation is seen as interdependent. The notion of epistemic cultures adds a more explicit concern for the role of knowledge in all of this, where the continuous development and circulation of knowledge is seen as a prime source of change (Guile, 2009, 2010). It underlines the need to "bring knowledge back in" (Young, 2006). By being sensitive to the configuration of knowledge practices and processes, and by providing a vocabulary for distinguishing between different qualities of such processes as machineries for knowledge construction, this perspective is productive for exploring distinctive features of professional domains and their implications for learning. It integrates and highlights the relationship between the epistemic practices in play when knowledge is created, distributed and validated; the products of these processes; and the specific modes of collective reasoning that constitute these practices and guide practitioners' engagement with knowledge in a given culture. In this way it also makes it possible to investigate how epistemic cultures work across institutional levels, by accounting for circuits of knowledge that exceed the boundaries of local work practices and constitute patterns of engagement within an extended social space.

Epistemic cultures and practices are highly interrelational, and their "machineries of knowledge construction" comprise ongoing dynamics between subjects and objects that need to be understood as mutually constituting. For analytical purposes however, and to be able to explore the two main concerns stated above – practitioners' opportunities for enrolment in a profession-specific knowledge culture, and for being introduced to circuits of knowledge that exceed the boundaries of local work practices – we will pinpoint two aspects of epistemic cultures and their relevance for professional learning: First, the organisation of knowledge in terms of artefacts, objects and their related "logics of participation," and second, the issue of practitioners' knowledge ties in terms of their knowledge-related identities, participation strategies and professional self conduct.

Organisation of Knowledge: Artefacts, Objects, and Logics of Participation

The production and circulation of knowledge in epistemic cultures is served by a range of material and symbolic support structures which not only provide access to given knowledge but also play an active role in organising knowledge and the ways knowledge can be interpreted and approached. From this perspective the character and role of intermediaries become important. Callon (1991) lists four general types

of intermediaries that define the creation and circulation of knowledge in a given area; human beings, artefacts that facilitate performance of work, texts and inscriptions (including written or recorded information as well as the channels through which they circulate), and different forms of money or capital. The relative presence and emphasis on different types of intermediaries in a given culture, as well as the connections between them, form an important part of the epistemic machineries. They not only circulate knowledge and information, they also serve to reconfigure knowledge by the ways in which connections are made and ideas are taken up. In this way they also serve to link various actors with the epistemic culture in question.

In the context of professional practice, the symbolic and material environment in which practitioners perform their work is in many ways growing more complex. Work practices are more often mediated by symbolic and material objects, such as texts, graphs, records and technological devices, and new advancements are often distributed by way of textual or technological means. These environments can be potentially stimulating, as they comprise what is described as "tertiary artefacts" (Wartofsky, 1973) which open different opportunities for action and engagement. Tertiary artefacts are often described as a "kind of higher order artefact" (Sutherland, Lindström, & Lahn, 2009, p. 41), as their nature is not one that primarily leads itself to direct and instrumental application in the context of productive activity, but they rather carry an imaginary potential that may or may not be realised. Sutherland et. al.. mention computer software, simulation programs, pedagogical designs and scientific models as examples of tertiary artefacts, and point out that tertiary artefacts play a key role in modern societies because "the use of such artefacts is not a closed but an open system" (ibid.).

In the context of the professions, the different artefacts and resources available in a given culture are embedded in larger epistemic machineries and thus do not stand alone but rather form complex sets of connections which carry different opportunities for exploration and use. A multiplicity of material and symbolic resources arises that invites and structures participation and engagement. Drawing on Rheinberger's notion of epistemic things (1997), Knorr Cetina conceptualises these "open systems" for engagement with artefacts as *epistemic objects*. The concept is used to highlight the ways in which problems and resources come together and simultaneously invite and form opportunities for exploration and engagement. In contrast to definitive things, epistemic objects are characterised by their question-generating character and their lack of completeness of being. As Knorr Cetina (2001, p. 181) states: "Since epistemic objects are always in the process of being materially defined, they continually acquire new properties and change the ones they have." In this sense Knorr Cetina adheres to a notion of knowledge as self-multiplying, and a source of variety rather than similarity (Bechmann et al., 2009; Callon, 1993). Epistemic objects are thus characteristically open-ended and complex, and when approached they increase rather than reduce their complexity.

These qualities give epistemic objects the capacity to foster further investigation, as they trigger a sense of excitement and signal ways to explore their

not-yet-fulfilled potential. Knorr Cetina (1997, 2001) describes how expert practitioners enter into unfolding or explorative loops when they are attracted by an object or a problem that engages a "heterogeneous amalgam" of material and symbolic resources. During this process a new awareness is generated that reframes the task at hand and turns it into something different (and analogous). While this new awareness is added to previous actions, it also results in diversification that is paralleled by integrative moves in the process of putting together resources with different origins. New tasks, knowledge, and opportunities elicit new framings and unfolding loops that potentially involve learning and stimulate change.

In one respect Knorr Cetina follows the ideas from Actor-Network Theory (ANT) that artefacts and objects are not passive products but rather active partners in knowledge practices. As she states (2007, p. 365), objects of knowledge tend to be "doers": "They have powers, produce effects; they may have their own internal environments, mould perception, and shape the course of an experiment." However, in contrast to ANT's more radical symmetry, where objects are lifted up to "judges" in what Latour[2] describes as "the parliament of things," Knorr Cetina (1997, 2001) posits a dissociative dynamic that is essentially relational and reflexive. From this perspective, the primary characteristic of object relations in expert cultures is dissociation, forcing the subject or self to stand apart from the object through modes of relating that are characterised by interruption, reflection and abstraction. Paradoxically this standing apart is what allows the subject to bind to the object, as it allows the subject to deliberately and reflexively "loop" her ideas and awareness through the object. The loop is reflexive in that this form of immersive relation permits the object to "speak back" to the subject by revealing unrealised opportunities. This kind of creative or constructive interaction occurs when practice becomes non-habitual or non-routine, and both subject and object are potentially modified. Using this perspective, it is possible to account for the forms of robust, reflexive, and experientially-based object relations that can occur in the interplay between knowledge objects and subjects.

One example of this dynamic is given in a study of how traders in investment banks work with the market as an object of "attachment" (Knorr Cetina & Bruegger, 2000). Here the market is seen as an object of knowledge which is unfolding and engaging those who work on it, not just to understand it, but also to

[2] As a founding figure of Actor Network Theory, Latour makes the controversial claim that non-humans can also have agency. From this radical position, and also drawing on Heidegger's notion of das Ding (the Thing) as "a gathering," he has developed the idea of a "ding-politic," where he sees an increasing role for new media and knowledge design when it comes to stabilising and securing practice. Knorr Cetina concurs with this view, but calls for a rethinking of the role of human agency. As actors become integrated into larger systems and knowledge worlds, a framework that is multi-layered, context-aware and capable of generating novel meaning is required, that accounts for the strengthening relations between actors, facts, artefacts, practices, and overarching knowledge cultures. Post-ANT perspectives are now working more along these lines (Fenwick & Edwards 2010). ANT studies, however, do not characteristically regard knowledge as something distinct that develops and structures modes of engagement over time. Instead it is seen as a social agent that emerges in line with other subjects and objects in the given socio-material network.

test, move and manipulate it and be stimulated by its capacity to generate questions. Engagement arises through practitioners' need to continually work on the object of knowledge and define it. The authors describe this engagement in terms of "lack" or incompleteness in their understanding of it and their desire to pursue a better grasp of what is there. The subjects' sensitivity in relation to the object, judgement and reflexivity are thus vital parts of this process.

Subject-object relations are not evolving in a vacuum, however, but are fuelled by their position as immersed in epistemic cultures. Epistemic objects incorporate characteristics of the culture in which they are embedded. They are shared by members in a culture across the boundaries of local sites, and live a life independent of the individual subject at the same time as they may be approached and transformed by individuals' engagement. In this way they constitute access points for individuals into a wider knowledge culture when approached in local settings.

By directing our analytical lenses towards the provision of and engagement with knowledge resources, we may account for, on one side, the emerging and "unfolding" character of knowledge and expertise in complex work practices, and, on the other, its embeddedness in a symbolic and material system of artefacts that stabilise practices. The relationship between professionals and knowledge is thus understood beyond situations of instrumental use. In addition to shedding light on problem-solving activities, the perspective described above accounts for "engrossment" with knowledge as an important part of professional practice. At the same time, the capacity to identify opportunities and explore issues beyond what is given rests on familiarity with the knowledge culture within which the object is embedded, as well as on shared models for interpretation and investigation. With reference to the questions raised earlier in this chapter, a critical issue in professional communities is the extent to which the organisation of knowledge and intermediaries may facilitate practitioners' enrolment in a profession-specific knowledge culture and serve to link local work practices with wider circuits of knowledge.

The chapters that follow delve into these questions in different ways. For now we will complement the picture by turning to how epistemic cultures also serve to constitute the knower and, in our context, modes of professional self conduct.

Knowledge Ties and Epistemic Agency

Like cultures in general, epistemic cultures provide mechanisms for social integration in terms of relations between people and their knowledge worlds, they offer identities and positions from which to act, and they stimulate as well as regulate practices of self conduct. Specific for the notion of epistemic cultures however is that these ways of thinking, understanding and behaving are constituted by knowledge. Moreover, epistemic cultures also distinguish themselves by forming beliefs about knowledge itself; for example, about "the correct distribution of knowledge, the naturalness of access to it, and the particular ways knowledge should be handled and inserted into personal and organisational life" (Knorr Cetina

2006, p. 37). As a parallel concept to machineries of knowledge construction, the term "epistementalities" denotes this cultural-cognitive dimension of epistemic cultures, comprising the interpretative framework which guides how people reason, envision and ascribe justifications to knowledge and epistemic processes. In the context of professions, we can say that practitioners appropriate certain epistementalities, which serve as a basis for enacting professional practice in meaningful ways as well as for taking on certain responsibilities while at the same time rejecting or delegating others. These styles of reasoning form the distinctness of a particular field or domain of knowledge, and contribute to channelling energies and encouraging specific ways of engaging with knowledge. At the same time, profession-specific epistementalities take up dominant ways of understanding and relating to knowledge in contemporary society, for instance related to user validation or transparency. The ways in which people envision knowledge – its character, outreach and opportunities for engagement – become constitutive for social life, and this holds general as well as profession-specific qualities.

In the context of this book we will highlight two features. First, we address how shared knowledge objects and belief systems in a profession allow for new mechanisms of social integration. Following the framework of Knorr Cetina, we question the widely held idea that modernity represents an individualising historical force. This idea she underlines, "ignores the degree to which the modern untying of identities has been accompanied by the expansion of object-centred environments which situate and stabilise selves" and thus contribute to "define individual identity" just as much as other relationships we engage in. (1997, p. 1). As the scientific modes of relating to knowledge diffuse into other sectors of modern societies, and epistemic cultures and practices are dispersed and opened up for multiple participation and interdisciplinary efforts, traditional mechanisms of social integration lose their binding force and have to be reinvented (Jensen & Lahn, 2005). In earlier works we have explored the binding role of knowledge within the field of nursing, where we find that members of the profession ally themselves around theories and concepts of care (Jensen & Lahn, 2005).The use of software programs and codes in engineering provides another example, for instance illustrated in the global cultures that have formed around open source movements (e.g. Himanen, 2001; von Krogh et al., 2003; Fugelli, 2010). A third example, in more specialised context, is the advanced instruments around which research teams form, e.g. a high energy physics accelerator or a detector (Knorr Cetina, 1999). Knowledge may in this way be seen to function as a core mechanism for social integration. By taking this role into account and by theorising knowledge in a way that allows for engrossment and excitement, this perspective paves the way for an understanding of the conditions for community formation in today's professions, beyond the interpersonal and local level**.**

Second, several chapters in this volume address how the culture and shared epistementality of a given profession generate notions of what it means to be a professional and what comprises appropriate modes of self conduct. Cultures operate through the actions of individuals and their ways of orienting themselves in their knowledge world. While epistementalities are formed as belief systems on the

collective level and give rise to collective subjectivities, they also guide the actions and orientations of individuals in specific work contexts. In many ways, it is by revealing the images and styles of reasoning which guide individuals' knowledge orientations and choices that we may get hold of the collective professional subject. Moreover, in a time where responsibilities previously attributable to professional communities are frequently being either insourced to individual practitioners or outsourced to external agencies (Nerland and Jensen, 2007; Dent and Whitehead, 2002), the models and practices of professional self conduct form an important part of the loops through which knowledge is circulated and warranted. Thus they serve as an important mechanism for enrolment as well as for continuous learning and development. By exploring the formation of collective subjectivities from the perspective of knowledge cultures and knowledge relations, we may also gain insight into how the relationship between professional subjectivities and other signifiers in social life is reconfigured through contemporary knowledge machineries. As discussed by Monica Rudberg in chapter 10 in this volume, one potential outcome of enrolment into knowledge cultures appears to be that gender differences become less visible as the logics of knowledge production and engagement take over as a prime guiding force.

By magnifying knowledge as structures and social worlds spanning across sites and institutional levels, the perspective described above highlights the interdependency between knowledge cultures and their practices, the emergence of knowledge objects created by and offered in these practices, and the role played by machineries of knowledge construction in connecting individuals to the given field of expertise. Thus, in the research underlying this book, we have explored the interrelation between epistemic cultures, their specific ways of organising knowledge, and professional subject formation with a special interest in how these arrangements form opportunities for learning and engagement. A common denominator for the chapters in this volume is that they are written by researchers who have worked within the framework of the Norwegian research project *Professional Learning in a Changing Society* (ProLearn). In the next section we provide an overview of this project in terms of the overall design, data corpus and main findings.

THE RESEARCH PROJECT PROFESSIONAL LEARNING IN A CHANGING SOCIETY

The project Professional Learning in a Changing Society (ProLearn, 2004–2009) takes these perspectives as a point of departure in exploring the knowledge cultures of computer engineering, school teaching, nursing and accountancy in Norway. These are contrasting fields with regard to their modes of organising work, societal mandate, relationships to other sectors in society, and types of expertise. At the same time they share the position of being responsible for core services in modern society, they are practice-oriented occupational groups grounded in a certain field of expertise, and in Norway their programmes for initial professional education are localised to university colleges within a state-regulated educational framework. The differences and similarities make them interesting cases to look into, both for

the sake of uncovering contrasting positions within the landscape of professional knowledge cultures and for the benefit of examining the potential of these cultures to learn from each other.

The selected groups represent professions that play a key role in all societies, and they are becoming increasingly embedded in European and transnational networks where knowledge circuits are concerned. As such, the characteristics of their knowledge cultures will be of general interest. A note should be made, however, as to the more specific conditions for professional work and learning in Norway. As a country characterised by cooperative engagements between the professions, the educational sector and working life under the framework of the welfare state, the professions and their practitioners are still entrusted with a relatively high sense of autonomy when it comes to issues of knowledge development and learning. This makes them relevant cases for focusing on knowledge dynamics as such, as well as how these dynamics shape conditions for learning.

Following the perspective described above, knowledge is seen as a "doer" – a processual and relational entity, and a driving force shaping the epistemic cultures and practices of the professions. Hence, the focus of analysis is the relationship between professionals and knowledge objects within the frames of epistemic cultures. These relationships are multidimensional and extend beyond the immediate tasks or learning sites. In order to study how approaches and ties to knowledge develop over time a design that goes beyond the study of local interactions is needed– that is, a design that accounts for the ties professionals develop to extended knowledge cultures and circuits of knowledge. The approach taken in this book is to focus on how knowledge is circulated and approached by practitioners in the respective professions, through defining instruments of knowing of acting, and constructing the world of objects to which practitioners relate. At the same time, we cannot restrict ourselves to what Lash, in a critique of Latour and his followers (Lash, 1999) has called "object tracking," delegating the moving forces to knowledge alone. We also need to reveal the subjects' collective ways of reasoning and orienting themselves in and towards knowledge as an important co-driver in these relationships.

The ProLearn project (2004–2009) comprised different sets of research activities: (1) document analyses of central curriculum reforms within the fields in question, (2) a comparative study of how the professional associations work to safeguard and regulate knowledge and competencies, and hence form a part of the epistemic machineries in the respective fields, and (3) a longitudinal study of practitioners' learning trajectories within the four professions. The research presented and discussed in this book is mainly related to the third activity; however we also refer to the other strands as they appear in earlier publications.[3] The aim here is to systematically explore ways in which the professionals' ties and relationship to knowledge are constituted by epistemic cultures, their practices and

[3] For examples of publications from the first two strands, please see Nerland and Jensen (2007) and Karseth and Nerland (2007).

objectual dynamics. The data material used contains questionnaires from the Norwegian survey StudData, qualitative interviews, learning logs, and focus group interviews. StudData is a longitudinal programme in which students at Oslo University College answer questionnaires in the first and the final years of their initial professional education, as well as 2.5 and 5.5 years after graduation.[4] The participants selected for the qualitative parts of the study comprise 10 practitioners from each of the four groups,[5] whose knowledge ties and learning efforts were followed during the first years of their professional life. These participants were interviewed individually in 2005 and by way of focus groups in 2006. In addition, they filled in and submitted logs of their learning needs and efforts during two periods in 2005, each lasting two weeks. The focus group interviews served the dual purpose of validating preliminary analyses and of providing additional data related to how knowledge is developed and institutionally handled within the respective professional domains. An overview of the data collection in relation to time is presented in Figure 1.

Together these strands of data provided the foundation for a "thick description" of the epistemic cultures that are in play and the way in which they form conditions for learning for the four professions studied. However, as the main basis for the chapters in this volume is the longitudinal data in which professionals are followed over time, we will comment briefly on the rationale for using questionnaires, interviews and learning logs.

As pointed out by social researchers, the emerging knowledge turn in society calls for new methodological approaches to the study of the professions, including studies from below that generate grounded descriptions of the emergent conditions for knowledge-based work. In our research design we therefore invited the participants to describe their approaches and orientations towards knowledge, with sensitivity for the ways in which they justified approaches and linked their local practices to extended knowledge worlds. No longer "cultural dopes," but seen as actors equipped with a conscience that is both discursive and practical (Giddens, 1987), in our approach we view our informants as the central players who are best able to articulate both their own engagement with knowledge as well as the wider

[4] For more information about StudData, see http://www.hio.no/content/view/full/10591 as well as the methodology section in chapter 3 in this volume. The analyses included in the ProLearn project are based on Panel 1.

[5] A survey of students graduating from Oslo University College in 2002 – Studies of Recruitment and Qualifications in the Professions, 'StudData,' was used as a basis for selection of participants. Ten persons from each professional field were chosen to participate, based on the following criteria. They were to have been working for approximately two years, their age was to be maximum 32 years, and the gendered sample was to correspond to the group's profile in the survey, while still ensuring that the sample comprised minimum two participants from the gender in minority. These criteria were used to ensure participants with some work experience and to secure comparable samples within the respective groups. Due to this latter concern, the sample of nurses was limited to participants working in hospital wards, as their work conditions deviate in significant ways from that of those working in home care services.

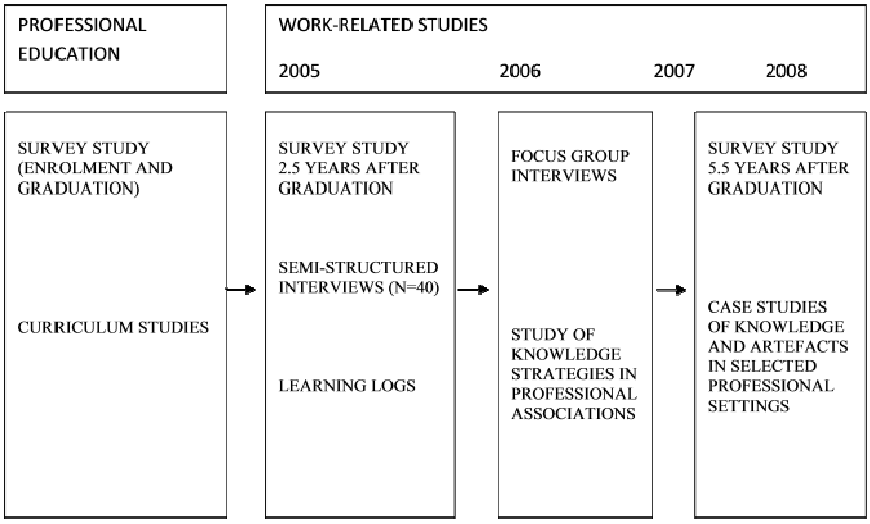

Figure 1. Overview of data collection in the ProLearn project

knowledge landscapes within which their practice is situated. An example of this is when one of the engineers in our study portrays the knowledge dynamics in which he is embedded as he is trying to keep abreast in his field:

> It is extremely important to … have an idea of what's happening. (…) So, very often, at least as I experience it, you try to see what's coming up in say the next six months. And after a while, when you have finished what you were working on and stand in front of new tasks you may take it into use.

On the one hand, he recognises the importance in keeping up to date with developments in his area of work; on the other hand, he acknowledges the points in time when that knowledge becomes relevant to his own specific tasks. In other words, he simultaneously keeps an eye on wider flows of knowledge as well as the more immediate application of his own expertise. Reading each interview as a whole in this light, we gain insight our informants' knowledge practices and orientations. When seeing it in relation to other data and informants' stories, we are able to conceptualise the collective epistementality characterising engineers' work and learning.

This brings us to the question of how data are represented. We posit that neither interviews nor observations of practice are in themselves more likely to capture "the real." Czarniawska (2007), for example, cautions that there are many different ways of "writing practice," each of them responding to a specific rhetorical strategy on how to give the impression of getting very close to the "real thing." In this sense, the growing popularity of the illocutionary style whereby a description of practice is realistic if it "reproduces a speech act or a discourse genre of real-world communication" (Czarniawska, 2007, p. 116) should be read not only in

terms of the increased heuristic capacity of the methods that embrace this type of representation, but also in terms of academic fashions and the shift in the accepted contemporary criteria of realist writing in social science (2007, p. 118).

The further analyses were conducted in two phases. The first phase compares and contrasts the four groups in regards to ways in which their epistemic cultures produce and warrant knowledge; the temporal and spatial scale of their knowledge and learning efforts, the ways in which they de- and recontextualise knowledge, their ways of dealing with complexity and uncertainty, and their types of orientations towards control, complexity or experience respectively. In the second phase we focused more specifically on the epistemic machineries encompassing professional work. For instance, what tools and infrastructures are offered and what kinds of professionals are formed. This multidimensional approach allowed us to study, from different angles, the dynamic merging of knowledge arrangements, practices and collective subjectivities involved in the epistemic activities of today's professional life. An important finding gained the projects longitudinal design and StudData in particular, is the "path dependent" nature of professional learning and the key role practitioners' initial education plays in laying the ground for processes related to knowledge enrolment and styles of reasoning developed in the course of their working life (Smeby & Klette in this volume).

Depictions of the Four Professions' Knowledge Cultures[6]

Through the project's comparative approach it became clear that knowledge is organised and dealt with in different ways within the four professional cultures. Even though most practitioners appear to be linked to wider knowledge cultures and networks of distribution, there are considerable differences among the groups in terms of how they orient themselves towards knowledge and in the character of the wider knowledge worlds in which they engage.

Nurses are well supported by an extensive knowledge infrastructure,[7] and professional updating is an integrated and regulatory aspect of their profession. They use multiple knowledge sources that have been specifically designed for the profession, including manuals, intranet, reference works and textbooks; receive systematic supervision from colleagues; and have access to a wide range of specialised expertise. Knowledge resources are locally adapted and appear to have strong "translation mechanisms" that mediate between globalised, abstract knowledge and the local realities of the hospital wards. Whereas the machineries of knowledge construction in the nursing profession have research communities and scientific knowledge production as important drivers, the situation for computer engineers and accountants is different. For engineers, the knowledge culture is marked by the influence of global technology providers and by market-driven

[6] The text in this and the following paragraph draw on and extend the project report submitted to the Norwegian Research Council (Jensen et al., 2008), summarising main findings and conclusion from the ProLearn project.

[7] It is important to note that our informants all worked within a hospital setting.

technological advancements. Practitioners in this group are thus offered a variety of artefacts and resources for exploration and use, but this occurs within a context of commercialism, and user-oriented development. The auditors are also embedded in extended networks of knowledge. However the knowledge culture in this profession is closely linked to legislation, thus the construction of artefacts and objects of knowledge in this field typically relate to changes in audit standards and international regulations specific for the practitioners' line of business. The teaching profession distinguishes itself by being more locally confined, and practitioners in this field describe a limited use of professional knowledge resources from outside the local community. When the teachers refer to research within their own profession or to extended circuits of knowledge, this contact has more sporadic character.

These differences also manifest themselves as distinct epistementalities in the four professions. While teachers emphasise face-to-face sharing of personal knowledge in local communities and claim a freedom to choose methodological approaches on an individual basis, the nurses access collective resources and show concern for ensuring that they are familiar with research-based advancements and collective procedures for good practice. The engineers actively orient themselves in global information structures to find solutions on everyday problems, and take individual responsibility for keeping up with technological advancements in order to "stay in" in the labour market. The accountants describe their knowledge domain as constituted by professional concepts and vocabulary, and in the period when the interviews were conducted a major issue framing their knowledge orientation was the introduction of new international standards for risk-based auditing.

The project's document analyses put these differences in a wider context. Much indicates that the differences in learning networks and connections that develop are neither arbitrary nor locally determined. Rather, they reflect the profession's priorities and knowledge history, which amongst other things becomes visible if we take a look at the knowledge strategies of the different professional organisations. While the Norwegian Nurses Association has established development of nursing science and the organisation of common knowledge resources as a central professionalising strategy, the Union of Education appears to have emphasised experience-based knowledge development from below. One way of achieving this has been to promote and enhance the distribution of experiences and reflections of individual teachers to the group as a whole by way of a major project called Professional Awareness (Karseth & Nerland, 2007). The Norwegian Institute of Public Accountants has focused on collective regulation of professional practice by linking the knowledge resources firmly to current standards and legislation and by making sure that their members are at all times kept up to date and given access to changes. NITO (The Norwegian Society of Engineers), the body that organises most technologists holding bachelor's degrees, including computer engineers, appears to emphasise the members employability and opportunities for career development, offering its members courses and knowledge resources in a close cooperation with representatives for technology providers on the market.

The chapters that follow provide a more thorough explanation and discussion of these differences and the ways in which they come to the fore in the empirical data. We will conclude this section by briefly pointing to some implications of the different knowledge cultures in terms of the conditions for professional learning.

Conditions for Productive Dynamics of Knowledge and Learning

If we look across the types of data and the professional groups' approaches to knowledge and learning, the analyses undertaken in the ProLearn project indicate that communities that manage to link local practices with extended networks and circuits of knowledge in a systematic and strategic way are more likely to develop an epistementality geared towards learning and continuous exploration.

The above description of the computer engineers may serve as an example on how practical problem-solving and the monitoring of more general trends of development in the field go hand in hand. The material shows that even though their work is related to use of existing and standardised technologies or program codes, the awareness that more efficient and "elegant" solutions to their current work may potentially exist contributes to a lasting search for knowledge that goes beyond the immediate needs. The computer engineers explain, for instance that they learn new programming languages not only because they need to in order to carry out a special task at work but also out of long-term interest, or simply because they find it intellectually stimulating. Because the artefacts and infrastructures in this profession constitute a well-organised reservoir of knowledge resources which also are specialised to different types of tasks, the computer engineers are able to navigate and get a good view of what is relevant for them. Because the knowledge at the same time refers to something unfamiliar and challenging, the process leads to knowledge-seeking that goes beyond what is necessarily required. When these learning dynamics occur, the engineers describe an experience of increased competence in knowledge selection and practical use. Thus, their descriptions resemble to a great extent the dynamics of objectual practice referred to earlier in this chapter (see also Nerland & Jensen, 2010). When the provision of knowledge and information increases, it does not lead to frustration. Rather it generates and upholds an epistementality in which knowledge is understood as simultaneously indefinite and applicable. Thus, comprehension extends beyond the instrumental use of knowledge, as the engineers describe learning as a playful examination of opportunities and a continual search for more elegant solutions.

Within the group of nurses we also find examples of objectual dynamics that generate a desire to learn. The nurses are oriented towards factual knowledge to safeguard and justify specific actions, but they simultaneously search for overarching explanations. They search for deeper understanding, and typically want to know not only what and how something should be done, but also why. Knowledge in the form of facts and procedures is often related to science-generated knowledge, and thereby invites and serves as an access point to explore these knowledge structures further. We find a related drive within the group of

accountants. As they relate to changes in existing rules and revision systems, they simultaneously search for deeper knowledge about the organisations and lines of business they work within. The transition towards a more future-oriented evaluation of risks also sets off new learning dynamics, where the potential and the unfinished becomes a more important dimension of the knowledge work. At the same time, both nurses and accountants state that professionally specific knowledge within their occupations can be too firmly attached to practical solutions, and thus lack some of the openness that stimulates continuous learning dynamics.

The teaching profession offers a different picture altogether. The teachers, too, express a great interest in learning and in exploring a variety of matters and knowledge issues, and they assume extensive individual responsibility for safeguarding their work in relation to the pupils' needs. However, as the teachers typically work in a complex and multi-disciplinary environment, their explorative efforts often emerge from complex and unlimited problems. These can, for instance, be related to ensuring the inclusion of all pupils, or how to support the pupils' personal and social development. Due to a dearth of profession-specific artefacts and resources designed to support professional practice, there is a danger that their questions remain unresolved as it is more difficult to find a match between the questions raised and collective tools or infrastructures for exploring and handling these. The teachers also describe a lack of systematic connection to large epistemic communities. This is partly the case in relation to educational science as a research field, but also concerns a general scarcity of professionally developed instruments to mediate between local practice and the development within large knowledge networks.

As a whole, the differences between the professions point to challenges as well as opportunities for professional communities in today's society when it comes to revitalising their know-how and ensuring knowledge as a public. We started this chapter by pointing to the increased complexity of professional work, and argued that two main challenges facing the professions today are that of securing enrolment of practitioners in profession-specific knowledge cultures and that of creating access points for practitioners to link up with circuits of knowledge that extend the local work environment. As the examples above illustrate, the dynamic interplay between subjects and knowledge objects is a key mechanism for developing and maintaining a dynamic attitude towards knowledge, and doing so requires appropriating the epistementality of the profession. In both cases, these processes are dependent on the symbolic and material infrastructures for engagement. Furthermore, it is important that the professions take collective responsibility for these structures and resources. Leaving this to the preferences of global information providers may lead to an erosion of collective knowledge and its related mechanisms for social integration in professional communities. At the same time, keeping it as a solely profession-internal concern may cut off the links to extended circuits of knowledge and the stimulating source these potentially provide. Navigating between these concerns and collectively practicing epistemic

reflexivity at the level of professional knowledge cultures thus comprises a core challenge for professional communities today.

THE STRUCTURE OF THE BOOK

The subsequent chapters all incorporate the concepts and ideas presented in this introduction, but each does so by focusing on different professional groups and by applying somewhat different approaches – by exploring the potential of using Knorr Cetina's concepts in professional settings, by testing out their relevance in specific settings, and by probing ideas further to address issues of relevance for professional learning. All, however, bring knowledge relations to the forefront. The book is organised into three parts, following the logic of the perspectives outlined above. The first part is called *Knowledge cultures and professional learning*. These chapters employ the notions of knowledge cultures and machineries of knowledge construction to examine questions related to the ways in which professional communities organise and circulate knowledge and how this creates opportunities and constraints for learning. Together these chapters reveal distinct features of professional knowledge cultures, which also serve as a basis for the chapters in Parts II and III.

The second part, *Artefacts and professional learning*, focuses more closely on the role of knowledge objects and advanced artefacts. The chapters in this section examine how conceptual and material representations of knowledge affect the daily work and learning of practitioners, emphasising the ways in which characteristics of the artefacts in play serve to shape strategies of learning and professional work.

The third part, *Knowledge ties and modes of self conduct*, focuses on the constitutive role of knowledge in sociality and subjectivity formation. The chapters in this section explore the relationship between individuals and knowledge, examining the variegated mechanisms that compel people to engage and shape their forms of engagement. Some of these chapters also relate to the call for continuous learning in today's society and discuss how the perspectives on knowledge cultures and knowledge ties provide conceptual tools for understanding the conditions and dynamics that mobilise practitioners to deliberately engage in learning and relearning.

For an overview of the respective chapters, we refer to the introductions at the start of each section.

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PART I

KNOWLEDGE CULTURES AND PROFESSIONAL LEARNING

As knowledge-based occupational groups, professional communities are constituted by their distinct ways of organising and managing knowledge. Their ways of producing, distributing, validating and approaching knowledge serve to give them an integrative power. Moreover, these processes form profession-specific knowledge cultures which constitute a basis for work and learning. Following the line of Knorr Cetina (2007, p. 363) knowledge cultures are understood as "sets of practices, arrangements and mechanisms bound together by necessity, affinity and historical coincidence which, in a given area of professional expertise, make up how we know what we know." Knowledge cultures form specific knowledge-oriented life worlds which unfold in space and time. They serve to shape knowledge practices and strategies in certain ways, by providing a referential context within which practitioners relate to knowledge and engage in professional conduct. In this way they are also constitutive of the knower. Practitioners are shaped, and learn to see the world, through the qualities and lenses of their knowledge culture, and its technical and social arrangements form the basis for introducing newcomers to the professional domain.

The chapters in this section explore the relationship of knowledge cultures to learning from somewhat different angles, and focus on different aspects of the machineries in play. The first chapter (chapter 2) by Monika Nerland provides an initial discussion of how professional knowledge cultures manifest themselves as distinct ways of organising and distributing knowledge which invite certain kinds of engagement and learning. The focus of this chapter is on the professions as knowledge cultures. By relating the stories of practitioners to discourses of knowledge advocated by core institutions and the professional bodies, the chapter explores and compares the general ways of organising and conceptualising knowledge in computer engineering and teaching. The cultural manifestations are discussed with regard to challenges for individuals and communities alike.

In chapter 3 Jens-Christian Smeby examines the role of initial professional education as a structure for enrolment into professional knowledge cultures. Pointing to how the spill-over of epistemic culture plays out in the educational programmes in terms of an academic drift and closer links to more abstract forms of knowledge, Smeby discusses the potential for students to create ties to knowledge during education. Using the concept of epistemic trajectories as a

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metaphor for learning over time, the chapter explores the relationship between ways of relating to knowledge during education and in early career work respectively.

In chapter 4 Kirsti Klette and Tone Cecilie Carlsten inquire further into the knowledge culture of school teachers, and examine the challenges teachers face as participants in new and more epistemic frameworks. The authors show how the teaching profession suffers from weak knowledge ties both at the individual and at the community level, which causes problems with regard to linking up with wider knowledge worlds and securing opportunities for continual professional learning. The chapter argues that the traditional model of learning within the boundaries of local practice and collegial cooperation is insufficient as complexity in knowledge and work increases.

Chapter 5 by Arve Mathisen delves into one specific dimension of the "machineries" of a knowledge culture, namely the temporal structuring of work and learning. Focusing on the profession of accountancy, the chapter explores how the "temporal design" of auditors' work and learning serves to facilitate learning and comprehension of new advancements in this professional domain. The chapter draws attention to how certain timescapes for participation emerge, with a sequencing of tasks and activities that brings knowledge and temporalities at different societal levels together in learning-conducive dynamics.

Together these chapters reveal different aspects of professional knowledge cultures and their ways of constituting opportunities for learning. In this way they describe a wider framework for the production of knowledge objects and mechanisms of desire in the professions, which will be explored in Parts II and III.

MONIKA NERLAND

PROFESSIONS AS KNOWLEDGE CULTURES

INTRODUCTION

The emphasis given to professionals' learning in today's society tends to focus on the individual learner as the core object of debates and policies. Less attention has been paid to the role of knowledge domains and expert cultures in forming opportunities for learning. Within educational contexts, researchers have pointed to how different disciplines are marked by distinct knowledge practices, modes of inquiry, and principles for determining validity, which constitute students' learning in distinct ways (Becher & Trowler, 2001; Neumann, Parry, & Becher, 2002; Donald, 2002). However, the knowledge domains of professions are often interdisciplinary in character. Moreover, they comprise theoretical as well as experience-based knowledge that spans the education-work divide. Nevertheless, the professions also form distinct cultures that handle knowledge and constitute clearly different processes of learning and identity formation. Knowledge cultures may thus be seen as a constitutive force that operates in the interface between political-economic efforts and individuals' agency.

A number of initiatives have been carried out to secure practitioners' opportunities for professional development. In some countries, efforts take the formal character of compulsory engagements (e.g., in the UK), while other countries frame their efforts within a rhetoric of rights (e.g., in Norway). In any case, learning in professional life is not only about meeting formal requirements. It is also about knowledge-related practices in which professionals engage in processes of improvement on a discretionary basis (Billett, 2004; Eraut, 2006). Such practices are encouraged and formed in specific ways by the knowledge culture in question.

This chapter examines the knowledge cultures of computer engineering and school teaching with regard to how they organise knowledge and frame opportunities for participation. How do these professional domains and their interrelated knowledge arrangements serve to construct the learning professional in specific ways? What kind of opportunities and demands are presented to individuals when it comes to continuous learning in working life? In order to explore these questions, this chapter draws on the concept of "epistemic cultures" introduced by Knorr Cetina (1999, 2006), as well as the ideas articulated by Nespor (1994) about how organisation of knowledge in space and time serves to mobilise actions and constitute opportunities for learning.

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KNOWLEDGE CULTURES AND THEIR MANIFESTATIONS

Professions are constituted through their specific ways of engaging with knowledge. The forms of knowledge in use, the artefacts and tools provided for professional practice, the traditions and methods of knowledge production, and the collective models for knowledge application serve to give communities an integrative power.

In this respect, some organisational aspects of knowledge are of special interest: First, the ways in which knowledge is *produced* are constitutive of the knowledge domain. For instance, professional domains differ in the extent to which their collective ways of knowing rest upon scientific achievements, upon personal experiences and reflexivity, or upon processes of codification. Approaches to knowledge production are interlinked with strategies for knowledge verification. How, for instance, do professionals know that something is true or considered best practice? A second dimension relates to the ways in which knowledge is *accumulated*. This aspect concerns the extent to which knowledge is regarded as cumulative in character and built up within the logic of linearity. It also concerns the extent to which accumulation is seen as a collective and collaborative project or as an individualised matter of gaining rich experiences. Third, the ways of *distributing* knowledge within the professional community are a distinguishing aspect that is closely linked to the character of the tools and infrastructures provided. These may, for instance, be more or less locally bounded, more or less technological in character, more or less based upon the written language, and so forth. And fourth, the profession-specific patterns of *applying* knowledge and the ways of handling the relationship between general knowledge and its application in specific work settings are a constitutive dimension in professional knowledge cultures.

In practice, these dimensions mutually shape each other and operate together in structuring both work practices and approaches to learning. They form the discipline-specific temporal and spatial organisations of knowledge that constitute the professional field and that also provide the grounds for introducing newcomers to the professional practice (Nespor, 1994). In other words, they form a certain knowledge culture, which, borrowing the words of Knorr Cetina (1999, p.1), may be defined as "those amalgams of arrangements and mechanisms—bonded through affinity, necessity, and historical coincidence which, in a given field, make up how we know what we know." Knorr Cetina points to the formative aspects of knowledge processes and utilises the metaphor of "knowledge machineries" to illustrate how the different arrangements and mechanisms work together to constitute a certain domain (1999). Further, as Knorr Cetina points out, these machineries also serve to constitute the knower. Practitioners are shaped through and learn to see the world through the lenses of their knowledge culture. Following this line of thought, professional knowledge cultures express themselves in certain practices and are, at the same time, made possible through the ways in which knowledge is organised and with which it is (collectively) engaged. This does not mean that knowledge cannot be something "real"; something materialised, something objectified, and something subjected to consensus. On the contrary, it is

in processes of materialisation, articulation, and codification that knowledge cultures manifest themselves; through these processes, they are brought into play, continued, and subjected to advancement. Moreover, as Nespor (1994) notes, the material and representational dimensions of a knowledge domain serve to produce the space and time relations through which practitioners move as learners. By examining how knowledge is developed and mediated by artefacts in collective practices, how these tools and activities are organised in time and space, how they are linked up with other structures of collective action, and how they invite certain kinds of engagement, we may reveal how the learning activities of practitioners are encouraged, directed, and perhaps restricted in certain ways.

The current chapter takes this perspective as a point of departure in portraying the general characteristics of the knowledge cultures of computer engineering and school teaching. These are contrasting fields in terms of modes of organising work, societal mandate, relationships to other sectors in society, and types of expertise. At the same time, they share the position of being responsible for core services in modern society, they are practice-oriented occupational groups grounded in a certain field of expertise and, in countries such as Norway, the programmes for initial professional education are, in both cases, located at university colleges within a state-regulated educational framework. The differences and similarities make them interesting cases to compare, both for the sake of revealing contrasting positions within the landscape of professional knowledge cultures, and for the benefit of examining these cultures' potential for learning from each other.

The discussion draws upon individual and focus group interviews from the ProLearn project, carried out among computer engineers and school teachers who graduated from Oslo University College in 2002, and whose experiences of knowledge demands and learning have been followed in their period as novices in working life (for more information, see Chapter 1 in this volume). In order to shed light on profession-specific ways of dealing with knowledge, these data are supplemented and related to an analysis of policy documents and recent debates within the professional bodies (Karseth & Nerland, 2007).

THE KNOWLEDGE CULTURE OF COMPUTER ENGINEERING[1]

The empirical frame for this part of the discussion is the working domain of computer engineers whose main tasks and functions are related to software development or system administration. Although the division of labour in this professional field comprises a range of specialities where both expertise and working tasks are concerned, the ubiquitous presence of and interaction with technological objects form a common frame for this group. Such objects may, for instance, relate to a computer network in an organisation, a programming language, or the user interface of electronic services provided by an organisation. The

[1] This part about the knowledge culture of computer engineers is also discussed in Nerland (2008).

constitutive power of the knowledge culture will be examined in terms of the key characteristics that premise the knowledge practices in this field.

Knowledge Production in Technological Markets

One distinctive feature is that notions of professional knowledge are closely linked to technological inventions and achievements. New computer programmes, platforms, and systems both premise the work of computer engineers and provide the foundation of the need for their expertise. Thus, to a large extent, the development of profession-specific knowledge pursues technological achievements. For the profession, this implies that the expert domain is characterised by dynamic interrelations with other parts of the industrial sector, making market orientation and cooperation an important dimension in advancement efforts. This comes into view, for instance, in the way in which the Norwegian Society of Engineers (NITO), the largest professional body of engineers and technologists in Norway, links its support services to recent inventions and allocates its courses to firms and arenas in the technological working field (Karseth & Nerland, 2007). The effects of this notion of knowledge production upon professional learning are, however, not clear-cut. While today's global markets might be said to undermine traditional professionalism based on jurisdiction within a certain field of expertise, they also require a widening of professional expertise along both vertical and horizontal dimensions (Beck & Young, 2005). Further, the market regulation of the domain contributes to the speeding up of the technological turnovers and to the intensification of the time and space relations of professional work. Some implications will be discussed below.

Distribution of Information in Global Networks

The ways in which the professional practice is embedded in a knowledge economy serve to generate modes of knowledge distribution that go beyond the boundaries of the profession. To a large extent, the epistemic infrastructures are given the character of information structures that are distributed in global networks, particularly by means of the Internet. Since technologies are subject to rapid shifts and changes, such information structures are regarded as the most reliable source of updating. As one engineer says about programming in Java; "In Java, for example, all the information you need is on their homepage. If something new happens you will find it there. That's not the case in schoolbooks."

Information structures provide a medium of transaction that cuts across institutional spaces and simultaneously allows for local embeddedness and global outreach (Knorr Cetina, 2006). Thus, when practising their work, the practitioners are linked up with wider movements of knowledge development. Further, the network mode of organisation implies that the logic of knowledge distribution is characterised by multiplicity and non-linearity (Castells, 1996; van Loon, 2006). A diversity of connections is possible, as the information provided could be accessed in different orders and in ways that disrupt any predetermined chronology of time.

At the same time, the knowledge domain is subject to increasing differentiation that follows from a growth in the number of programming languages and technologies. As a consequence, the request for specialisation is increasing and a range of sub-networks for different technologies is emerging. In this regard, the thematic structure of forums provides practitioners with opportunities for focused inquiries, as described by this engineer:

> You find new knowledge on different websites where people have had the same problem as you before and where many have posted their solutions. I often look at the IRC [Internet Relay Chat] chat programme; the people who hang there know their stuff. It doesn't take long before you get an answer.

One implication of this mode of distributing and sharing knowledge is that there are close links between information structures and the application of knowledge in professional work. The information provided often has the character of codified procedures and recipes. The underlying logic reflects an epistementality that corresponds to what Schon describes as a *technical rationality*, in which practitioners are seen as "technical problem solvers who select technical means best suited to particular purposes" (1987, p. 3). Thus, the kind of learning offered when accessing networks of information is often restricted to updating the repertoire of programming skills and codified knowledge as part of the activity of identifying appropriate means to deal with particular problems.

At the same time, the connections between knowledge production and dissemination, and the way in which these processes are linked to global information structures and market interests, serve to involve professionals in structures of innovation that go beyond local problem solving. The interdependency between the production and distribution of new technologies and the utilisation of such inventions in engineering practice give rise to new arenas of participation in which the traditional distinction between market and profession (Freidson, 2001) is rather blurred. One example is the website of Sun Developers Network, a site that was mentioned as a main source of updating among our interviewees. Here, the producer of new technologies, Sun Microsystems, offers access to information and knowledge by providing online courses, conferences, catalogues of programming patterns that are regarded as "best practices," as well as software that can be downloaded by developers worldwide. What is interesting to note is the ways in which such distribution of knowledge and information are linked to social structures of participation and community alignment. By means of weblogs, forums, and discussion groups, members of the network are invited to share their personal as well as professional interests and to contribute to advancements in the field by testing technologies and sharing experiences. As Sun proclaims at one of its sub-sites for Java developers:

> java.net provides a common area for interesting conversations and innovative development projects related to Java technology. By participating on java.net, members learn from each other, discover solutions to programming challenges, find new colleagues and mentors, and have more fun with Java

> technology. (http://developers.sun.com/learning/academic/, accessed January 2007)

Thus, while certainly providing information about advancements in the field, these kinds of networks also offer developers professional identities that are grounded in certain technologies and which exceed the local work settings. The learning professional is constructed as a member of a technological community who is encouraged to commit him/herself to certain technologies and invited to contribute to the collective knowledge of the community. Moreover, the networks incorporate means of encouraging reciprocity and social commitment. As an engineer described in reference to one of the developer forums:

> On their websites, you find something called DukeDollars. If you have a question you want answered, you can use these. You just put three or four DukeDollars on the table and give these to the person that has the best answer. The other way around, you start with 25 dollars and if you want more you have to answer other people's questions and then pile up more, and then you can get people to answer your questions again. I think it's a neat system.

For the practitioners, these websites and information networks represent important arenas for sharing and updating their knowledge about current software and technologies. They also constitute learning processes in certain ways by giving priority to the application of codified knowledge and technical skills, within specific technological boundaries, and through patterns of interaction that mainly consist of structures of concrete questions and answers.

Accumulation by Standardisation and Codification of Procedures

A powerful dimension in the knowledge culture of computer engineering is the emphasis given to the standardisation of devices and codification of procedures. Standards serve as a precondition that allow the network structures described above to be efficient. Moreover, standardisation is closely interlinked with the technical rationality characteristic of the field. Informal standards come into view in the way in which engineers assess the work of colleagues and possible solutions. In spite of the multiplicity of possible connections and technical solutions, there are established principles for good engineering work. One of our interviewees described it in the following way:

> I believe it is more generally accepted in this field [than in others] what a good solution looks like. If five code developers work individually on the same task they will probable all agree – or at least four of the five will agree – upon which solution is better.

Moreover, in approaching problem situations, the engineers often turn to codified "best practices" that are distributed in the information networks. They also embrace these patterns as models for their own work as developers. As one engineer says, bearing in mind the ideal-typical approach to work; "when you face

a new challenge, you will [try to] solve it in ways that are so good, so generic, so recyclable and effective that it could have served as a best practice."

The accumulation of knowledge in this professional domain, for instance through practices of developing and reprocessing programming codes, is also linked to the development and distribution of standards of a formal character. In contrast to many other arenas of everyday life, in which individuals constantly engage with standards without paying any attention because they are so taken for granted in their social practices, computer engineers are dealing with standards in a very explicit manner. This is, to a large extent, what their work is about: knowing the technological standards that are in play, knowing how they may or may not work together, and knowing how to perform different tasks within the different technological regimes. The commercial ways of advancing the knowledge domain by launching new versions of technologies serve to reinforce the importance of knowing and understanding the relevant standards.

Accordingly, technological and procedural standards are heavily present in the everyday language of computer engineers; in their ways of talking about their work, negotiating competence, and committing themselves to learning. For instance, our interviewees tell us about how the discussion among developers during the first phase of a new project is largely about deciding which standards to use when approaching the present task or problem. This phase is often marked by energetic negotiations of preferences that have an emotional dimension. As one engineer stated; "Discussions among developers are often somewhat heated; however, disagreements are never long-lasting." What seems to be discussed less are the ways in which the ever-present standards influence the social practices in the profession, including the practices of learning. Standards serve to create distinctions as regards competence, spaces for movements, differentiation of working tasks, and learning areas. Moreover, they serve to "make up" kinds of engineers through their inscribed quests for specialisation. In our data, this comes into view in the ways in which some engineers identify with certain technologies and standards. For instance, one engineer talks about himself as a "J2EE developer," while another describes himself as "the Linux evangelist" in his workplace. The trend is also reflected in how employers tend to search for programmers who are specialised in certain technologies or programming languages.

This aspect of the knowledge culture is both supportive and challenging for the engineers. Standards open and close possibilities at the same time. As one engineer expresses it, there is a danger that you can "get squeezed if the short-term interests of your employer make you less attractive on the labour market"; for instance, if the technologies preferred by the employer become out of date. Thus, in order to navigate as learners in this professional domain, the engineers are requested to monitor their engagement with standards and to secure their own position in relation to upcoming technologies.

Complex Artefacts and the Request for Creativity

At the same time as the knowledge culture of computer engineering highlights the need for standards and consistency, the practice is characterised by engagements with artefacts that have an ambiguous and open-ended character. Systems, programmes, and codes can always be improved to be more efficient, more widely applicable, or more complex in their functionalities. In the moment of resolving a technical problem by means of, e.g., applying distributed codes or patterns of practice, new possibilities and untried functionalities appear. The professional practice is thus characterised by a richness of what Knorr Cetina (1997, 2001) calls epistemic objects; that is, objects that are marked by their unfolding character and their lack of completeness of being. Such objects are characteristically open and question-generating, and when individuals try to reveal them, they typically increase rather than reduce their complexity (Knorr Cetina, 2006).

The presence of epistemic objects in a knowledge culture allows for an externalisation of learning and knowledge engagements. This again constitutes the relationship between knowledge and practitioners in certain ways, where objectual relationships—that is, the relational dynamics between humans and their non-human material—define the knowledge processes. Knorr Cetina (2001) uses computer programmes as an example of objects that propel such dynamics by their way of being simultaneously both ready to be used and in a process of transformation. On the one hand, engineering work such as programming is heavily commodified and objectified in terms of standards, software, and platforms that are defined and materialised as physical things. On the other hand, the technology and computing practices are continuously changing. Following the arguments of Mackenzie (2005) and Bowker and Star (2000), complex technological objects and practices also resist commodification. The open-ended character of epistemic objects brings a creative dimension to work, which may serve as a primary driving force in work-based learning (Jensen, 2007).

As a consequence, it is not sufficient to understand the practice of computer engineers in terms of restricted problem solving and rule following. Engineering work also implies an interest in discovery and an ability to see the unfulfilled potential inherent in the technological scene. In a group interview, this came up as a topic when the engineers discussed challenges arising when routine-based actions are insufficient. One engineer, who works as a software developer in a large consulting company, provided the following example:

> In some cases, you have a customer who has a hybrid server park, and who, due to, e.g., new ownership structures, has received the message that no more money will be spent on that equipment. Then you have to make sure that what you do is compatible between the different systems, which may not speak the same language. Such situations require a lot more creativity than just depending upon logic reasoning. You have to think broader and to think more freely than you would have done in a homogeneous technological environment.

This example points to how existing knowledge and standards are challenged both by the local work context and by the objects' inherent potential for change. Codified or materialised knowledge needs to be recontextualised in the specific context of problem solving. Moreover, this often takes the form of exploring the prospective opportunities of the technologies. As noted by Bucciarelli and Kuhn (1997, p. 211), engineers typically "go about making up scenarios about things and principles, physical concepts and variables and how they relate." While such scenario making requires creativity, the aim of the activity is to achieve closure by arriving at a solution that is "fixed, repeatable, stable, unambiguous, and internally consistent" (Bucciarelli & Kuhn, 1997, p. 212). Thus, there is a paradox between the specified and the ambiguous in this knowledge culture, which allows practitioners to develop their competencies by constantly moving between the unfulfilled and the temporarily fixed. Interestingly, this dynamic is not only a case for developers, but also for engineers who mainly do system administration. As one of our interviewees belonging to the latter group stated; "In fact the most important thing is to realise the potential of the system you are working with. As you learn more about it, you also see many new opportunities."

For the professional, the relationships with objects require an experimental attitude in which the practitioner needs to be sensitive to the unfulfilled potential of the technology in question. That is, he/she needs to be sufficiently familiar with the field of knowledge to be able to interpret objects in terms of their ways of displaying not-yet-realised opportunities and to see their inherent potential for change (Knorr Cetina & Bruegger, 2002). At the same time, the objects may provide the learner with directions for further investigations and in this way also give the objects "binding" functions that may propel learning forward (Jensen & Lahn, 2005; Jensen, 2007).

Knowledge Application within Series of Problem Solving

The ways in which the knowledge practices of everyday work are organised both reflect and constitute the knowledge culture of the profession. As in engineering cultures in general, the domain of computer engineering is characterised by a dominant pragmatist way of thinking. This implies a high value placed on the application of knowledge in dealing with practical problems, a focus on validating theoretical principles through activities of inquiry, and an overall emphasis given to making things work and getting the task done. The problem-oriented approach implies that engineering work is largely organised as a series of problem solving (Bucciarelli & Kuhn, 1997; Downey, 1998; Sørensen, 1998), either in terms of correcting malfunctions that occur in a technological system, or in terms of developing new functionalities in accordance with given specifications.

With regard to the question of work-based learning, the regulation of the problem-solving activities in time and space is important. The activities are characterised by restrictions in two ways. First, they are spatially limited in terms of *content*, as the engineers' responsibilities are often allocated to specific functions or parts of a project or a computer system. In larger firms, the

practitioners are often organised in teams dealing with specific tasks that are linked together in a broader work structure. For instance, one of our interviewees is based in a "user interface team" that develops functionalities that other teams use as a basis in their work:

> My team and another team develop modules that the business teams utilise to develop their logic. (…) So, in a way, we provide the framework, or the components that the other teams use to, e.g., make screen images.

Within the team, the tasks are further specialised. In this case, the user interface team comprises one leader who specifies the requests of the task; three code developers; one tester; and one person who is responsible for securing documentation. This division of tasks and responsibilities serves to constitute the space of learning opportunities in ways that are both enabling and constraining. On the one hand, one could argue that the engineers are involved in limited parts of the knowledge domain and, therefore, exposed to limited opportunities for learning. On the other hand, they are provided with opportunities to specialise their skills in ways that may enhance the opportunities for focused learning. Further, the ways in which additive structures of accumulation are developed through cooperative efforts allow for a sense of meaningfulness in the performance of limited tasks. One engineer links this to the performative character of the knowledge practices:

> You feel that you are part of a dynamic structure that, when working at its best, as it generally does, gives you an incredible feeling of satisfaction. Moreover, in my work situation, you see the results of what you have done in a very, very explicit manner. That really gives you a good feeling.

Second, the problem-solving activities are restricted in terms of *time*. The working days are often characterised by a series of "short-term loops" where processes of inquiry and specific problem solving coalesce. The quest for quick solutions and knowledge application may give priority to surface forms of learning and undermine possibilities for more profound engagements with knowledge. Moreover, the dominant project organisation characteristic of the field contributes to an intensification of time where the problems in question have to be resolved within a limited time frame (Ó Riain, 2000; Davies & Mathieu, 2005). In some cases, this may serve to undermine possibilities of work-based learning, as the timeframe does not allow for the development of new skills. In Ó Riain's ethnographic study of a software team, this came into view when the team found itself in need of new skills, and, due to time constraints, was forced to bring in an external consultant with the necessary competence instead of training current employees (2000, p. 196). Also, in our interviews, the ways in which the tight schedules restrict opportunities for learning was a recurrent theme. Quite a few of the interviewed engineers stated that they would have liked to engage more broadly in learning but that the time pressure of their work made this difficult.

Seen as a whole, the knowledge culture of computer engineering has distinctive characteristics that shape and encourage work-based learning in certain ways. Emphasis is given to the application of standards and codified knowledge in

particular situations of problem solving and to the mediation of knowledge through complex artefacts and information structures in global networks. This gives learning in the workplace the character of inquiry-based activities that are partly internally driven by the problem setting at hand, and partly externally by the invention of new standards in the technological field. At the same time, the rapid shifts relate continuous learning to issues of career management. Our interviewees express a concern for staying informed about what is happening on the technological scene, and, by and large, they assume that this is an individual responsibility (for further explorations of this issue, see chapter 11 in this volume).

THE KNOWLEDGE CULTURE OF SCHOOL TEACHING

School teachers are, of course, working in a very different environment from computer engineers. Their profession is grounded in a societal mandate where supporting the intellectual and personal growth of the next generation is the prime concern. Teachers share the engineers' orientation towards practical issues and situated decision-making; however, their field of expertise constitutes a quite different knowledge culture, which also generates different ways of encouraging learning. Some general features will be explored in the following sections, within the context of teaching in primary and lower secondary schools (for a more detailed analysis of the teachers' learning patterns, see chapters 3 and 4 in this volume).

Experience-Based Production and Accumulation of Knowledge

A major dimension in this knowledge culture is the notion of professional knowledge as acquired and developed by way of personal experience. A common narrative is that the individual teacher needs to build up a wide repertoire of first-hand experiences gained in a variety of teaching and learning situations. This view of knowledge and expertise is, for instance, reflected in the way in which teachers see themselves as being closer to craftsmen than to academics. As expressed by one teacher; "The teaching profession is about craft, I think. It is a lot of knowledge that needs to be achieved by way of experience." Another teacher shares this view, and relates the emphasis on personal experience to the nature of the knowledge itself. According to her, the knowledge is hard to define and to make explicit, and thus also difficult to extract from external sources: "The knowledge is not very tangible," she says, "you have to build it up yourself."

This way of thinking is manifested more broadly in the history of the teaching profession, which in Norway has been related to an egalitarian way of thinking as well as to a strong sense of individual autonomy within a national, unified, and curriculum-regulated school system (Lauglo, 1990; Hagerman, 1992; Michelsen, 2002; Karseth & Nerland, 2007). On a collective level, the emphasis on personal knowledge is reflected in the ways in which the teachers' union frames its efforts by protecting the opportunities for individual autonomy and by advocating a bottom-up strategy for knowledge development. In 2004, the Union of Education

Norway launched a project on *Professional Awareness* as a means to strengthen the identity of the profession and develop collective ideals for professional practice. The president and vice-president of the union described the project as a matter of creating a shared platform for reflective practice by way of bringing the experiences of individual members to the fore:

> We are not going to create something entirely new. This is about articulating and summarising reflections about practices in the workplace. We want to disclose these reflections and turn them into a collective platform for member groups as well as for the entire organisation. This will provide the foundation for the Union's work on educational policy. (Letter to the members of the Union by President Hjetland and Vice-president Aahlin, 2004)

In this way, experience-based knowledge was highlighted as the basis for developing the profession's collective knowledge base. Teachers were asked to initiate group discussions in their workplace that aimed to reveal and verbalise tacit knowledge, and to bring the outcomes of their discussions "upwards" in the organisation. Moreover, the teachers' union underscored the need for respecting the individual teacher as a professional practitioner. As the president stated;

> Teachers are different and must find their own, personal way of teaching. We meet students with different needs of suitably adopted education. It is very important to maintain that teachers have the freedom to choose how they will proceed. (Hjetland, 2005)

Protecting teachers' rights to choose teaching methods has been a continuing concern for the teachers' union in Norway, as well as in later debates. For the learning professional, this way of thinking implies that work-based learning is individualised and closely related to the practitioner's reflective practice. At the same time, it is the individual teacher's responsibility to contribute to the development of a collective sense of identity and to feed one's experiences into the profession "from below."

Knowledge Distribution by Way of Human Interaction

A related facet of teachers' knowledge culture is the emphasis given to human interaction in strategies for knowledge distribution. Where the engineers are accessing sources of knowledge that are codified, technologically mediated, widely distributed, and open "to all," the access to professional knowledge for teachers is still heavily dependent upon chains of human interaction. Although teachers frequently access the Internet and written sources to seek out facts and information about specific themes (Caspersen, 2007; Klette & Smeby, chapter 8 in this volume), their engagement with profession-specific knowledge related to pedagogical issues is typically mediated by human interaction. For instance, a primary strategy for updating oneself in these domains is related to asking colleagues about their experiences and ways of doing things (Lahn, chapter 6 in this volume).

According to our interviewees, one reason for this is that the professional knowledge is not accumulated and provided in more structured ways. As one of them explained; "You have to ask your colleagues, because it [the knowledge] is not systematised and made available in other ways." Another teacher describes her experience in a similar way: "It is oral transmission of knowledge all the way," she says, "that's the way it works." In addition to the logic following from emphasising personal knowledge, they explain this situation by referring to time pressure and tight schedules at work, which leaves the practitioners with little space for documenting teaching procedures and experiences. As a consequence, learning in the workplace is related to informal interaction and knowledge sharing within the local school, in which the learning professional is implicitly asked to take personal responsibility for seeking out advice and ideas.

In recent years, the profession has shown an increased interest in developing more collective structures for professional development, e.g., by developing and offering courses around methodological topics. It is, however, interesting to note that efforts to provide more formal learning opportunities seem to employ a comparable strategy for person-mediated knowledge sharing. For instance, in some municipalities, the local educational authorities organise chains of person-to-person communication as a way of implementing new teaching methods:

> At every school [in my district], there is one teacher who is called a reading teacher. He receives tuition from [name of specialist]. The research and method is built around his [the specialist's] approach. And then the reading teacher is responsible for training the staff at his school in this method.

This way of organising knowledge distribution seems to rest upon the idea that professional development requires personal training in appropriate contexts, which provide opportunities for practical exploration and for dialogue around the knowledge issues. At the same time, it reflects an emerging interest in standardising and establishing a common knowledge base for teachers who are working in the same subject area. However, the ways and extent to which such collective learning is promoted varies from district to district and seems somewhat fortuitous. Another teacher tells of a related structure of knowledge sharing, which, in her case, is carried out within a more informal setting and based on the initiatives of individual teachers:

> My colleague, who teaches in third grade, is currently involved in continuing education and participates in a network for math teachers. She does this on a voluntary basis, and then she is asked to share some of her knowledge with us. However, if she was not interested, no one would have done it. We don't have anyone in this role when it comes to teaching the Norwegian language.

The fact that several teachers express an interest in extending this model for knowledge distribution to other areas and subjects by way of a "local tutor" indicates that this aspect of the profession's knowledge culture is well adopted at the level of individual practitioners. Many teachers seem to prefer to engage in learning within a context of human interaction.

The person-mediated way of distributing knowledge implies that the epistemic infrastructures are given a local profile in the sense that most teachers connect with profession-specific knowledge within the boundaries of their local community. The strength of this model is that engagement with knowledge takes place close to its application in practical teaching, and that it allows individual and organisational learning in the workplace to coalesce. The possible limitations include that it may be difficult to exceed the local boundaries and thus to reconceptualise current practice, and that the practitioners are not offered the sense of excitement that being in contact with wider structures of knowledge development may provide. As one of our interviewees expressed it; "I feel that when I get to know about something new, it is from colleagues and those I am sharing working space with. And that's it, in a way." In the long run, this limitation may contribute to undermining the professionals' drive for continuous learning.

Knowledge Application as a Matter of Differentiation

It follows from the notions above that this knowledge culture is marked by a resistance to standardisation in terms of strict guidelines and codified procedures for how work is to be performed. This is related to three interlinked ways of understanding the application of knowledge in professional work: First, it emerges as a consequence of the complexity of the professional knowledge domain, which makes knowledge difficult to set permanently and to apply directly in practical settings. Teachers' field of expertise encompasses subject matter knowledge as well as knowledge about the cognitive, social, and emotional processes involved in learning (Klette, 2000). Thus, any idea about the direct application of knowledge becomes problematic. As one teacher says about knowledge related to teaching students how to read:

> It is a very wide-ranging domain of knowledge. Thus, you have to pick and choose from here and there, and try to use your own imagination. That's why I feel it would be very problematic to organise it [the knowledge] in a catalogue and state how exactly practice should be performed. Because, I don't believe the knowledge is fixed in that way.

The idea seems to be that general knowledge needs to be filtered and transformed through the individual teacher's judgment and personal approach to be applied efficiently in educational practice.

Second, there is a general concern that teachers work in very different settings that are dependent upon the actual students and educational context within which the teaching is to take place. The nature of work as being closely related to the needs and learning approaches of different students calls for a sense of carefulness and prudence that rejects the direct application of predefined standards. Thus, a constitutive facet of teachers' knowledge culture is the idea that knowledge has to be applied within an ethos of differentiation, in which the specificity of the situation at hand premises the best approach to teaching just as much as theoretical knowledge or predefined guidelines.

Third, at a collective level, the professional body has brought forward the argument that extensive use of standardised methods undermines the opportunity to accomplish their professional responsibility. As stated by the president of the teachers' union:

> Practice cannot hinge on so-called documented methods alone. For one, such overregulation will imply a dramatic loss in experience-based knowledge, which has traditionally been our basis for professional work. Second, it will undermine the freedom of methods and reduce our mandate as a profession. We will lose the right to practise qualified, professional discretion. In that case, we do not qualify for the term profession anymore. (Hjetland, 2006, speech to the general assembly of the Union of Education Norway)

Although efforts to strengthen the knowledge base by developing guidelines and collective repertoires of teaching strategies are increasingly coming up in this professional field in Norway, as in the professional sector in general, the concern for protecting individual autonomy by resisting standard-driven regulation of work is still very powerful. This may be related to the Norwegian history of regulating teachers' practice by means of a national curriculum that defines the content of schooling (Klette, 2000; Carlgren, 2000). For the learning professional, this way of thinking contributes further to an individualised responsibility for improvement and professional development. It generates an ideological space that encourages the continuous search for more efficient teaching methods and has the potential to stimulate reflexive learning on the basis of experience. At the same time, however, the resistance to standards may undermine the possibilities for linking local teaching and learning activities with other practices and levels of knowledge development. One function that standards may potentially assume is to mediate between scientific knowledge advancements and practical work. A lack of such mediating devices may leave the practitioners in a vacuum where secured guidelines for practice are concerned, and contribute to restricting the space of knowledge engagement to the boundaries of the local community.

Knowledge Engagements within Wide-ranging Tasks and Responsibilities

In contrast with computer engineers, whose work is often organised around specific technologies and thus also specific knowledge issues, the culture of school teachers is marked by indistinct boundaries and wide-ranging working tasks. Norway has a strong tradition for manning elementary schools with general teachers, thus both the educational programmes and the working tasks comprise responsibilities related to a wide range of subject curricula.[2] The idea is to follow the class and students instead of specific subjects as the principle for organising work. Thus, knowledge practices in the workplace are traditionally discriminated

[2]At the moment of writing, this is about to change, as a new and more specialised national curriculum for teacher education was instigated in 2010.

in relation to grades and the age of the students, but teaching obligations typically comprise a range of subject matters and responsibilities within these frames. One teacher describes her work in this way:

> I work with … everything, really … planning lessons, performing lessons, and not least monitoring and supporting students. It includes planning work in relation to different kind of students, because they are very different when it comes to knowledge and learning. And quite a lot of collaboration with other teachers. It is about everything, from following students to planning and administrative work. Quite different tasks. Marking...

In recent years, teachers' work has increasingly been subjected to team organisation, which aims both to facilitate collaboration and to frame responsibilities in a more distinct way. The team organisation is, however, also complex in structure, comprising teams formed around levels and classes, teams formed around subjects, and teams formed around specific projects. Thus, the knowledge demands are multiple, and individual teachers are often still left with the task of creating limits around their own work. Besides, teachers are given the responsibility to follow specific groups of students, a task that is not restricted to activities in the classroom but includes connecting to other areas of the student's life and staying in dialogue with the student and his/her parents or guardians.

As a consequence, teachers as learners are presented with multiple knowledge demands that span a range of subject-specific domains of knowledge and include complex social and emotional matters. Our interviewees express a general need for learning more about how to personalise teaching and how to support students with special needs. They also point to the unlimited areas of subject matter knowledge in which they feel they should have engaged themselves as learners. As one teacher expresses it;

> I wish I had time enough to develop [my knowledge] in all these subject areas … there is so much more you wished you could learn in social science, in geography, in mathematics … I mean subject-related. It's just so much … All world history and the history of Norway I wish I knew better. And I would really like to learn more about all the different religions … I would have liked to know more about everything, really.

Thus, in one sense, the knowledge culture of teachers provides a plenitude of open-ended questions and matters for further exploration that may invite learning. However, seen together with the lack of standardised procedures, and the time pressure and extensive demands for "front stage performance" at work, the support structures around the learning professional may be too fluid and too open to provide clear directions for learning (for further discussion, see Klette & Carlsten in this volume). Teachers as learners are encouraged to engage in improvement and professional development by means of reflexivity and self-governed inquiry; however, the horizontal and multi-dimensional organisation of knowledge may leave them with unclear support structures to cope with these demands.

The Primacy of Students' Learning

Last but not least, a powerful aspect of teachers' knowledge culture is the overall mission of supporting students' learning. The complexity involved in observing, assessing, understanding, and supporting students' learning presents constant challenges to teachers and requires their full attention. However, rather than leading to significant attention towards knowledge and professional procedures, many Norwegian teachers seem to be oriented towards the students as human beings. At the level of the profession, this comes through in the abovementioned emphasis on differentiation, as well as in a dominant construction of the teacher as "pupil centered, caring and including" (Søreide, 2007).The attention towards the student is undoubtedly crucial for performing good work, but, at the same time, it may contribute to making teachers' own learning less visible and accessible. A typical tendency in our data is that teachers answer in terms of their students' learning when they are asked about their own experience of knowledge demands and learning needs. One teacher describes the challenges he faces as "a matter of really coming through to the students. To reach them where they are. And to try to create teaching activities that really catch the students' attention." Another teacher states that such processes entail continuing efforts in terms of trying out new approaches and methods, and that these processes of trying and assessing how the strategies work imply an ongoing creation of one's own teaching style:

> You learn new methods, new things all the time, see how it works. So that part you're in charge of yourself, and while travelling you see what works and not. So, in a way, you construct your own style and you continually strive to develop it further.

As these examples show, learning and professional development are closely linked to everyday teaching. Moreover, teachers' learning is mediated through the students' learning activities and learning requirements. The teachers' possible space for learning is largely framed by the content and form of the students' current learning tasks. These tasks are again premised and regulated by the national and local curricula for the specific subjects. Another example of how the learning requirements for students command teachers' learning comes into view in teachers' habits of seeking out new subject matter knowledge. One of our interviewees describes the circumstances that mobilised her to search for new knowledge. These are typically related to gaining insights into a topic scheduled to be taught in the near future: "It happens when you see the topics coming up. In the planning period, you will try to read a bit about it, to check with colleagues how they have approached the issues, read what they have done …." She continues by providing an example from her reading about Egypt in a period when this topic was scheduled in the curriculum for her class. One consequence of this approach to learning may be that subject matter knowledge is brought to the fore as crucial for teaching and is subjected to deliberate learning. As discussed above, profession-specific knowledge related to pedagogical issues seems to be approached in

different manners closely related to experience-based judgments and reflection embedded in practice.

On the positive side, the comprehensive orientation towards students' learning may serve to bring teachers' own learning close to practice and keep it relevant for the multiple working demands. At the same time, this way of thinking about professional development may undermine teachers' opportunities for dealing explicitly with learning in working life. Moreover, it may lead to an absence of knowledge objects for teachers to engage with that link their immediate work context to wider knowledge worlds.

Seen together, the powerful dimensions in the knowledge culture of school teachers construct work-based learning as forms of experiential learning, in which the professional is invited to embrace the position as a reflective practitioner who examines and intervenes in his/her own practice on a discretionary basis. The repertoire of approaches to teaching is subjected to individual accumulation and enacted within the logic of diversification. Moreover, learning opportunities are largely bound to the local context and school community. By virtue of the emphasis on students' current learning tasks and the requirements of the curriculum, teachers' own learning is mediated by the students' learning activities. This presents challenges to the professionals for dealing explicitly with their own competence development. Without stronger support structures for this mission at a collective level, teachers who are not fully capable of taking up the position as reflective and reflexive practitioners may be in danger of eroding themselves as learning subjects.

CONCLUDING DISCUSSION

The above exploration has revealed profound differences between the two professions in regard to their ways of organising knowledge and positioning the knower. The two groups differ in the logics and arrangements through which knowledge is developed, circulated, accumulated, and applied in professional settings. These logics and arrangements also serve to form ways of envisioning knowledge and opportunities for learning. In this concluding section, I will relate the differences to three aspects that seem particularly relevant for our understanding of "machineries of knowledge construction" (Knorr Cetina, 1999) in professional domains and their ways of influencing learning: i) the temporal and spatial scale of knowledge practices and participation; ii) the types of intermediaries through which knowledge circulates; and iii) the collective belief systems and orientations that emerge through the former aspects.

The first issue concerns the space and time relations through which practitioners are invited to move as learners. As noted by Nespor (1994) in the context of educational programmes, (professional) communities are not only situated in space and time, they are also characterised by their ways of setting up patterns of movement and participation across space and time. This also seems to be highly relevant in the context of work-based learning. In the engineering culture, knowledge circulates in wider information networks in ways that bring spatial

extension to work. The engineers move on these structures in multiple ways, and their knowledge practices may be simultaneously locally embedded and distributed. By connecting to other spheres of the knowledge world while exploring or solving present working tasks, the local-global divide becomes temporarily resolved and aspects of the wider infrastructure for engineering work become activated in local practices. Moreover, this co-presence of different spaces for engagement is also mirrored when it comes to time scales. Although work is often organised as series of problem solving within restricted time frames, the engineering culture is also geared towards the future. This comes into view, for instance, in the overall attention towards new technological advancements and unfulfilled opportunities. Hence, engineers may actively engage with future scenarios when performing current work and, in this way, move along different time scales simultaneously. Such heterochrony of practice is also described by Lemke (2000). However, while Lemke elucidates how the longer timescale processes related to human history produce effects on shorter timescale activities, the culture of computer engineering may turn this the other way around and allow ideas and visions of the future to influence activities in the present.

The space and time relations in the knowledge culture of school teachers are composed differently. In this culture, the professional practice is more locally bound and relies more on local circuits of knowledge. The emphasis given to face-to-face communication and to experience-based knowledge makes the local work environment the prime setting for knowledge engagement. In one sense, the long-term commitment to students and their development provides extended time frames for teachers' engagement. In spatial terms, however, this engagement is still locally bound and does not necessarily incorporate movements within extended knowledge worlds. Moreover, although teachers are also subjected to multiple and simultaneous demands, this simultaneity seems more related to the co-presence of concerns embedded in working tasks than to their own movement across space and time.

The second issue concerns the type of intermediaries that define the ways in which knowledge is produced, circulated, and approached. Such intermediaries may be of different material character, and include humans, artefacts, texts of various kinds, and forms of capital (Callon, 1991). In the culture of school teaching, knowledge tends to be mediated in personal interaction and enacted by the individual teacher with concern for the current needs of the student. Each professional accumulates his/her personal knowledge base, mainly by way of attaining teaching experiences and through the sharing of such experiences with colleagues in the local community. Profession-specific distributed knowledge is sparsely referred to in our data. Although the teachers engage quite extensively with codified knowledge, this is typically related to subject matter knowledge that is utilised to prepare lessons. In contrast, the knowledge culture in the field of computer engineering rests, to a great extent, on processes of commodification. This knowledge domain is heavily structured in terms of collectively shared knowledge objects and codified procedures. As also pointed out by Knorr Cetina (1997, 2001), a primary feature of object relations in expert cultures is the

separateness of subject and object; that is, a distance that makes interpretation and exploration of something possible, and allows for abstraction, decontextualisation, and recontextualisation. The richness of objects in the engineering culture may facilitate such processes to a larger extent than the more oral and person-oriented culture of school teaching.

The third issue is related to both the above, and concerns ways of envisioning knowledge and the collective belief systems that frame practitioners' orientation; that is, what Knorr Cetina (2006) terms "epistementalities." Different knowledge cultures will embody certain visions about how knowledge should be handled and inserted into personal and organisational life (Knorr Cetina, 2006). The explorations undertaken above show that both knowledge cultures emphasise applied knowledge and envision learning as embedded in current working tasks. Yet, there are significant differences in how knowledge application is envisioned. The knowledge culture of the teaching profession stresses the need for differentiation in the way in which the professional work is performed, whereas the culture of computer engineering advocates the need for standardisation and consistency. In sum, the teaching culture is marked by an "inwards" orientation, which highlights the particularities of the situation with reference to the present and the past, while the engineering culture is more "outwards" and future oriented with attention given to new advancements that are externally introduced. These orientations contribute to constructing professional development as a matter of experiential learning in the teaching profession, whereas the access to and application of new and universal knowledge is given emphasis in the field of computer engineering.

The investigations undertaken in this chapter are explorative in character, and more empirical research is needed in order to develop a thorough understanding of how the characteristics play out in different settings, as well as how they may vary between local and national contexts. At the same time, the identified differences between the two professions demonstrate the relevance of conceptualising professional cultures as knowledge cultures marked by distinct heuristic practices and knowledge relations, and constituted by complex amalgams of instruments, strategies, practices, and ways of envisioning knowledge. The chapters that follow in this book will delve deeper into these issues, and hopefully spur more research that can complement the picture and increase our understanding of how knowledge, professional practice, and responsibilities are constructed in the interplay of local and extended knowledge worlds.

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JENS-CHRISTIAN SMEBY

THE SIGNIFICANCE OF PROFESSIONAL EDUCATION

INTRODUCTION

One of the key characteristics of professions is that they are based on a body of abstract codified knowledge obtained in some kind of university or university-like institution. While there are different and conflicting perspectives and definitions of professions and professionalism, this characteristic is not contested. Moreover, professions nowadays are often defined simply as knowledge-based (Evetts, 2003) or "expert" occupations (Abbott, 2001), implying that the characteristic above is considered to comprise the only, or at least the core, definition. It has been argued in the introductory chapter that theoretical knowledge has become even more important during the last decades. A general characteristic of a knowledge society is not just that scientific knowledge has become more important in the economies of advanced capitalism, but also that expert knowledge penetrates into all spheres of social life (Giddens, 1990; Knorr Cetina, 1997). Theoretical knowledge, therefore, is not just a basis for professional problem-solving; professionals also have to provide scientifically based arguments to defend their diagnoses and decisions to a greater extent than previously. Thus, the manner in which professional knowledge is developed in higher education is at the very heart of professionalism.

It is possible to distinguish between "knowing that," i.e. knowing that something is the case, and "knowing how," being able to do something (Ryle, 1949). Professions are characterised by combining these two types of knowledge. This dual basis distinguishes professionals from, on the one hand, craftspeople, who emphasise techniques per se (Abbott, 1988 p. 8) and typically receive their training on the job as apprentices (Freidson, 2001 p. 89), and, on the other, academics, who are concerned about pure disciplinary knowledge and knowledge for its own sake. The complex nature of professional knowledge and the role of practical skills and personal experience is heavily emphasised in the literature (e.g. Benner, 2001; Eraut, 2004; Schön, 1987). However, this does not challenge the basic assumption in the sociology of professions that theoretical knowledge is a basic characteristic of professionalism. The focus in this chapter is to explore central aspects of the role of higher education in professional learning.

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Two Perspectives on Professional Education

Although there is general agreement that one of the core characteristics of professions is a body of abstract codified knowledge obtained in higher education, the reasons *why* this is important are heavily contested. The basic perspective in functionalistic sociology is that education has a socialising function. Socialisation implies not only training for specific knowledge and skills, but also internalisation of values as the acceptance that goods should be distributed on the basis of performance. Selection is important to allocate the most important and demanding jobs to the most talented individuals (Parsons, 1959). Higher education and abstract codified knowledge are considered highly important as a basis for professional discretion and autonomy as well as for the development of a critical attitude to knowledge and professional practice. Professional education also has a socialising function in terms of strengthening the students' commitment to and identification with the profession and professional values (e.g. Freidson, 2001). This corresponds to the meritocracy model, which presumes there is a rational and socially productive relationship between school and work and individuals are rewarded based on their merits and qualifications (Bills, 2004 p. 38). The meritocratic perspective matches the traditional lay perspective on the relationship between education and work.

In another approach, it has been asserted that expert knowledge is a core element in professionalism, used as a basis for occupational groups in their claims and competition for status and income (Johnson, 1972). Larson (1977) defined the *professional project* as a "monopoly of competence legitimised by officially sanctioned 'expertise,' and a monopoly of credibility with the public." It is also argued that knowledge and skills are mainly learned in occupational life and that professional education and credentials are largely means of regulating the admission to privileged positions in occupational life (Collins, 1979, 1990). Collins argues that medicine is one of the few professions which is clearly based on an objective technical skill built upon general principles that can be thought. Therefore, he finds it striking that the medical profession had high status prior to the development of a scientific knowledge base. According to Collins medicine before the mid-1800s was based on virtually no valid expertise, and many of the procedures developed from ancient theories – practices such as bleeding and purging – were not just wrong, they were directly harmful. He concludes that the monopoly position and high standing of physicians before the later nineteenth century was based on fraud (Collins, 1979, pp. 138-139).

While the latter perspective on professions was developed as a critical alternative to the former, these perspectives are not fundamentally incompatible (Evetts, 2003). Professional education may have a qualifying as well as a credential function. There are only few studies examining the extent to which higher education has a qualifying function, however, and the results are somewhat contradictory (Bills, 2004). One reason is the methodological challenge involved in examining whether education has a primarily qualifying or credential function. Education is not just an indicator of knowledge and skills; the number of years

spent in education is also positively correlated with good health and job stability and negatively correlated with smoking and drug and alcohol abuse. It is therefore rational for employers to prefer persons with more education, not just because of their competence and skills, but as a kind of screening for unobservable characteristics. Based on the same rationale, students will choose to educate themselves not just to qualify for a future job, but also to signal their capabilities as employees (Weiss, 1995).

Epistemic Trajectories

Another challenge related to examining the qualifying function of professional education is that while education may be directly, concretely relevant to performance and problem-solving in occupational life, it may also have more indirect relevance in promoting development of analytical skills as well as motivation for future learning. From a situated perspective (Lave & Wenger, 1991) the traditional cognitive assumption that knowledge learned in the context of education can simply be transferred to the context of work is challenged. This does not mean, however, that the education has no qualifying function. The concept of "boundary crossing" (Engeström, 2001; Guile & Young, 2003) and "recontextualisation" (van Oers, 1998) may be appropriate to understanding the challenges as well as constructive processes that graduates face in their first years in professional work, when they have moved across boundaries in time and space (Saunders, 2006).

One way to understand how professionals relate to more abstract modes of knowledge is to focus on the process around the incorporation of students into the specific temporal and spatial organisation of knowledge: how students get connected to knowledge (Nespor, 1994). Knowledge and learning do not take place in the mind in isolation; they are the products of social activities. Knowledge constitutes activities organised by networks spread across space and time. Students get connected to knowledge along trajectories, where representations such as textbooks, lectures and technical instruments are mobilised. Such a focus on knowledge and learning is somewhat similar to Knorr Cetina's perspectives on epistemic cultures and the machineries of knowledge presented in the introductory chapter (Knorr Cetina, 1999, 2006). Moreover, emphasising the social aspect of trajectories paves the way for an understanding of trajectories as influenced by larger socio-economic, environmental and institutional contingencies at the community level. The professional body of knowledge is also a matter of "professional projects" and jurisdiction. To stress the focus on knowledge as well as the social perspective on learning the term *epistemic trajectories* may be more appropriate than *learning trajectories* which generally are based on a psychological approach (Lahn, 2010).

A trajectory perspective on professional learning is not limited to initial education. Workplace learning is of significant importance. Lifelong learning is more than rhetoric; graduates from professional programmes are not ready-qualified. The first years of professional practice are essential for the development

from novice to expert (Benner, 2001). An important question is which types of knowledge are best learned in higher education, which are best learned in professional practice, and which are best learned through integrated courses involving both contexts (Eraut, 1994, pp. 100-122)? The fact that professional graduates may lack important knowledge and skills does not necessarily represent a weakness of the respective educational programme. Using the basic perspectives in the sociology of profession as a point of departure, it may be argued that a core challenge for professional education is to stimulate and encourage students to connect to abstract bodies of knowledge.

LONGITUDINAL DATA

Studies on professional learning are first and foremost based on qualitative data. A discussion of the strengths and weaknesses of qualitative and quantitative data is beyond the scope of this chapter. The only claim here is that quantitative data may also be useful in shedding light on some general patterns that characterise professional education and learning.

One reason why there have been relatively few studies on the qualifying function of professional education is the lack of longitudinal data. Although certain data on the importance of education may be collected as retrospective information, it is reasonable to assume that such data will be subject to reinterpretation based on workplace experiences. Moreover, the reliability of information about the past is doubtful simply due to forgetfulness. One solution is to conduct comparisons based on data on groups from different stages in an educational and occupational career. However, consideration must then be given to the fact that patterns may be due to characteristics of the respective generations or cohorts rather than to the different stages in their careers. Moreover, cross-section analysis based on the same generation or cohort from different periods of time must cope with the problem of ecological fallacy. Patterns at the aggregated level provide no information about mechanisms at the individual level. It may, for example, be reasonable to assume that a difference in dropout rate between student groups is related to a corresponding difference in reported professional commitment when students enrol. Since we do not know whether dropout rates are higher among less committed students, this assumption may be wrong. Longitudinal data at the individual level is needed to shed light on such mechanisms, which often are highly complex and controversial.

The present chapter is based on studies drawing on a longitudinal Database for Studies of Recruitment and Qualifications in the Professions (StudData). The development of this database has been an important area at the Centre for the Study of Professions at Oslo University College to stimulate longitudinal research on professional learning, commitment and careers. The database is mainly composed of professionals from shorter programmes such as nursing, teacher training and social work, but physicians have also been included as an example of a traditional core profession. StudData consists so far of three panels or cohorts. Each student has been requested to respond to a questionnaire four times: when they commence

their programme of study (Wave 1), in their final term (Wave 2) and again three (Wave 3) and six years (Wave 4) after graduation. Since this database is being developed over a long time-span it takes time to finalise it. The studies reported in this chapter are based on the first three Waves[1].

In the following, three different case studies based on StudData are presented. These studies examine different aspects of the relevance of professional education. Two studies focus on specific phases: the first study examines the extent to which students *connect to knowledge* during their initial education, while the second study focuses on the challenges related to the *boundary crossing* between education and work. The third study examines *epistemic trajectories* focusing on relations between epistemic strategies developed during their initial education and professional learning at the workplace. The professional groups as well as some of the concepts and categories differ somewhat due to the focus in the respective studies.

CONNECTING TO PROFESSIONAL KNOWLEDGE DURING INITIAL EDUCATION

The first study (Smeby, 2007a) focuses on the extent to which students in different educational fields *connect* to professional knowledge during their initial education (Nespor, 1994). Students in nursing, teacher training and administration (business and public administration) are examined based on data from the two first Waves in StudData, at the beginning and end of their professional education.

Different Aspects of Knowledge

Professional knowledge comprises a number of different aspects including phenomena that are only or mainly possible to learn, criticise, disseminate and articulate through action (Grimen, 2008). As emphasised by Eraut (1994) it may be appropriate to use the term "knowledge" to address all aspects of knowledge and skills relevant to professional work in order to avoid becoming embroiled in definitional issues. Moreover, the distinction between theoretical and practical knowledge has become blurred (Henkel, 1994) and the question can be raised regarding the extent to which the different types of knowledge may be distinguished as separate and independent forms. To avoid a narrow understanding of knowledge, it is nevertheless useful to distinguish between different aspects. Several categories have been developed (Becher & Trowler, 2001; Bennett, Dunne, & Carré, 1999; Eraut, 1994; Squires, 2005; Stark & Lattuca, 1996). The study differentiates between *specific knowledge*, *practical skill* and *reflexivity*. A basic characteristic of professions is that they combine codified or propositional knowledge such as discipline-based theories and concepts, and practical process knowledge based on impressions, interpretations and experience (Eraut, 1994).

[1] Further information about the database is given in the appendix. More detailed information on design, response rates among the different professional groups as well as all questionnaires is available on: http://www.hio.no/studdata.

This corresponds to Ryle's (1949) classical distinction between "knowing that" and "knowing how." In this article the terms specific knowledge and practical skills are used to distinguish between these two aspects.

Schön (1983, 1987) introduced the term "reflection-in-action," which he claimed was essential as a mediation between theory and practice. He stressed the value of reflection in the development of knowing-in-action into knowledge-in-action. Eraut (1994) also argues that deliberate processes lie at the heart of professional work that involves intuitive as well as analytical thinking and discussion. A distinction may be made between different levels of reflection (Kember, 2001). Moreover, Beck (1992, 1994) distinguishes between reflection and reflexivity and uses the latter to refer to self-confrontation with the effects of risk society. It may be argued that reflexivity is particularly important in professional work because it is a way of opening up established ways of thinking, not just for improvement, but also for fundamental objections. Reflexivity may also be a way of recognising clients' and lay audience points of view as constructive contributions to knowledge. Here reflexivity is used in a broad sense to include various types of reflection.

One of the most striking findings in the study was the differences between the educational programmes. Nursing and teacher training students reported generally higher expectations for, and connected to a higher degree to, professional knowledge. Nursing students reported higher expectations for practical skills than teacher training students and the former also connected to specific knowledge and practical skills to a greater extent than the latter. On the other hand nursing students were more anxious about not mastering work tasks and expected that they would need more supervision when they started working than the two other professional groups. Students in administration are also more anxious about not mastering work tasks than students in teacher training. These differences between the professional fields could be an indicator of the quality of the respective programmes. In general, however, students in nursing are significantly less satisfied with their education than students in the other programmes (Terum & Mastekaasa, 2006). The difference between the programmes may therefore instead be due to differences between the respective professional fields. Focusing on the extent to which the occupational groups have developed an exclusive monopoly of task and their own unique knowledge base (Karseth, 2002), it may be argued that nursing is the most professionalised, while administration is the least. A study of trade unions' knowledge policy also confirms that the development of a professional knowledge base has been much more focused in nursing than in teaching (Karseth & Nerland, 2007). Degree of professionalism may therefore be one reason for the differences between the professions as regards their expectations and connection to knowledge. The reason why nursing students are more anxious about mastering tasks and expect that they will need more supervision and continuous observation than students in administration and teacher training may be that the consequences of making mistakes can be more dramatic in nursing.

Self Confidence, Prior Marks and Efforts

The study also examines various individual background variables. It turned out that male students had somewhat lower expectations than female students when it came to specific knowledge and practical skills, while there were no gender differences in terms of connection to knowledge and their expected challenges related to the transition from education to work. One reason why male students had somewhat lower expectations may have to do with self-confidence. Studies indicate, for example, that males tend to overestimate their mathematical competence relative to females (Correll, 2001). Such overestimation of one's own competence may result in underestimation of what they need to learn and lower expectations for educational outcome. Students' assessment of the transition from study to work is also, at least partly, a matter of self-confidence. According to the arguments above it is therefore not surprising that male students are less anxious about not mastering work tasks than female students and that the older students are less anxious than younger ones.

More surprising was the lack of significant relationships between prior marks and students' expectations and connection to knowledge. Research literature indicates that marks from upper secondary school are one of the best predictors of student success in higher education (Pike & Saupe, 2002). One reason why the results in the present study appear to contradict these findings may be that the professional programmes are more practically-oriented than traditional university programmes and that college students, therefore, consider achievements in upper secondary school of limited relevance for their expected outcomes. Moreover, professional programmes are generally more teaching-intensive and based less on students' own study activity than traditional academic programmes (Aamodt, 2003).

Research literature indicates that students' efforts, approaches and the manner in which they spend their time are important for their educational outcome (Carbonaro, 2005; Koljatic & Kuh, 2001; Pascarella & Terenzini, 2005; Prosser & Trigwell, 1999). This is not confirmed in this study. The reason why study efforts in terms of "hours used for study" and "study strategies" are positively related to students' connection to knowledge may be that students who participate in professional programmes adjust their efforts according to what is considered sufficient. Consequently, the results should not be interpreted as an indication that students do not improve their educational outcome if they use more time or if they develop more active and critical study strategies. Students' assessment of teaching quality, however, is positively related to their connection to knowledge in terms of specific knowledge and practical skills, while their assessment of the social climate among students is positively correlated to practical skills. The importance of social climate and integration is central in earlier studies, especially of student drop-out rates (Tinto, 1998). The significance of students' perception of teaching environment is also confirmed in the literature (Lizzio, Wilson, & Simons, 2002). A review of validity and reliability of students' evaluation of teaching indicates that students are apparently able to distinguish between their instructors' strengths

and weaknesses, at least when ratings are aggregated to cover many students (Marsh & Bailey, 1993).

Students' Motivation and Expectations

The study confirms that students' motivation and expectations have a significant impact on their connection to knowledge. Uncertainty in educational choice is negatively related to students' expectations for, as well as connection to, specific knowledge, practical skills and reflexivity. Moreover students' expectations for the three aspects of professional knowledge when they enrol are positively related to their connection to the respective aspects of knowledge in the final term of study. This corresponds with results from earlier research, which indicate that student motivation is positively related to performance, especially when it corresponds to discipline-specific goal structures (Breen & Lindsay, 2002) and perceptions of relevance to their future work (Lizzio & Wilson, 2004).

Terms such as "practice shock" illustrate that transition from study to work is difficult and a personal strain. This first study shows that students' connection to specific knowledge is negatively related to their anxiousness about not mastering work tasks, while their connection to practical knowledge is negatively related to their expected need for supervision. How newly qualified professionals assess knowledge acquired in higher education as well as the impact of education on further professional development is explored in the two next studies.

BOUNDARY CROSSING

The second study (Smeby & Vågan, 2008) examines the challenges related to "boundary crossing" (Engeström, 2001; van Oers, 1998) between education and work, focusing on the discrepancy between newly qualified professionals' assessment of acquired knowledge in higher education and their assessment of the knowledge demands in occupational practice. Data are drawn from Wave 2 (end of education) and Wave 3 (three years after graduation) in StudData. The focus is on two professional groups: newly qualified physicians and nurses. There are significant similarities between the occupational practices of nurses and physicians: their general obligation is to treat patients for various types of diseases within the same institutional contexts. Their tasks are not identical; there is a rather well-defined hierarchy and division of labour between these groups based on their respective professional knowledge base. Nevertheless, compared to other professional groups, their tasks, professional challenges, ethical dilemmas and knowledge bases share many of the same characteristics.

Physicians and Nurses

According to the perspectives of the sociology of professions, the aim of higher education is to train professionals into a specific knowledge base and to socialise them into a professional community with a certain ethical code. The educational

programmes qualifying for nursing and medical practice are, however, very different. Medicine was established as a professional education within the first medieval universities. Its breakthrough as a modern academic discipline first took place during the nineteenth century, when scientific knowledge began to have a decisive influence on the profession and its medical practice: clinical researchers started applying scientific methods in investigating the symptoms and underlying causal mechanisms behind disease. The well-established scientific knowledge base comprises constitutive bulk in its professional education and is one of the reasons why medicine has been considered as an ideal type in the sociology of professions (Abbott, 1988; Freidson, 2001; Parsons, 1968). Although continuous reforms place an increasing emphasis on earlier clinical and more practical and relational knowledge in the six-year long professional education, medical education has many of the same characteristics as other pure academic university programmes (Pauli, White, & McWinney, 2000).

Nursing education has a different origin. The establishment of nursing education from the mid-nineteenth century was closely related to the development of modern medical practice. The physicians needed professional assistance in their work. Three-year educational programmes were established in the beginning of the last century. Physicians were responsible for the theoretical part of the programmes and gave lectures in anatomy and physiology, while the practical-technical part was the responsibility of a senior nursing officer. Nursing education has been upgraded to higher education and nurses are to a great extent also responsible for theoretical part of the programmes (Fause & Micaelsen, 2002). The educational programme still lasts three years, however, and half of the curriculum consists of practice in hospitals and other medical institutions.

As pointed out in the first study, the question may be raised as to the extent to which different types of knowledge may by distinguished as separate and independent forms. Nevertheless, to avoid a narrow understanding of knowledge it is constructive to distinguish between different aspects. In addressing the theory-practice gaps there are three distinctive aspects that are central in nursing and medical practice: *codified*, *practical* and *relational* knowledge. While the first two correspond with the two aspects examined in the first study, the last is different. The discrepancy reflects that the two studies have a somewhat different focus. Moreover, whereas the three aspects in the first study are related to single items in the questionnaire, the three aspects in this second study are based on indexes.

Comparisons of newly qualified nurses and physicians facilitate examination of the extent to which curriculum characteristics as proportion of practice reduce the discrepancies between what is acquired in higher education and what is required in occupational practice. They also provide indication of the types or aspects of knowledge that are best learned in higher education and those that are best learned in occupational practice.

Knowledge Gaps

In general newly qualified nurses and physicians report relatively high demands in occupational practice for all forms of knowledge. The profile of the knowledge demands in occupational practice also exhibits very similar patterns among nurses and physicians. Nevertheless, there are some differences. When it comes to codified knowledge, nurses report a somewhat higher demand for planning and organisational knowledge than physicians, while physicians report a somewhat higher demand for professional specific knowledge, also indicated by Prince et al. (2005). Nurses further report somewhat higher demands for most of the indicators on practical and relational knowledge.

The assumption that the differences in curriculum characteristics between nursing and medical education have implications for their respective educational outcomes is only partly confirmed, however. Physicians report that they have acquired a somewhat higher level of "general" and "specific knowledge" than nurses, while nurses report a higher outcome in terms of "planning and organisational knowledge." There are no difference between these groups with respect to "insight into rules and regulations." Contrary to our assumption, nurses acquired a somewhat lower level of practical knowledge than physicians in terms of "ability to work under pressure" and "ability to work independently."

These patterns become even more significant when we look at the gaps between knowledge acquired in professional education and knowledge demands in occupational practice.

Nurses report knowledge gaps to a greater extent than physicians. It is not surprising that nurses report greater gaps in terms of codified knowledge. But nurses also report the greatest gaps in terms of all aspects of practical knowledge, especially "ability to work under pressure." The differences in gaps in terms of relational knowledge are less significant. Another study based on the same data material shows that knowledge gaps are significant among newly qualified teachers and social workers as well (Heggen, 2008). Teachers report a somewhat greater gap than nurses and social workers with respect to relational knowledge, while nurses report a somewhat greater gap with respect to practical knowledge than the two other groups.

The high level of codified knowledge among medical students also appears to be a resource with respect to practical challenges and, in particular, the ability to work under pressure. Moreover, as emphasised in the introduction of this chapter, science and more abstract forms of knowledge play an important role in the development of professionalism. Therefore, strengthening nursing students' knowledge in basic subjects (physiology, pharmacology, ethics and psychology) may increase their professional confidence and provide them with perspectives for understanding, reflecting on and elucidating pressured situations at work. This, as opposed to more practical training, may be what nurses need to help them act in a strained work environment.

The discrepancies between newly qualified nurses' and physicians' assessment of knowledge demands in professional work and knowledge acquired in education

are in accordance with the gaps discussed in the literature (Gerrish, 2000; Landers, 2000; K. Prince, Van de Wiel, Van der Vleuten, Boshuizen, & Scherpbier, 2004; Ramage, 2002). The reasons cited for the gaps, as well as initiatives to bridge the divide, are many. However, it is also pointed out that classroom theory can never truly mirror real-life situations (Landers, 2000) and these theory-practice gaps may in part be explained by the fact that education and work are significantly different learning contexts (Gerrish, 2000; Gillespie & McFetridge, 2006). Moreover, the gaps may also be viewed positively as a means of developing students' problem-solving skills (Corlett, 2000).

When students develop and enter the role of professional practitioner the "stuff" of learning activity in higher education become "mediating means" at work (Le Maistsre & Paré, 2004) and requires new learning where knowledge undergoes various forms of transformation (Daley, 2001). Knowledge has to be recontextualised. The boundary-crossing perspective implies that the theory-practice gaps can never be removed completely since the gaps are not merely the result of failure in the delivery of knowledge from classroom to clinical practice (Rafferty, Allock, & Lathean, 1996). Moreover, boundary-crossing is not just challenging and problematic. It also provides expanding and constructive learning processes (Engeström, 2001; Guile & Young, 2003).

Recontextualisation

Van Oers (1998) distinguishes between recontextualisation in a horizontal and a vertical sense. Horizontal recontextualisation takes places when one is doing something familiar in a new setting, for example when students who have been trained in giving injections using oranges are going to give injections to human beings the first time. Recontexualising knowledge in a vertical sense take place when individuals or groups use problems that occur while performing tasks as a basis for developing new patterns of activity. An example can be when theories on reason for variations in body temperature learned in an educational context are used as a basis for making a diagnosis in a practical setting. The boundary-crossing perspective (Engeström, 2001; van Oers, 1998) relates to a somewhat different theoretical perspective than the concepts of "connection to knowledge" (Nespor, 1994) and "knowledge cultures" (Knorr Cetina, 1999, 2006). Nevertheless, these perspectives may complement each other since the latter do not address the challenges related to the situated aspects of knowledge.

Our study indicates that training in recontextualising knowledge is important. Students reporting that relevance and employability was emphasised in their education programme appear to be more equipped to recontextualise their educational knowledge in genuine, practical contexts in both a vertical and a horizontal sense. Training in recontextualising theoretical medical knowledge of medications, learned in lectures and books, for treatment in practical contexts is an example of training for vertical recontextualisation. Executing procedures and skills rehearsed in nursing educational laboratories in real situations is an example of horizontal recontextualisation. Newly qualified nurses who have undergone

sufficient "lab-learning" are probably better prepared to perform similar activities in new real-life situations, which often involve time pressure and concerned patients. Moreover, we found that students who reported having an active and critical study strategy are more likely to be able to resituate acquired practical knowledge into real practical context both vertically and horizontally. An example of the latter could be students who develop critical attitudes towards the subject matter. By expanding their coursework, moving beyond what is compulsory and expected from reading lists, students develop an understanding and an ability to reflect on practical problem-solving that is not limited to the simple "know how" of practical procedures. Students developing interrogative and critical attitudes as an integral part of their practical training and professional practical knowledge may experience horizontal recontextualising as less problematic. Hence educational programmes that promote and stimulate students into developing active and reflexive attitudes towards the subject matter, and focus on the relevance of what is learned for practical problem-solving, probably lessen the burden for newly qualified professional.

Finally, some aspects of knowledge seem to be more difficult to recontextualise horizontally than others. Such knowledge is probably best learned and developed in professional practice. Our results suggest that this is particularly the case with respect to relational knowledge. Learning to cooperate, communicate and conduct ethical deliberations are important parts of practical and practice-based training in relational knowledge for medical students and nursing students. However, recontextualising these skills into work contexts as a newly qualified physician or nurse with a professional responsibility constitutes a challenge that may be too difficult to recreate realistically in an educational context. Preparing for "real life in clinical settings" (Baxter & Rideout, 2006) must therefore be developed in professional practice. Medical students carry out a preliminary internship under the professional guidance and supervision of a senior physician, but this is not the case for nurses, at least not in Norway. It is reported that one of the obstacles to further development of professional knowledge among nurses is the lack of dialogue and reflection on work experiences, among other things, due to the time-pressure among employees (Bjørk, 1999). The challenges of horizontal as well as vertical recontextualisation, illustrate the importance of workplace learning among newly qualified professionals.

EPISTEMIC TRAJECTORIES

The third study Smeby (2006, 2007b) examines the extent to which students' epistemic strategies developed during initial education in nursing and teaching relate to their epistemic strategies in professional work. While the second study focused on the challenges related to "boundary crossing" between education and work, this third study follows up the perspective examined in the first study, focusing on the extent to which students' "connection to knowledge" (Nespor, 1994) transcends the different local contexts constituting "epistemic trajectories"

(Lahn, 2010). For an examination of differences between nurses and teachers in the assessment and use of knowledge sources, see Klette and Smeby (in this volume).

Assessment of the Importance of Different Knowledge Sources

In general the newly qualified nurses and teachers report that organised training, structured supervision, informal contact with colleagues and specialist literature are of significant importance to their professional development. Structured supervision is considered somewhat more important than the other sources, but the differences are rather insignificant. The professionals' assessment of the importance of specialist literature is positively related to an active and critical study strategy during their initial education as well as their professional interest and job requirements, while marks from upper secondary education were not significantly related. Their assessment of the importance of the other knowledge sources, however, was not related to any of these variables. Since the professionals' epistemic strategies appear to be developed at college and not before they were enrolled, our data indicate that initial education plays an important role in connecting professionals to an abstract body of professional knowledge (Nespor, 1994; Smeby, 2007a).

Professionals' assessment of the importance of the various knowledge sources involves their *attitudes and values*. To measure what they actually *do*, the frequency with which they consulted various knowledge sources when confronted with demanding tasks was also examined.

Use of Different Knowledge Sources

The newly qualified professionals were asked how often they consulted superiors or colleagues, external experts, specialist literature and the Internet when they were confronted with difficult tasks in their ordinary work. Examination of the relationship between various individual characteristics and the use of the different knowledge sources shows many of the same patterns as the analyses of the assessment of the importance of various knowledge sources above. The use of specialist literature is significantly related to an active and critical study strategy during initial education, professional interests as well as local expectations at the workplace. Job requirements and being employed full time are not, as it turns out, significantly related to the use of this type of knowledge source. This corresponds to the perspective highlighted in the first study that students get connected to knowledge along trajectories where representations such as textbooks, lectures and technical instruments are mobilised (Nespor, 1994).

The use of superiors or colleagues and external experts, on the other hand, turns out not to be related to an active and critical study strategy during initial education and professional interest. Rather, the use of both these knowledge sources is significantly related to job requirements, and not surprisingly the use of superiors or colleagues as a knowledge source is also related to local expectations. Finally the use of the Internet seems to be significantly related to all these variables,

indicating that the use of this knowledge source is related to individual epistemic strategies as well as workplace characteristics. Nevertheless, the analysis of the use of various knowledge sources shows more or less the same patterns as the analyses of the professionals' assessment of their importance. Specialist literature is first and foremost related to the professional's epistemic strategies developed during initial education as well as his or her professional interest, while the use of collegial knowledge sources primarily relates to workplace characteristics. Just as in the analyses of the importance of the various knowledge sources, marks from upper secondary school appear not to be of any significant importance for use of any of the knowledge sources.

Time Used for Reading

Finally the newly qualified professionals were asked about their use of time for reading professional journal and articles, books and works of reference and other type of information on the Internet. These variables could be considered to be a more concrete measure of the frequency of consulting professional literature examined above. There is an important difference, however: while the professionals were asked about the frequency with which they consulted professional literature when they were confronted with demanding task, they were asked how much time they used for reading professional literature irrespective of their reason for doing so. It is, therefore, reasonable to assume that time used for reading is even more dependent on epistemic strategies developed in initial education and professional interests. There may, however, be some differences when it comes to reading of the different types of literate sources.

Analyses show that the only variable related to reading all three types of knowledge sources is own professional interest. An active and critical study strategy during initial education is positively related to reading books and works of reference as well as information on the Internet, while job requirements are positively related to reading professional journals and articles and information on the Internet. Marks from upper secondary school appear not to be significantly related to reading any of these literate sources. It seems reasonable that an individual interest is of particular importance to how much time professionals use for reading. The reason why reading professional journals and articles is not related to an active and critical study strategy in initial education may be that reading such types of specialist literature is not emphasised during education. Job requirements may therefore be of greater importance for time used for reading journals and articles.

Epistemic Strategies

The examination of newly qualified teachers' and nurses' assessment of various knowledge sources for their professional development as well as the frequency with which they consult such sources show that epistemic strategies developed during initial education and individual interests are of significant importance with

respect to the assessment as well as the use of literate knowledge sources, while the assessment and use of collegial knowledge sources mainly relates to workplace challenges and characteristics. The use of literate knowledge sources and reading, which are epistemic strategies mainly related to codified knowledge, traverses the two contexts. This may indicate that students who connect to the abstract body of professional knowledge during their initial education to only a limited extent (Nespor, 1994; Smeby, 2007a) will also connect weakly to literate knowledge sources in professional practice.

The strength of schooling is generally assumed to be its efficiency in systematic transmission of ideas and information (e.g. Sullivan, 2005). The socialising role of higher education is also important, however. As pointed out by Jensen and Lahn (2005) the knowledge base in nursing education is not only composed of technically relevant knowledge, but also of rather abstract philosophical theories of care which turn out to be an important basis for nursing students' identity. They suggested that such closer links to science and more abstract forms of knowledge may carry the seeds of renewal and ensure that professionalism remains a socially responsible and vital way of organising and controlling work. From such a perspective the responsibility of professional education is not just to disseminate a core body of abstract and practical knowledge which is technically relevant for professional practice. The challenge is also to meet students' expectations and stimulate their curiosity in a way that connects them to professional knowledge (Nespor, 1994). Moreover, the emotional and ideological role of knowledge has to be emphasised in the development of curricula.

The lack of relationship between epistemic strategies developed in professional education and the assessment and use of collegial knowledge sources is also interesting from a trajectory perspective. The second study presented indicated that some types of knowledge (e.g. relational knowledge) are more difficult to recontexualise between an educational and workplace setting than codified knowledge (van Oers, 1998). The third study shows that also a collegial epistemic strategy appears primarily to be developed in an occupational context.

THE RELEVANCE OF PROFESSIONAL EDUCATION

As pointed out in this introduction of this chapter, one of the key characteristics of professions is that they are based on a body of abstract codified knowledge obtained in some kind of university or university-like institution, but the research literature gives no clear evidence whether higher education has a primarily qualifying or credential function (Bills, 2004). The two perspectives are not fundamentally incompatible, however (Evetts, 2003; Freidson, 2001). The aim of this chapter has therefore been limited to exploring the extent to which professional education programmes have a qualifying function.

Freidson (2001) emphasises that ideal-typical professional schooling is to strengthen the students' commitment to and identification with the occupation, not just to teach a specific body of professional knowledge. Moreover, he stresses that the institutionalisation of professional education in universities or university-like

institutions encourages critical thought rather than acceptance of received ideas and methods. The perspectives and results presented in this chapter support this view of the role of professional education, at least to some extent. Focusing on epistemic trajectories, it has been emphasised that the role of higher education is not limited to transmission of a body of codified knowledge but also serves to connect the students to knowledge (Nespor, 1994) or epistemic cultures and machineries of knowledge to use terms developed by Knorr Cetina (1999, 2006). The significant relationship between the use of literate knowledge sources in professional practice and epistemic strategies in terms of an active and critical study strategy as well as educational outcome during professional education indicate that these perspectives are relevant to understanding the role of professional education. The quantitative data, however, do not shed light on the complex processes by which students connect to knowledge as well as epistemic cultures.

The results presented also show that epistemic trajectories in the professions are not just a matter of connecting to an abstract body of knowledge. Students who find that relevance and employability is emphasised in the educational programmes appear to connect to professional knowledge to a greater extent and appear to be better equipped to recontextualise their educational knowledge in practical contexts. Knorr Cetina has developed her perspectives on epistemic cultures based on studies of scientists in physics and biology. Nespor (1994), too, is inspired by framework developed in sciences studies. His focus is also limited to educational contexts and he does not address the challenges related to knowledge demands in occupational contexts. Professions are characterised by combining "knowing that" and "knowing how." Relevance rather than cognitive boundaries is the constituting basis for a professional field (Smeby, 2008). The concepts of boundary crossing (Engeström, 2001) and recontextualisation (van Oers, 1998) may be appropriate for including the significance of practical relevance in studies of epistemic trajectories among professionals.

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KIRSTI KLETTE & TONE CECILIE CARLSTEN

KNOWLEDGE IN TEACHER LEARNING: NEW PROFESSIONAL CHALLENGES

INTRODUCTION

How are teachers equipped to meet the new challenges of continual learning in the knowledge society as a professional group? As Feinman–Nesmer (2001), Borko (2004) and others have pointed out, if we want schools to offer powerful learning opportunities, we have to provide more powerful epistemic environments for teachers. Such environments are both grounded in a conception of learning to teach as a lifelong endeavour and designed around a continuum of teacher learning opportunities. In this chapter, we apply insights from the sociology of knowledge to seek answers to questions that are frequently raised in concurrent discussions of professional development (Ball & Cohen, 1999; Hiebert et al., 2002; Borko, 2004; Koellner et al., 2007; Timperly & Alton Lee, 2008; Horn & Little, 2010). The analysis is based on interviews and log material from Norwegian novice teachers' experiences in the transition from their initial training to assuming their role as newcomers in their workplace.

Since the 1980s, research on teacher learning has been characterised by an emphasis on experience-based and individual knowledge, i.e. shared skills and understandings within local community settings (Hargreaves, 2000; OECD, 2003; Borko, 2004; Little, 2002). Also, Ball and Cohen claimed in their contribution to Teaching as the Learning Profession: A Handbook of Policy and Practice (1999): "In the absence of these key resources, the system limps along, with teachers collecting material from a wide range of sources, their teaching experience the principal site for their individual and idiosyncratic development" (1999, p. 5). What has typically been explored is the manner in which teachers perceive their own professional learning (Fishmann et al., 2003), and how they express their attitudes and epistemological beliefs within daily practices (e.g. Elbaz, 1991; Clandinin & Conelly, 1991; Van Manen, 1994; Doyle, 1997). The idea of teachers as reflective professionals (Schön, 1983, 1987) captures the essence of this approach. However, when attempting to explain how teachers meet the challenges of the knowledge society, it is not enough to examine professional learning as a matter of personal belief, individual opinion and reflection. This emphasis on communicative dispositions and personal skills downplays the crucial role that abstract and theoretical knowledge play in the development and continuous revitalisation of professional expertise. A central issue we raise in this chapter is how to provide support structures for teachers as they collectively develop their profession towards a situation in which abstract knowledge works together with

K. Jensen et al. (eds.), Professional Learning in the Knowledge Society, 69–84.

experience-based knowledge, in what Foray (2001) and others have described as "epistemic communities."

Bernstein (1996), Beck (1992), and Drucker (1993) have noted that the relationship that practitioners have to abstract and theoretical knowledge is a driving force behind professional development in post-industrial society. The dynamic relationship to knowledge that recognises workplace learning as "object-centred" is also emphasised in recent studies on technological and scientific work (Latour & Woolgar, 1979; Knorr Cetina, 1997, 1999; Pels et al., 2002). Blackler (1995) follows the same line of argumentation, and stresses that the dichotomy between differences in knowledge types should be downplayed, with focus instead directed at the way in which abstract knowledge works together with experience-based knowledge. Inspired by these insights, we challenge the traditional divide in empirical research on teachers' learning as individual and experience-based vs. teachers' learning as abstract and theoretical. Rather, we discuss how existing professional communities in teaching could profit from being more embedded within a theoretically framed workplace.

Supported by reviews of research on teachers' professional expertise (Borko, 2004; Penuel et al., 2007; Timperly & Alton Lee, 2008; Grossman & McDonald, 2008), we claim that the role of abstract and theoretical knowledge has been clearly emphasised in recent studies of strategies of professional learning among teachers. In this chapter we add to this discussion by presenting an analysis of the extent to which novice teachers are equipped to meet the challenges of dealing with rapidly changing knowledge and expertise. How do established knowledge practices and knowledge sources within the teaching profession facilitate, stabilise and support emerging epistemic challenges? We address these research questions through analyses of learning logs and interviews with novice teachers from Norwegian comprehensive schools. The data are drawn from the more extensive material compiled under the ProLearn project, which analyses professional learning across professions (cf. introduction to this volume).

We will examine the dilemmas and tensions that novice teachers face in their attempts to deal with a wide variety of professional tasks on the basis of what is apparently a workplace characterised by weak theoretical orientation (Ball & Cohen, 1999; Hargreaves, 2000; Nelson, 2000; Grossman & McDonald, 2008) and a highly individualised work culture (Lortie, 1975; Little, 1990; Klette, 1998; Hargreaves, 2003). We aim to take stock of some of the crucial challenges facing the expectations of teachers today, as they encounter the demands of the knowledge society. First, we clarify the meaning and significance of teachers' learning context and contemporary epistemic challenges. The analytical framework is mainly derived from developments in the field of the sociology of knowledge, from which we take central concepts focusing on the role of knowledge in organising work and learning. We apply these perspectives in our examination of three sets of challenges that form an analytical, interpretive account of teacher learning as a collective endeavour: attraction and recruitment patterns to teacher education; features of teachers' workplace knowledge culture; and the knowledge sources and mediating tools and instruments currently available in teachers'

workplaces. We discuss our findings on how teachers' knowledge ties influence their encounters with new epistemic challenges, and conclude that teaching as a profession suffers from weak knowledge ties both at the individual and at the community level. On the one hand, our findings show that teachers expect to engage in continuous and lifelong learning. However, their accounts also indicate that their learning environments lack some of the crucial elements needed to stimulate and support such continual professional learning. Relevant elements would include more adequate knowledge resources, and systematic infrastructure for supporting learning at the community level. In addition, better mechanisms of diffusion are needed between the practices of research and theoretical knowledge production, *and* workplace learning.

THE THEORETICALLY FRAMED WORKPLACE?

It has traditionally been argued that professions hold an exclusive position in relation to knowledge domains and expertise (cf. Larsson, 2007; Abbott, 1988; Freidson, 2004). Recent developments in knowledge production and distribution have a dual role, as they both challenge and strengthen the privileged position of domain-specific expertise in the professions. As rapid changes in knowledge dissemination underscore the role of abstract and mediated knowledge, one of the key issues in professional expertise today is to empower professional groups to have their own strategy for facilitating and demarcating the limitations of knowledge.

Knorr Cetina (2003) is one of the sociologists to claim that knowledge is the crucial constitutor in post-industrial society: "[…] knowledge has become a productive force replacing capital, labour, and natural resources as the central value and wealth-creating factor" (op. cit., p. 6). Knorr Cetina's work (e.g. 1997) has also identified objectual knowledge as a key dimension of contemporary knowledge development. Based on empirical observations from laboratory scientific work, she argues that the rise of modern science has provided for and reinforced new forms of object-centred relations, extending the social ties previously secured by and within more weakly framed expert communities. According to Knorr Cetina (1997), the functions and foundations of such epistemic cultures are currently diffusing into other communities such as the professions and semi-professions. In this chapter we apply her perspective in our analysis of the empirical material in order to explore what constitutes a theoretically framed workplace for teachers.

First, however, let us take a closer look at the different forms of knowledge that may come into play in the theoretically framed workplace as outlined by Knorr Cetina (1999), Foray (2001) and others. Blackler (1995) differentiates between five modes of knowledge relevant for studying professional expertise and professional work in late modern societies: i.e. *embrained, embodied, encultured, embedded* and *encoded* (op. cit., p. 1023). *Embrained knowledge* is a knowledge mode dependent on conceptual skills and cognitive abilities often labelled within the terms of abstract knowledge (cf. concepts such as "knowing that" / "knowing about" / "declarative knowledge"). *Embodied knowledge* is performance and action-

oriented, and is likely to be only partly explicit (i.e. knowing how, tacit knowledge, procedural knowledge). Embodied knowledge is acquired by doing and is rooted in concrete and specific contexts. *Encultured knowledge* is knowledge processing within collective systems of shared understanding. Such understanding is dependent on language and discursive practices, and is socially constructed and open to negotiation. *Embedded knowledge* is knowledge which resides in systemic routines and procedures. Embedded knowledge is closely linked to social and institutional arrangements. It is linked to the relationships between technologies, roles, formal procedures, and emergent routines. *Encoded knowledge* involves information systems conveyed by signs and symbols, such as books, manuals and codes of practice based on textual and electronically mediated material. Although Blackler himself criticises this categorisation, saying that it pays more attention to diverging distinctions than to the relationships of agreement that constitute post-industrial knowledge work, he still holds that current interests in knowledge and knowledge work mark a change in contemporary society away from knowledge as embodied and embedded to knowledge that is embrained, encultured and encoded (1995, p. 1022).

Professional work draws on all these sources of knowledge – with certain distinctive traits and fashionable features figuring within different periods. Following Blackler's modified argumentation, we find the claim made by Drucker that "knowledge [is now] being applied to knowledge itself" (Drucker, 1993, p. 45). In the knowledge society, knowledge has become *the* resource rather than *a* resource (ibid). Accordingly we observe a shift in focus, moving from embodied and embedded knowledge towards embrained and encultured knowledge. We find it fruitful to combine the ideas of Knorr Cetina with the argumentation of Blackler and Drucker that abstract and theoretical knowledge are beginning to assume a more privileged position within professional work. Of special interest is how teachers – as professionals – meet and draw on the changing roles of knowledge.

STUDYING EPISTEMIC PRACTICES AMONG TEACHERS

It is clear from the reviews of teachers' professional expertise mentioned earlier that the role of abstract and theoretical knowledge is being downplayed. Such epistemic perspectives are, in fact, barely discussed and brought to the fore in the research on teachers' professional knowledge literature (Grossman & McDonald, 2008; Rowan et al., 2002; Bryk et al., 2010). As noted, however, the role of abstract knowledge has been widely acknowledged and debated within organisational and sociological studies (Blackler, 1995; Drucker, 1993; Foray, 2001; Knorr Cetina, 1997, 1999; Latour & Wolgar, 1979). In the analyses that ensue we aim to combine approaches from studies of teachers' professional knowledge with perspectives from the sociology of knowledge to understand the epistemic practices novice teachers are challenged with today.

According to Knorr Cetina, epistemic cultures are object-mediated and based on object-centred relations, rather than person-centred relationships (1999, p. 243). As such, they exemplify a theoretically framed workplace. It should be noted that

Knorr Cetina has developed her concepts based on studies of laboratory scientific work in bounded systems. However, she argues that such epistemic strategies are in a state of "spill-over" to knowledge work in general. Therefore, we apply this argumentation as we explore knowledge work within the teaching profession. Epistemic cultures as outlined by Knorr Cetina are characterised by their "liminal approaches to truth" – they are knowledge cultures that have an inherent apparatus for demarcating the limitations of knowledge through the working methods of *unfolding, framing and convoluting strategies* (op. cit., p.71).

The incomplete and *unfolding* character of knowledge objects is what gives the objects their energy, attraction and enchantment (ibid). Epistemic objects are always in the process of being materially defined. They continually acquire new properties and change the ones they have. It is this open and unfolding feature of epistemic knowledge that puts new demands on the subjects and systems of knowledge engagement, and that accounts for creative performance and strong personal commitment in expert work (Knorr Cetina, 1997). In this chapter we ask how knowledge objects may be seen as a factor in shaping teachers' workplace learning opportunities.

In early articles Knorr Cetina discusses the knowledge-seeking processes ascribed to expert cultures as a largely mental disposition, i.e. the will and ability to enter into looping practices. She pays less attention to the instruments and material infrastructure supporting and surrounding these practices. In later work (1999), however, attention is drawn to framing and convoluting practices accompanying unfolding processes central to epistemic practices. *Framing* as an epistemic strategy refers to the consideration of objects and pieces of information in light of other components. The strategy serves to check, control, extend or compensate for former pieces of information. Through framing, different components of an experiment or of the field are related to one another (op. cit., p. 72). In order to explain how teachers are equipped to meet the new challenges of continual learning in the knowledge society as a professional group, we therefore look at the knowledge sources, instruments and other theory-mediated objects that are available to them in their workplace. These instruments should be of a nature that supports the unfolding processes as well as informs the mechanisms found in regulation, i.e. strategies of quality assurance and accountability on a professional community level. In Knorr Cetina's conceptualisation this is referred to as convoluting strategies.

Convoluting means folding something together. Convoluting is a special form of framing – a way to push the framing method to its limit (op. cit., p. 76). Convolution as an epistemic plan describes the general strategy of mixing resources that come from different origins "… in an attempt to come to grips with the limitations of specific data or approaches" (ibid). It is a strategy of framing rather than a strategy for testing out specific theories. Convoluting is "… a strategy for generating experimental outcomes in a world that refers back upon itself and seeks recourse in manipulation its own components" (op. cit., p. 78). As such, convoluting strategies refer to the epistemic infrastructures regulating the profession. Emphasis is placed on aspects found within and around knowledge

resources themselves rather than those that are external to professional learning as an epistemic practice.

In the empirical analysis to follow, we link the two research foci dealing with features of teachers' workplace knowledge culture and their knowledge sources and mediating tools in a discussion of how the three limitation strategies of unfolding, framing and convoluting play out within the teaching profession, as expressed from the point of view of novice teachers. In order to make a critical examination of our third research focus on attraction and recruitment patterns to teacher education, a brief introduction is given to the role that knowledge mediation plays when it comes to fostering expertise in teaching.

TEACHERS' ENGAGEMENT WITH KNOWLEDGE

Teaching has a long history as a mainly normative and ideologically-driven profession with weak ties to empirical research and investigations. Teachers rarely draw from a shared empirical and theoretically-driven knowledge base to improve their practice. They do not routinely locate and translate research-based knowledge to inform their efforts (Grimmet and MacKinnon, 1992; Huberman, 1989; Richardson & Placier, 2001). As novice teachers begin to examine their students' learning of the curriculum, for example, they rarely search the research archives for help in interpreting their students' conceptions and misconceptions, plotting their students' learning trajectories, or devising alternatives that are more effective in helping their students master the curriculum.

Significant studies document that the knowledge teachers use is of a very different kind than that normally produced in laboratories and research communities (Lortie, 1975; Schön, 1983; Huberman, 1985; Leinhardt, 1990; Clandinin & Conelly, 1991; Elbaz, 1991; Eisner, 1995; Doyle, 1997; Cochran Smith & Lytle, 1990; Cochran Smith & Zeichner, 2005). Called "craft knowledge" by some, teachers' knowledge is characterised more by its concreteness and contextual richness than its generalisability and context independence. Paraphrasing existing literature, teachers' professional knowledge is described as practical (Leinhardt, 1990), personal (Elbaz, 1991), concrete and specific (Doyle, 1997), integrated (Eisner, 1995), narrative (Clandinin & Conelly, 1991) and reflective (Schön, 1983, 1987). This resembles what Blackler (1995) described as embodied and embedded, which is linked to shared skills and understandings typically understood as tacit and/or embodied. Abstract and theoretical knowledge is either taken for granted or pushed into the background in these studies. Objectual knowledge and knowledge linked to technologies, tools and other mediated artefacts are equally poorly recognised.

In his classical study "Schoolteacher. A sociological study" dating back to 1975, Lortie claims that teachers and their knowledge sources are characterised by three basic orientations which impede and frame their professional orientation and potential development – *presentism, conservatism* and *individualism*. *Presentism* combines with *individualism* and inhibits work with others in the search for common solutions, thus constraining the development of teaching as a

collaborative and reflective practice. This combination also gives priority to the interpersonal role over the engaged and creative involvement with knowledge. *Conservatism* Lortie links to recruitment patterns, organisational features of the workplace and available knowledge sources. He documents how dominant reward systems in teaching derive warrants primarily from interaction with children and youngsters – what Lortie labels interpersonal and psychic rewards (op. cit., pp. 39-40). Structural and cultural aspects of the professional commitment emphasise the use of psychic rewards as a primary reward mechanism in teachers' work. As a profession, teachers are involved with knowledge and its diffusion; their work has often been described as "an art of knowledge mediation" requiring special sensitivity to context and a high degree of personal creativity. Involvement with knowledge and the call for creativity could therefore quite logically serve as the lens of attraction to teaching, Lortie suggests (op. cit., p. 28). It is therefore interesting he continues, " … that neither of these aspects of the role receives as much attention as the interpersonal" (ibid.).

Although Lorties' study is more than three decades old, his sociological account of the schoolteacher is still taken into consideration in debates about teachers, teachers' work and knowledge (Bransford et al., 2005). We argue, however, that changes and challenges in the knowledge economy such as those suggested by e.g. Blacker and Knorr Cetina point to changes in knowledge production and knowledge itself that cannot be interpreted using Lorties' conceptualisation. If we wish to look at teachers' engagement with abstract and theoretical knowledge, we must therefore incorporate additional considerations into our research design. For instance, essential in Knorr Cetina's accounts of epistemic cultures and "the theoretically framed workplace" is the presence of knowledge building and epistemic commitment in a long-term perspective. Warrants are linked to the long-term accumulated processes rather than "quick wins" here and now. This is therefore a focus to be explored in a study design examining how the established knowledge practices and knowledge sources within the teaching profession support and facilitate emerging epistemic challenges.

In order for novice teachers to understand and navigate as young professionals in this landscape, an epistemic infrastructure that both regulates and stimulates further learning processes is required. In the following sections we present our empirical analyses and findings. We start out with a general account of how the novice teachers characterise their workplace, then move on to teachers' attraction and recruitment patterns. After a description of teachers' knowledge cultures as portrayed in the data material, we conclude the empirical analyses with an analysis of the learning resources available to teachers in the workplace.

METHODOLOGY

The analyses draw on learning logs and qualitative interviews with ten novice teachers working in ten Norwegian primary and lower secondary schools. The material is part of a larger four-year research project designed to compare teachers' professional learning with that of nurses, computer engineers and accountants. The

informants have been selected on the basis of the longitudinal Database for Studies of Recruitment and Qualifications in the Professions (StudData) in Norway. The informants were interviewed twice, first individually and then as part of a focus group interview the following year. The same informants were also asked to fill in precoded learning logs covering 24 days of work in the period between the interviews.

The interviews were transcribed into qualitative data analysis software (Atlas.ti) and conceptually aligned with the theoretical framework of the ProLearn project (see interview guide in the appendix). This level of cross-professional analysis paved the way for a more contextual text-sensitive interpretation of the teacher interviews.

The learning log material covered two periods of the school year, late autumn and late winter respectively. The precoded learning logs were designed to provide us with insights into teachers' alignment with knowledge sources.

In our representation of the data we draw on the individual interviews, group interviews and the logs. The findings are presented as thematic and codified summaries, and these findings are supported by more concrete quotations and illustrations.

PRESENTATION OF FINDINGS: NOVICE TEACHERS TALKING

All our respondents were working in the comprehensive school system. Six of them taught at the primary level and four had positions at lower secondary level. Altogether our novice teachers covered grades 1-10 within the compulsory educational system in Norway.

Within a selection that has taken gender, school level and subject matter into consideration, our informants speak as a relatively unified professional group when it comes to characterising their workplace: They describe their colleagues as "inclusive and tolerant," and their workplace as being pervaded by a "good and friendly atmosphere." When novice teachers talk about their own learning in the workplace, they enthusiastically tell how their colleagues – especially those working in the same grades or in the same team – are open-minded and willing to share their experiences, tips and practical solutions with the newcomers. The informants refer to their own work situation as productive and supportive when it comes to being able to "ask whatever and whenever," as one of them says. These main features are mutually strengthened when we compare data from individual and focus interviews with data from the learning log material. On the whole, these modes of collaborative professional sharing and informal knowledge exchange mechanisms are based on practical problem-solving and practical tips on a day-to-day basis, according to our teachers.

In the following, we pursue these features of novice teachers' workplace learning by exploring three interrelated themes: Attraction and recruitment patterns, features of teachers' workplace knowledge culture; and the knowledge sources and mediating tools and instruments currently available in teachers' workplace settings.

MYSELF AS A PROFESSIONAL: ATTRACTION AND RECRUITMENT PATTERNS

All informants document a strong dedication to becoming a schoolteacher. Although only a few of them had teaching as their first preference for occupation preference, several of them state that "it had always been there as an opportunity." The following statement from a young male teacher illustrates this: "Well, it was really a bit coincidental. I had always thought about whether it would be an option. But then I had a year where I just tried to work as a journalist and then as a teacher simply to try it out and find my preference. And then it turned out that teaching was more fun."

When we asked the informants to look back and clarify their pathway into their professional preferences, most of them recognised what might be described as a "continuous theme" regarding their choice of the teaching occupation. "I have always found pleasure in interacting with other people and especially children," several state. They refer to mothers, aunts and others in their home environment as signifiers for own preference of occupation. In addition, some of the female teachers made explicit claims about how they wanted to be trained in an occupation where it would be possible for them to combine work with family life. Although only two of our respondents had had teaching as their primary preference for a future career, all of them indicate that the possibility of becoming a teacher had been there as a sort of "second option" during their entrance to early adulthood. After making the choice to pursue educational training, all novice teachers display a strong dedication and commitment towards their career of choice. As one of our teachers mentions: "After I made my final decision I knew it was meant to be."

When asked about their reasons for becoming a teacher, all the interviewees paraphrase the interpersonal theme highlighted by Dan Lortie: being part of an encounter with children and youngsters. They either draw attention to interpersonal work as being of special value to them and/or combine this argument with an interest in connecting with and assisting children and young people in learning. One informant puts it like this: "[There is just this] pleasure rooted in working with young people and children." Another one emphasised the "dynamics and forces inherent in being together with youngsters." Several refer to the joy of being a part of the students' learning processes, "to help them when they strive for something" and assist them in order to "ensure that the students get it right."

All these quotations confirm Dan Lortie's theses on the interpersonal theme as the key facilitator for entering teaching. Working with people may function as a facilitator for several occupations (i.e. nurses, social workers, service industry). There are few occupations that involve such a steady, time-consuming and unfolding interaction with the young as the teaching profession: [Teaching] presupposes the ability to: "… be there … in a very … well, you're never alone. Only when you need to use the restroom, of course. Except for the restroom excuse you just have to relate to other people the whole time. And this means that you have to be socially competent – for close, interpersonal relations the whole day."

So, what about the "art of knowledge mediation" as a factor in recruitment patterns? Continuing to apply Dan Lorties' argument (1975), our novice teachers

tend to be attracted to what he described as the "interpersonal theme in teaching" (p. 27) and have a lesser, more indirect interest in knowledge diffusion as such. Our respondents provide surprisingly clear answers to these questions, i.e. how they perceive and relate to theoretical (and abstract) knowledge. Quite a few of our interviewees had some experience with academic studies at universities and university colleges prior to entering teacher training, within disciplines such as language arts, political science and psychology. However, during the course of their university studies they had realised that they did not identify with a theoretical and academic career: "I just can't see myself sitting in the library five years of my life studying twelve hours a day. It's just not who I am."

Another made the distinction clear: "Yeah, because those who are academics they're…well, they're just totally different. In academia they are interested in knowledge and not of being social, you know, empathy, everything I find important in my education." One of the female respondents in the group interviews followed up on this:

> "We are not academics! […] The last time I went to a party with academics everyone just sat there and discussed, and it was so terribly boring. […] There were academics as well as artists and musicians, and the ones sitting there quarrelling were the academics. And then I just think: there is after all a difference between teachers and academics, because we are more like craftspeople."

What does this tell us about how the overall theme of attraction and recruitment patterns affects how teachers are equipped to meet the new challenges of continual learning in the knowledge society as a professional group? While earlier studies have underscored the role of teachers and teaching as public academics and public "Bildung" workers (Klafki, 2007; van Manen, 1994; Slagstad, 2003), we found that the novices in our sample have chosen teaching primarily because of the practical and interpersonal role as learner facilitators. The role of "the art of mediating knowledge" is either treated as mediator or as a background framework primarily linked to their prior formal training. The lack of academic interest may contribute to less than adequate competence in critically assessing and valuing theoretical knowledge for the inherent qualities it may or may not bring to inform professional development.

In the following section we explore this dilemma, moving beyond expressions of intentions and into findings related to teachers' engagement with the changing roles of knowledge in their current workplace.

FEATURES OF TEACHERS' WORKPLACE CULTURE

The dynamic and unfolding character of the protracted contact with children and young people is what gives teaching its attraction, benefits and rewards, according to our interviewees. As indicated in the section above, it is in the "here-and-now" communication and interaction with children and youngsters that teachers experience their professional wins and losses. All interviewees exhibit a strong link

to and captivation with teaching as primarily "here and now" and what they label as a "non-academic" activity. One of the novice teachers describes how communication skills and practical logistics – "orchestrating communication settings within a learning framework" – lie at the very heart of their professional satisfaction and commitment. Our analyses indicate that it is the quest to ensure that all students feel at ease and comfortable, that they get sufficient support and appropriate challenges, that they have friends and get involved with classmates and others that is of central concern to their professional obligations. All in all, this underlines the picture of teaching as an interpersonal and caring profession. It also reveals, however, that they see themselves as craftsmen rather that academics. Their actions are only to a limited degree based on theoretically and empirically accumulated (i.e embrained) knowledge.

Little division of labour and distribution of expertise across community members within the teaching staff may further obstruct the fostering of a knowledge culture of embrained knowledge in the workplace. Rather, the teachers as a group appear to represent an encultured professional culture based on person-centred relationships as opposed to tools and object-centred relationships. On the whole, our novice teachers do not meet and draw on the changing roles of knowledge to the extent suggested by Blackler (1995), Knorr Cetina (2003) and others as a requirement in today's society. The general outcome of our analyses so far supports the understanding that there is an inherent tension between the teachers' existing person-oriented knowledge culture and the expected object-orientation.

While the novice teachers describe their colleagues and professional communities as inclusive and supportive, at the same time they describe their job performance as done mostly "on their own" with little external insight and external support: "We are simply on the job alone – each one in her own classroom." Some of the teachers seek more feedback on how they perform on the job. School leadership is described as withdrawn from direct involvement in the daily classroom life of these novice teachers. They feel they are "left on our own and could do whatever we like to do …." One of our informants describes this situation as follows: "[The school leadership …] they are just very open-handed about the whole situation. I could probably have played cards with my students all year if I wanted."

This call for supervision and support infrastructures is also found in the informants' wish for a clearer leadership when it comes to knowledge aggregation and structures for knowledge dissemination. The level of complexity resulting from the increase in information and knowledge, technology and new communications is also felt by the teachers: "you can't always take the initiative yourself, because there is no way you can know the range of everything."

There are, however, tensions in our material that give us reason to reconsider this lack of correspondence with the general epistemification of society, as described by Knorr Cetina. According to our data, there are also reasons for claiming that teachers acknowledge and accept the rhetoric of the knowledge society, and that being "up-to-date" on theoretical knowledge relevant for their

tasks is seen as a professional duty. There is nevertheless no clear indication in the interview or log material that this attitude has manifested itself in daily workplace activities. This is related to the lack of any comprehensive epistemic infrastructure that would induce and provide collective support structures for such informal day-to-day engagement with theoretical knowledge on the part of the individual teacher. The teachers also expressed a general desire to move beyond their experience-based knowledge culture.

WORKPLACE RESOURCES

What new initiatives do teachers think will be expected of them in the knowledge society? And what measures are being taken in their workplace to meet such expectations? So far the results presented in this chapter indicate that there is not a clear-cut answer to these questions. What we see, however, is that teachers want to engage in a lifelong learning process, but they appear to lack the appropriate and relevant knowledge provisions to invoke the looping dynamics that Knorr Cetina considers a crucial driver for persistent learning in the knowledge society (cf. Jensen, 2007). The problem appears to be not so much a lack of *unfolding* theoretical knowledge in itself, but that it is hard for teachers to get an overview of the theoretical knowledge that might be relevant for them. As mentioned, this problem may be a result of their non-academic educational affiliation (Heggen, 2003; Aamodt & Terum, 2003). It may also be an inevitable consequence of an overly present-oriented and individual-oriented knowledge culture that does not have a tradition for decision-making based on accumulated knowledge.

In the section that follows we address the dilemmas and tensions we have found so far in novice teachers' attempts to deal with a wide variety of professional tasks within a workplace characterised by a weak theoretical orientation. How do established knowledge practices and knowledge sources within the teaching profession help novice teachers to navigate in this landscape?

First of all, when asked how they access different kinds of organised theoretical and experience-based knowledge resources, our novice teachers agree that they are in a constant struggle against an almost non-existent support structure. What they appear to lack is a systematic overview of the knowledge sources that are available and their quality. They also express a desire for a higher degree of systematised informal learning opportunities and in-service courses at the institutional and local level, which would align them with available, updated and relevant knowledge sources they could use in their classroom practice (cf. Klette & Smeby, see this volume).

The novice teachers do report the existence of formal professional communities at the institutional level. These professional communities are mostly organised within teams for teachers working in the same grade or unit or for the school as a professional community. Individually, teachers may apply for funding for in-service courses, but according to the interviewees, such initiatives appear to be motivated by individual initiatives. The dominating trend is that these courses are offered outside the schools, and that they are weakly connected to professional life

in the classroom. Nor are they linked to the existing professional communities at the school level. There are no routines, nor any formal infrastructure for knowledge distribution at the school level to serve as bridges between these external courses and the institutional and local level. This makes the strategic coordination of pieces of information and knowledge (e.g framing) hard to come to grips with.

The formal sites of encultured professional communities among our novice teachers are for the most part occupied with planning activities organised within a horizontal framework that corresponds with what Little (1990), Rosenholz (1989), Hargreaves (2003) and others have described as collaborative and contrived professionalism. It is, in a sense, a "community of learners" (Lave & Wenger, 1991) built on practical and emotional support and exchange mechanisms with little influence from theoretical and other abstract sources of knowledge. The absence of framing strategies makes it hard to develop a professional plan for mixing resources from different origins (cf. convoluting). Lorties' insights on the negative consequence of the egg-crate organisation of schools are that they continue to preserve individualism and presentism within the teaching profession. These arguments also refer back to Blackler's typology of knowledge. The ability of teachers to be prepared for the observed shift into the encultured and embrained cultures of knowledge meets potential barriers within the school culture itself.

When asked about quality assurance mechanisms and standards our teachers either describe them as "not existing" or as individual, private, and personal. Rather they legitimise standards and tools for good work by referring to policy documents (cf. National Curricula) or their personal professional decisions. Some teachers report that they take a quick glance in pupils' workbooks as an aid for assessment; they mention conversations with the pupils, individually or as part of classroom interaction, or they speak about how they use feedback from parents as their complementary tools for ensuring quality in their teaching. The lack of instruments and tools is frequently expressed as a source of frustration: "I feel really insecure about these matters […] what do I really know [based on my teaching]?"

The frustration over the lack of tools is not only related to assessment, but also appears to point to a more general demand for systematising professional resources. As one informant put it, "I have this dream about keeping an index file. I've thought about that so many times. Just think how convenient that would be – you go there and find a file called '1st grade: Maths.' It's all about recycling really." He emphasises how such a resource kit could serve both instrumental and creative purposes: "[You] just get so tired of going around searching. Right now we are about to make Easter cards [in my class], and I'm looking for a simple stencil of the Easter bunny. And every single second grade teacher has had to make that stencil … *every year*!"

The mismatch of knowledge practices and lack of clearly arranged knowledge resources intensify teachers' emerging epistemic challenges rather than alleviating them. According to our findings the teachers have to deal with an ill-defined domain of relevant knowledge. As such teachers are facing an impossible situation

as they attempt to meet new epistemic challenges within existing structures for the weak theoretically-developed workplace depicted in our empirical material.

CONCLUSION

Norwegian novice teachers in comprehensive schools are ambivalent about how to access knowledge and theoretical learning situations. They want to participate in sustainable engagements with knowledge, but lack sufficient support structures and available tools at their workplace to fulfil this ambition.

Findings on attraction and recruitment patterns to teacher education illustrate that (abstract and theoretical) knowledge is a weak driving force for pursuing teaching as a career. Throughout our analyses we have attempted to show how teaching as knowledge work paraphrases contemporary knowledge requirements. Teachers as a professional group have fostered reflective communities of practice. These are, however, mostly linked to the informal exchange of experiences on a day-to-day basis.

Teaching as a profession suffers from weak knowledge ties both at a community level and at an individual level. Recruitment patterns and motivational forces together with the endemic features of teaching (i.e. warrants and work rewards) strengthen presentism and "quick wins" as a professional orientation.

The absence of an accumulation of available professional tools and instruments that enables mediation between general ideas and concrete practices in classrooms is not preparing professionals to meet the emerging challenges of the knowledge society, according to our study. Within a weak theoretically-framed workplace, it seems that teachers will have to learn to deal with unsatisfactory solutions to the responsibilities they face. In sum, these are factors that encourage a new debate on the role of knowledge in teacher learning.

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ARVE MATHISEN

TEMPORAL DESIGN IN AUDITORS' PROFESSIONAL LEARNING

Contemporary Epistemic Machineries and Knowledge Strategies in Risk Auditing

Can time be turned into a "tool" for better learning? This question arose while studying how a group of newly educated Norwegian auditors[1] dealt with professional demands for further learning and knowledge acquisition. Auditors are of course suffering from the scarcity of time occurring everywhere "time is money," but these professionals did not, surprisingly, seem to be unduly hindered by the usual time-pressure on learning. Questions of time and learning were apparently not only about amounts of time available, but regarded just as much how the professionals were dealing with it. Using the notion of *temporal design,* this chapter explores how different time qualities can be brought into play for the support of learning. Reflecting the turn in auditing practices towards greater focus on risk, it also examines the connections between auditors' local learning activities and events on a larger societal scale. How to deal with the impact of knowledge-driven changes can be seen as a major concern for both professional workers and research in the field. As professional learning increasingly takes on extended features through the advancing "knowledge turn," new concepts and frames of understanding are needed in research on professional learning and its conditions. Auditors' roles within larger societal transformations will here be discussed with regard to the notion of *epistemic machineries*, put forward by Knorr Cetina (1999). Drawing on interviews and learning logs with the auditor group in the ProLearn project, the overall aim of this chapter is thus to examine possible links between auditors' professional learning, temporality and broader developments towards a knowledge society. See the introductory chapter for more information about ProLearn research design and objectives.

[1] While auditing in UK is generally performed by senior accountants, this task is in Norway exclusively performed by a professional group working within a more restricted legal frame. Throughout the chapter these professionals will be termed *auditors*. This is in accordance with, among others, Scandinavian research literature on auditing (Hope & Langli, 2007; Ohman et al., 2006), with the terminology used in the official Auditing Standards regulating this profession and with significant international contributions to the field (Robson et al., 2007; Curtis & Turley, 2007).

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The ongoing transition to a society which is more and more dependent on production and distribution of knowledge has led to radical changes regarding how time interacts with and influences life and work (Adam, 2003). This originates to a large degree in technological advances which have altered the speed and density of almost any activity. The simple formula is: when things go faster, there is time for more to happen. But speeding up the pace of work and life has led to new challenges. Current alterations in temporality are to a large degree understood as a distortion of time, primarily by increased haste and compression of more "natural" temporalities (Hassan, 2003; Urry, 2003; Menzies & Newson, 2007). While these temporal transformations have put new burdens on professionals (Pierce & Sweeney, 2004), the research discussed in this chapter also points to how learning processes can build favourably on current temporal changes.

In recent years there have been extensive alterations in how auditors use and depend on knowledge. Current legal and professional reforms have placed risk at the core of auditing practice. This has radically transformed auditing by turning the profession towards more analytic ways of working (Curtis & Turley, 2007). As risk analysis begins with the whole situation of the client, regulative temporal boundaries have to be implemented on auditors' work in order to keep costs at an acceptable level. More time spent will usually decrease uncertainties, but will also cost more. The analytic and risk-oriented turn in auditing therefore requires careful planning and a strictly balanced use of time. Interestingly, the main strategy for saving time revealed in the interviews was an extended attention to the risk analysis of each client. This indicates a circularity in how knowledge, temporality and risk are reciprocally affecting and driving each other. Such interactions can be regarded as pointers to an emerging "epistemification" occurring in local as well as regional and global settings (Stutt & Motta, 1998; Paavola & Hakkarainen, 2005). On a macro level these connections and dependencies have been discussed by several authors (Habegger, 2008; Boudia & Jas, 2007; Virilio, 1995; Beck, 1992). This chapter brings to the fore how auditors' learning can be seen both as conforming with, and also partly counteracting at the micro level, the developments towards an all-encompassing "epistemification" process outlined in macro terms.

PROFESSIONAL LEARNING IN TUNE WITH ITS TIME?

In comparison with the teachers, nurses and computer engineers studied in the ProLearn project, auditors' learning and acquisition of new knowledge was characterised by a certain ease, by a well managed information flow and a functional temporal design. There was time for learning and time for executive work. All ten auditor informants in the ProLearn project expressed that learning was, in one way or another, smoothly integrated into their daily and annual work cycles. On a regular basis they received new information and relevant knowledge from several sources depending on the workplace. This could be technical

guidance by specialised in-house departments, legal advice from the *Norwegian Institute of Public Accountants* (Den norske Revisorforening) or simply gathering client specific information on the net. While the teachers studied were generally left to themselves or to the unstructured consulting of colleagues for knowledge related inquiries, the auditors appeared to be enrolled into viable frames and dynamics of knowledge production, delivery, supervision and assessment. (For a detailed report and analysis of teachers' learning and knowledge challenges, see Klette & Carlsten in this volume.)

Why is this so? How can such variation in the conditions under which learning and knowledge work is arranged be explained? Different perspectives of understanding could be linked to such findings. A major research direction has focused on legitimisation and professionalisation processes performed by auditing organisations and firms where knowledge plays a crucial role in gaining and maintaining a professional monopoly (Abbott, 1988; Birkett & Evans, 2005; Sciulli, 2005; Robson et al., 2007). The consequences of these professional strategies could partially materialise in the advanced support structure that promotes and assists auditors' learning and knowledge activities. On the other hand the contrast between auditors' and teachers' learning could be explained by differences inherent in characteristics of the knowledge fields or types used by the two professions. Several authors have pointed to how professionals deal with different types of knowledge (Carr, 1995; Blackler 1995; Power, 1996; Kalthoff, 2005). Other approaches would highlight how this condition reflects the social and economic status given to professional workers in different areas (Evetts, 2003; Beck & Young, 2005).

The aim of this chapter is to propose and discuss an additional explanation as to why the auditors' learning and knowledge acquisition was regarded to be so well-functioning. While sensitive to the macro-perspectives of professional work, the focus here will first be directed towards the reports of learning and knowledge activities as it came to the fore in the interviews, learning logs and discussion group. By initially locating the research emphasis around auditors' experiences and reflections, the following considerations are intended to supply insight from below to the dominating macro orientation in accounting and auditing research (Robson et al., 2007).

The concepts of learning and knowledge work shaping this study are understood in terms of a temporally sensitive "epistemic tool perspective" (Lahn & Jensen, 2006). This perspective implies a comprehensive understanding of learning and knowledge processes reaching out beyond the conceptual limits of the *acquisition* and *participation* metaphors (Sfard, 1998). Recognising time as an epistemic tool adds to Lahn & Jensen's approach in emphasising how altered temporalities have a potential to reshape today's professional learning.

ENROLLED IN EPISTEMIC MACHINERIES

Auditors are currently embedded into sophisticated orchestrations of knowledge being developed in scientific and expert cultures across the globe. In the ongoing transition to a knowledge society, learning appropriately is becoming more and more dependent on dynamic merging of the technologies, practices and identities involved in contemporary epistemic activities. The notion of *epistemic machineries* takes account of the interoperability of these phenomena, and was advanced by Knorr Cetina in a study of researchers from two different natural sciences (Knorr Cetina, 1999). It was primarily used to point at the diversity and "fragmentation of contemporary science" (ibid. p. 3). Epistemic machineries should not be understood as a concept solely comprising the technological character of today's knowledge production. The "machinery" metaphor, as used by Knorr Cetina, pays particular attention to the social, processual and transforming capabilities of contemporary knowledge. One main argument in her work is concerned with how "epistemic subjects (the procurers of knowledge) are derivatives of these machineries" (ibid, p. 24). This implies that epistemic machineries are constitutive of knowledge processes on several levels, ranging from, and including, the mental act of thinking, socially and individually embodied skills, and of the symbolically composed discourses so abundant in knowledge settings. Recently, the notion of epistemic machineries has been brought into connection with learning in cross-disciplinary settings, and in relation to the convergence of different research fields (Mørk et al., 2008; Kastenhofer, 2007). The concept itself has not been further defined or elaborated by Knorr Cetina.

The notion of epistemic machineries resembles, but extends, the practice-based approach to theorising and studying work-based knowledge and learning processes. While the concept of practice locates knowledge in a historically and culturally responsive web of interrelations comprising social and material activities, the idea of epistemic machineries implies a stronger orientation towards the transformative consequences of knowledge processes. The words *praxis* and *machine* both etymologically go back to old Greek, and originate respectively from connotations of doing and contrivance, giving the latter notion an augmented epistemic meaning in direction of strategy and tactic. Practice as a research metaphor indicates an evolved way of operating, whereas machineries connote a further degree of abstraction, implying a contrived and more constructed temporality. For Knorr Cetina the epistemic machineries are "composed of practices" and thus represent a higher level concept (Knorr Cetina 1999, p. 10).

Before looking more carefully at the theoretical vista introduced here, a review of three significant topics from the empirical material will be presented: 1) the apparent good functioning of auditors' learning, 2) reports on the temporal design governing their learning, and 3) how risk at the core of auditing contributes to intensified learning.

AUDITORS' REPORTS ON WELL-FUNCTIONING LEARNING

Norwegian auditors have undertaken an education specially designed to meet national requirements expressing that financial statements from all limited liability firms must be audited. According to a recent reform auditors are personally responsible for the quality of their work and their compliance with professional standards. Auditors in Norway are required to spend at least one week each year on relevant courses designed to promote professional learning and development. In addition to this, the auditors interviewed in the study were faced with a wide supply of carefully designed and progressively structured learning programmes either devised by the firm where they were employed or by the Norwegian Institute of Public Accountants. All of the participants in the study were aware the necessity of continuous learning, as illustrated by a characteristic remark from one of them: "I simply can't continue in this job if I am not able to answer the questions that are showing up." The accounting and auditing field is characterised by continuous reforms as new laws, regulations or auditing standards are implemented. In Norway there is also a constant pressure upon the auditing profession to comply with European and other international standards.

> All the time there are new laws and regulations demanding that we must update ourselves. The new auditing law is arriving next […] and then there will be a lot of new things to learn there. So new requirements are constantly emerging.

Despite a broad agreement among all informants on the need for continuous learning, compared to the other professionals in the ProLearn project, the auditors were generally less worried and stressed about their obligation to stay updated. Interestingly, several of the answers concerning learning were expressed in the passive form of the verb:

> I think the acquisition of new knowledge slides automatically into everyday work. There is no hassle about it; it comes when it's needed. […] Changes must first be taken into the system, and then we must be taught to understand how to deal with them.

Generally the auditors regarded learning and knowledge acquisition as a shared responsibility where the workplace and the professional organisation provide the information and the frameworks for learning, while the employee transforms this into a sufficient understanding:

> It's my responsibility to get things into my head, but of course it is employer's duty to facilitate and arrange for learning.

The auditors' knowledge activities were integrated into a wide sphere of technological and social arrangements. Larger firms had developed specialised departments providing updated information and knowledge resources within their fields. Knowledge and information were systematically distributed through

databases, journals, collegial exchange and courses. The auditors used computer applications specially designed for their particular methodology, including the widely used *Descartes*, developed by the Norwegian Institute of Public Accountants, and *Sticos,* a commercial web-based information database for accounting and auditing.

On several occasions the auditors reported that cooperation between colleagues with different competencies was neatly woven into the fabric of daily work. Instead of pointing to difficulties with generation gaps or conflicts regarding a theoretical versus practical orientation, the overall aim was to facilitate knowledge sharing and collaboration. An auditor explained:

> I work a lot with one of my bosses; he is 50 years old and has been in the branch for 30 years. He is very practical. We have some clients together; he knows them really well […] and has some smart solutions. I am more theoretically oriented, and since I recently left the university, I remember the theory. When we discuss, he asks me; what does the law say? Then I ask him; what does the praxis tell you? In this way we very often find a solution.

There was very little evidence of discomfort about the pressure to learn, to keep up to date, in the interviews. This points to what may be the greatest contrast between the four professional groups studied in ProLearn. However, there were noticeable differences within the auditor group regarding how they positioned themselves in relation to their personal learning and knowledge ambitions. There appeared to be room for very ambitious and constantly knowledge-seeking professionals, as well as for those who felt comfortable with the minimum learning requirements. Individual participants seemed to be involved in the overall knowledge production and utilisation in a balanced and differentiated manner.

TEMPORALITY AND STORIES OF ENHANCED LEARNING

Maybe the most significant temporal feature reported by the auditors was the time structure inherent in the methodology they used. The audit was commonly performed in three main steps; planning, performing the audit proper, and doing documentation work. These activities were spread out in the annual cycle so that planning was done in autumn, the audit proper and its report in winter or early spring, and finally, the documentation was conducted to close the cycle:

> The year is divided in two for us auditors; one period from autumn to New Year's where we gather information about the client and some figures. This is used for planning how to work with the client in the next period. The second period reaches from New Year's to summer. Here we work with the final figures and bring the audit to an end by producing the required reports. The first period is quiet, with the opportunity to take extra leave, while the second is very active, with much work and little leisure time. We have approximately 50/50 of these periods.

Generally the planning phase is regarded as crucial and is performed cautiously both to save time and to locate the controls properly. During planning work the temporal structure of the audit proper was outlined, and, as shown in the following quote, it was, put on the "map." Through time conscious preparation the simultaneity characterising the busiest period was broken up and laid out using visual computer-based aids:

> In this period, in the autumn, we have to plan what to do in finalising the annual settlement and be prepared when it arrives. Because then a lot of things come at once. We have something called planning-maps, and we plan the auditing work in those.

With regard to time and resources, the auditor has to devise an overarching strategy and a concrete plan of how to perform the audit optimally. This requires a temporally balanced judgment since more work will decrease the uncertainties, but will also cost more. The planning determines which steps must be followed in the concrete auditing, and this in turn, gives the material for final report and documentation. These temporal steps were connected through the performance of the auditor's professional judgment. While the overall framework was given, the auditor's analytic reflections settled the content and procedures within each step.
An example illustrating the necessity of carefully planned knowledge activities extending the predefined auditing rules were provided by one of the informants. When he estimated a client's inventory values according to the standard auditing procedure, it amounted to NOK 10 million (GPB 1 million[2]). But this auditor had done contextual research while planning his work, and had discovered that a superior competing product now made the inventory practically unsaleable, giving it a negative value i.e. the cost of throwing it away. Without proper planning, the next step in the auditing process could easily have been very erroneous.

In addition to its main temporal location in the annual cycle of work, planning was reported to be a continuous process as auditors had to evaluate the further significance of each step with regard to upcoming alterations in the original plan. The auditors felt responsibility to work according to the plan, even knowing that changes had to be implemented along the way.

> *Q: Is there something in your work where you feel a special responsibility, where it bothers you when it isn't working well?*
>
> Yes, it's planning and the use of time. I have many clients, and lots of strange things, I would almost say, happen all the time. Things get delayed, people get ill, and you have to wait. One has to be patient.

A similar responsibility came to the fore regarding their attitude towards performing the necessary, but less attractive parts of the auditing. There was a broad consensus among the auditors in the study about which steps in the

[2] February 2009.

temporally structured knowledge activities were considered engaging or interesting and which were generally termed boring. Planning, learning and expanding the knowledge horizon were described as engaging and pleasurable work. Most rewarding were situations in the audit process where discoveries were made that led to change. Most tedious was completing the necessary documentation at the end of the audits.

Q: Can you name something that is boring in your job?

> Yes, it is the follow-up work. When you are ready with something, it is really nice to close a book, or a report, and say; done! But it very seldom turns out like that. […] There is always a lot to do after you finish a job. This is not particularly exciting, but work that simply has to be done.

While the documentation procedures were regarded as time-consuming and sometimes too rigid, the auditors were clearly profiting from doing this as they very often reported going back to their records of past work. This annually completed documentation increased the transparency of practices and transformed unstructured and personal working papers to a standardised format. Documentation serves as memory for the auditor when picking up the client in the following year. It is also the main material for regular quality controls performed by the Norwegian Institute of Public Accountants, and it facilitates sharing and cooperation within auditing firms.

> A colleague of mine had this client last year. I will make an appointment with him to go through practice from earlier years. I found his papers from last year, some quite advanced Excel-sheets.

To put it simply; spending time on documentation paves the way for significant time savings later on. Documentation ends the annual cycle of an auditor's work with the client. This closure is contrasted to the open and learning oriented planning phase, constituting a definite temporal rhythm in auditors' learning and knowledge activities. Each phase is one-sided: expansive searching, intensive producing, or routine documentation, but taken together the year has a complete, but rhythmically sequenced form.

Another main temporal influence on the auditors' learning came from the legal and regulatory frames governing both accounting and auditing in Norway. It is explicitly stated that it must be possible to perform these professional activities in a satisfactory manner with a limited use of time and resources (Myrbakken & Haakanes, 2006). Accordingly, it is also set out in the Auditing Standards that an auditor's task is not to uncover all errors but to locate material or relevant errors in relation to the specific client. The stipulation to focus only on significant issues came clearly into view when the informants talked about the time used for learning:

> I read until I get the understanding I feel I am comfortable with. I have to make choices about how I spend my time. We are a profession where you constantly are measured on time use. […] You have to take one thing at a time, sort things out simply, and then take what is most useful.

The auditors in the study expressed an orientation towards evaluating available information and the learning process by means of the temporal resources needed. The challenge did not seem to be learning as much as possible in the shortest time, but rather to pinpoint what was necessary and useful and leave the rest out. One can say that they were performing a kind of professional reduction:

> If I am unsure about something, I seek information where I find it presented briefly and concisely, so that I can learn it fast.

In auditing there is a constant search for auditing errors or other kinds of non-compliance with the law. Normally it is easier to plan the time needed to build something up rather than calculating how much time is required to find faults and errors in the construction. This is well known from computer programming. For the auditors in the study, the chosen method for locating errors and incorporating this into the temporal design of their daily work and learning was to constantly look for and evaluate, "what is most important here?" They were not simply hunting all errors, but were focused on material or critical ones. This "epistementality" of sorting out and identifying the essential permeated all aspects of auditing (Knorr Cetina 2007, p. 370). Working with errors thus required constant judgment, giving the planning and the time structuring a distinctly epistemic touch. Timing grew out of decisions (Gherardi & Strati, 1988). Auditors' strategic temporal designing was an activity permeated with knowledge.

To summarise: two main strategies were reported regarding the auditors' temporally structured learning and knowledge activities. First, the auditing year was rhythmically divided into three distinct phases, each with its own time quality. In this way, auditors' time-cost-efficient work appeared to consist of both slower, more contemplative temporal "spaces," and periods of pronounced haste. Second, strategies for limiting learning and work to a necessary minimum came to the fore through active compliance with the auditing standards, requesting focus on material matters only.

RISK AUDITING AND INTENSIFIED LEARNING

Norway implemented the new risk-oriented laws and auditing standards in 2006. The ProLearn auditor informants were interviewed partly before and partly after this important change in their professional framework. The challenges of mastering the altered techniques of risk auditing were the centre of their attention, and were described as a major learning task at the moment:

> *Q: Are there any professional challenges that you repeatedly meet in your work and want to learn more about?*

> Yes, risk analysis, because I can never learn enough about it. How do you map risk? What is the leadership thinking? How can I say something about their way of thinking? What tools do they use in handling risk? Auditing is really about risk.

Focusing on risk radically changed the auditing methodology, and altered the relation between regulating standards and professional judgment by giving more weight to the latter. This is how one of the auditors described her experiences working with the new method:

> Using risk-oriented auditing you must of course work in relation to the regulations, but they are not the starting point. You start with an analytic process to locate weaknesses. That takes more time, because you have to know the entire company, the entire system in a different way. But I think there is more help in this kind of auditing.

In relation to earlier auditing methodology this turned the work process "upside down." Now the analytic process is the starting point, looking at "the entire company, the entire system" from above, instead of the earlier substantial control commencing with auditing details and documentation.

Using the old methodology, auditors could in principle go through all accounting vouchers and thus examine everything. Initiating the audit from above with an analysis of the company and its context is confronting the auditor with potential infinite informational needs. Therefore risk auditing must aim at sorting out what is relevant for this specific client. The analysis from above and the task of setting appropriate limits are certainly augmenting the epistemic character of auditing and partially loosening the profession's traditional tightly-regulated knowledge structure. Here is a comment from one of the informants:

> If you perform a risk analysis in the beginning, then you can make choices and say: No, we don't need to go further; we don't have to go deeper into these particular auditing details. Here you need the theory and the understanding of how to do the analysis. To save time overall, we spend more time planning. If you can locate the risk elements, then you can focus on them and perform a lighter audit on the rest.

In a way this sums up most of the arguments from the interviews presented so far: By spending more time on risk analysis, auditors constantly need to learn, but then they can perform a temporally optimised audit, focusing on the most important risk factors or the material ones, to use auditing terminology. In the following section the empirical statements presented above will be discussed by bringing in applicable theoretical considerations.

THE INTERPLAY OF LINEAR AND CYCLIC TIME IN AUDITING

To a large extent current literature on temporality has a pessimistic tone, reporting on the compression, commodification or commercialisation of time as means of reducing the quality of life, work, knowledge, learning etc. Abbreviated thinking, for example, is believed to replace earlier more profound modes of thought (Hassan, 2003; Urry, 2003; Menzies & Newson, 2007). Studying auditors' temporal design in conjunction with their apparent ease of learning opens up for reflections on a wider array of possibilities concerning the ongoing alterations in temporality.

The temporal design guiding auditors' work and learning can, for the sake of simplicity, be divided into two main aspects. Their orientation towards what is new, upcoming and unknown may be connected to a view of time as a forward pointing movement directed towards an undetermined future. This aspect of the auditors' work was clearly stated both with regards to the obligation for continuous learning and pertaining to the investigative openness belonging to auditing. The analytic, top-down inquiries performed by auditors were forward looking and especially attentive to novelties, forthcoming trends as well as to the complex present situation. On the other hand, auditors' annual work and learning phases also included repetitive temporal patterns, where a backwards orientation predominated. Their professional adherence to auditing standards, methodology and thorough documentation carried hallmarks of traditional temporal forms with its sensitivity for prescription, convention and a reduction of complexity. These two temporal qualities, observed in the auditors' account of their work and learning processes, to a large degree correspond to the notions of *linear* and *cyclic time*.

Linear and cyclic time represent two contrasting logics regarding the understanding of time (Hassard, 1989). They have been recognised to predominate in industrial and traditional societies respectively. Several scholars have pointed to the changes in temporality following the transition first to an industrial society and again in the ongoing passage to a knowledge society (Adam, 1990, 1995, 2004; Nowotny, 1994; Hassan, 2003). While the industrial revolution marked the fulfilment of a long historical reductive process transforming the cyclical time of pre-modern societies into the rationalised arrow of linear time, the burgeoning knowledge revolution implies a radical complexification of temporality, where also cyclicity seems to play a role. As industrial production more and more is taken over by the production of knowledge (Drucker, 1993), the question arises: What is happening to time in an emerging knowledge society?

Linear time is usually conceived as an even, unidirectional and measurable flow of empty "moments." Its forward pointing arrow implies constant occurrence of new events because repetition is principally inconceivable (Nowotny, 1994). This temporality has been variably termed as mechanical time, clock time or as the machine time of early modernity (Adam, 1995; Gell 1992). While the constant movement of linear time is taken to be mathematically inelastic, it still allows for compression as every moment can contain more when speed is increased (Kern,

1983). Temporal compression is probably best exemplified by the many representational techniques conserving past events in a minimum of space and with more and more ease of retrieval. Also anticipation of future events has taken on specific forms within the domain of linear time. Through the concept of causality the calculative potentials of linear time was developed into scientific prediction techniques. The notion of risk, which is of central importance to auditing, represents a significant example of this. Risk, as a knowledge construct, is connected to a future oriented, reflexive society that is actively breaking away from its past by utilising and constantly refining its knowledge-driven technologies (Giddens, 2001).

Modernity's main influence on time has accordingly been to compress it, to appropriate the future though calculative practices and to freeze the past in a vast array of representational media. The machine time of industrial society is developing into epistemic temporalities in line with other developments towards a knowledge society. One of the consequences of modernity could hence be understood as turning temporality into an epistemic tool. And calculational and representational technologies transforming time can thus be regarded as decisive "engines" in an ongoing epistemification process (Kalthoff, 2005; Porter, 2008).

While linear time points to the future, traditional cyclic time was mainly oriented towards past events and their reoccurrences. The notion of cyclic time allows for an integration of repetition and change and is modelled on the cyclic movements found in natural phenomena like changing seasons and the rhythmicity of living organisms. As a farmer explained: "Our time is primarily regulated by the cows" (Adam 1995, p. 86). Cyclic time is extendable and defies exact calculation. The repetitive character of cyclic time was clearly oriented towards building on experience rather than exploring the unknown. In this way unnecessary build-up of knowledge was avoided. Several studies have pointed to the significance of temporal rhythms and phases structuring work and learning (Pinae Cunha, 2004; Reddy & Dourish, 2002; Zerubavel, 1981, 1979).

The rhythmic embeddedness of auditing in predictable "seasons" reflects a cyclic temporality. Dividing the year into separated phases gives a temporal elasticity that, according to the auditors in the study, afforded periods of both "abbreviated" and prolonged thinking. The interplay between planning, producing and documenting constituted temporal dynamics which were not unlike farmers' traditional time-structured tasks, even if they were performed on an advanced abstracted and technological level.

Another aspect of auditing connects to more traditional ways of working as well. In the same way that earlier craftsmen trusted their traditions to avoid unfruitful choices, the auditors in the study were constantly chasing the essentials in their work. By means of professional judgment they complied with standards and regulations framing their profession. The auditors had at hand a legal framework, detailed auditing standards and a professional culture of documentation helping them focus and benefit from accumulated experiences and their

professional knowledge base. A repeating theme among the auditors in the study was the necessity of defining time-saving limits for learning and work. Standardisation thus functioned as a temporal strategy and a complexity-reducing factor (Alstyne & Bulkley, 2004).

Looking deeper into the transformational capabilities of linear time reveals several issues pertaining to learning and knowledge. According to Castells, current temporal alterations by means of compression and other modes of processing are resulting in abstract temporalities such as simultaneity and timelessness (Castells, 1996). The "natural" flowing time has been forced to a standstill. Virilio argues similarly that earlier conceptions of chronological time must be replaced by terms like *chronoscopic time*, regarding how the moving course of time pulverises into standstills of decontextualised timescapes[3] (Virilio, 1995). With the almost infinite compression possibilities of digital representation technologies, temporality has taken on spatial properties. What previously had to unfold in time, is now instantly delivered, is practically at hand in a virtual space. Timescapes represent an ultimate compression.

Knowledge complexification and information overload have been regarded as main challenges to learning leading to *dromoscopic* effects, which can be likened to informational traffic jams caused by increased epistemic mobility (Virilio, 1995). In line with this kind of argumentation, current transmutations of linear time have to a large degree been understood to put further pressure and new demands on professionals (Pierce & Sweeney, 2004). On the other hand, the "scopic" reshaping of time is making certain aspects of learning and knowledge work more accessible. The compression and timelessness of Castells' and Virilio's decontextualised timescapes can hence be regarded paradoxically as both challenging learning, and as technologically created knowledge enhancers, radically augmenting the general knowledge potentials inherent in facing "the world" as temporal.

Timescape and rhythm, representing the two logics of time, can further be shown to enhance learning and knowledge in more generic ways. A closer look into the new "scopic" forms of temporality unveil modes of operation that resemble the temporal functioning of thinking and knowing in general, as described by, among others, George Herbert Mead. Bringing the flow of time to a standstill is, according to Mead, providing the necessary "temporary inhibition of action which signifies thinking, or in which reflection arises" (Mead, 1967, p. 90). Mead goes on to describe the "undertaking" of knowledge as dependent on a temporal destruction taking place when present events flow into the past and thus are "ceasing to be" (Mead, 1938, p. 64). Epistemic activity is for Mead deeply rooted in a "temporal world," and is made possible through the contrasting experiences of the flowing present and the annihilated, or in our terminology,

[3] This view on *timescapes* differs from Adams (1998) more organic conception, building on the metaphor of an embodied and alive landscape. Virilio's notion on timescape highlights instead the "'-scopic-'" and instant visuality pertaining to compressed time.

"scopic" past (Mead, 1932, p. 68). Understood this way, technologically imposed temporal compression, resulting in phenomena such as Virilio's timescapes are imitating, or laying the ground for, basic epistemic activities like auditors' optimised handling of information. Moreover, cyclic temporal phenomena can be linked to more general aspects of knowing and learning.

The epistemic significance of temporal phases, boundaries, sequences and rhythms has been pointed out by several authors (Southerton, 2006, 1988; Zerubavel, 1979; Geertz, 1973). Framing and lifting out a certain timepiece from the flow of time has been regarded as a prerequisite for epistemic activity to take place. One example of this is how incomprehensible language usually is perceived as an unstructured and continuous flux of time and sound, while a beginning understanding is based on perceptions of its temporal boundaries (Zerubavel, 1979). Similarly, Clifford Geertz has argued that first when a calendar cuts time into bounded units did it become possible to give certain days social, intellectual or religious significance (Geertz, 1973). Inserting starting and stopping points in the flow of time gives potential meaning to the episodes which otherwise would just pass by. Framing lifts forth something to anticipate and aids the memory. Temporal boundaries constituting episodes are thus a necessary prerequisite for knowledge activities to unfold in the course of time.

Building on the argumentation above, the temporal designs of learning and knowledge activities reported by the auditors denote that they partake simultaneously in both linear and cyclic logics of time. Their learning was accordingly gaining strength from two temporal sources that were neatly interwoven in practice. First, auditors' analytic knowledge work was supported by informational timescapes, instantly delivering facts, standards, legal frameworks or relevant advice. This aligns with Mead's argument that knowledge activities depend on bringing the flow of time to a standstill. With regard to the utilisation of "scopic" technologies the auditors in the study conformed to a general epistemification process ranging from the process of thinking to global epistemic developments. Second, their learning was taking advantage of several techniques for standardisation and a thoroughly constructed rhythmicity and sequencialisation. In this regard they were partly counteracting global knowledge developments leading to a one-sided speeding up and the creation of more complexity. By bringing elements of cyclic time into their learning and work, the auditors created a set of differentiated temporal "spaces" and thus gained support from the possible knowledge enhancements described by Zerubavel and Geertz.

Compared to teachers and nurses in ProLearn, the auditors were working under less rigid temporal schemes or timetables. To a larger degree they composed their own temporal workflows by integrating components of linear and cyclic time. This integration did not simply add linear "elements" to the overall cyclical framework. Instead the auditors employed the two temporal logics in a partly dialectic manner. Where "scopic" temporality was threatening to undermine the elasticity needed for performing professional knowledge work, predictable rhythms and seasons were

delivering slower and "unhastening" learning spaces (Pels, 2003). If their analytic research threatened to lose itself in infinite complexity, time-saving standards and a partly routinised methodology was narrowing the field and helping them to keep focused on what is of material importance. "Paradoxes of plenty" were thus being challenged (Nye, 2002). Auditors' simultaneous attention to risk and materiality was temporally realised by combining the timescapes of linear time with a de-contextualised cyclic time orientation. This double effort makes up the gist of temporal designs found among the auditors in the study, and provides one specific answer to the question of what is happening to time in an emerging knowledge society.

The auditor informants were understood to have a temporality in their learning practice that did not seek to fully control or domesticate time, but partially sought to come to terms with it. A temporal design comprising dialectics of compression and extension, of judgment and standardisation, indicates that time is not a "container" to be filled with activities, but rather a "partner" with whom you employ different kinds of dialogue. There is an expression; "to be like water," which means that the appropriate reaction to any event has to be carefully measured avoiding either overreacting or using too little force. With regard to the elements of a temporal design in the auditors' learning, several methods came to the fore for partaking in the beats, measures and rhythms of learning and knowledge activities "like water."

AUDITING KNOWLEDGE PRODUCTION IN EPISTEMIC MACHINERIES

In this last section, auditors' learning and knowledge activities will be discussed in relation to the notion of epistemic machineries. Important for using the machine metaphor is the underlying assumption of a knowledge society where knowledge has become a productive factor of prime importance (Bell, 1973; Drucker, 1993). The production of knowledge leads, among other things, to a blurring of borders between humans and technology (Knorr Cetina, 1997). New hybrid constructions are emerging where knowledge is acting as a binding force (Latour, 1993). Experts will thus be understood as enfolded into contemporary epistemic machineries (Van House, 2004). In this way the idea of a knowledge society can be linked to the concept of a machine culture: "We are no longer, like our ancestors, simply supplied by machines; we live in and through them" (Sengers, 1999).

The previous analysis of auditors' temporally designed learning can be further expanded by including way in which a concrete and situated learning activity must be regarded as embedded into larger epistemic operations on a global scale. One example, mentioned by several of the interviewees, was how distant financial scandals were influencing their daily work:

> The risk situation has changed recently; especially in financial auditing where there has been much more focus on risk since we had the *Worldcom* and *Enron* scandals.

In this way global incidents are being brought into the "wheels" of epistemic machineries and engaging auditors worldwide into new learning activities. Likewise the auditors' use of technologically advanced information tools and their professional sensitivity to trends and novelties link them to worldwide knowledge developments. Another example showing the embedded character of the auditors' learning processes was their talking of a passively "being taught" as well as their active responsibility for deliberate use of new knowledge. By both receiving and providing knowledge the auditors appeared to be enrolled into professional machineries of knowledge production and application.

The way in which the auditors' knowledge activities can be regarded as parts of larger epistemic machineries reaches, however, even more deeply into the structures and challenges of an emerging knowledge society. In addition to being enrolled into contemporary epistemic machineries in a conforming manner, the auditors in the study were also understood to regulate or even counteract the epistemic machineries in two different ways.

First, the temporal designs governing auditors' knowledge processes were described as both following, but also resisting and taking control over certain epistemic trends or developments. The rhythmic division into differentiated phases of work and learning and the auditors' sustained use of standardised procedures restricted the potential endless complexity of information overflow. On the other hand the optimised use of advanced information technology and the constant need for professional judgment held the auditors back from being fully taken over by cyclic routine and repetition. By combining linear and cyclic temporal qualities these professionals appear to have turned time into an epistemic tool, by means of which they have created their own professional "space of epistemic activity" within the larger epistemic machineries. In this sense, the auditors provided an interesting example of how a professional group was actively dealing with the challenges and opportunities of contemporary epistemic machineries.

Second, the products of auditing are playing a special role within the overall knowledge production. Auditing does not directly contribute to the accumulation of knowledge compared, for example, to scientific research. The aim of auditing is to put up a reflective "mirror" pointing to what is wrong or missing in the economic routines or documentation of its clients. And the knowledge produced in the process of auditing is primarily intended to regulate and inhibit unsafe or unwanted activity. This gives auditing its distinctive pursuit within the epistemic machineries.

Epistemic machineries, as with all forms of machinery, are to be understood as fundamentally paradoxical (Virilio, 1995). While they are aimed at achieving greater control, they also produce additional risk and uncertainties. Their intended simplification generates more complexity, and the liberation they are built to provide, spawns new restrictions, and so forth. Machines are generally used to accomplish productive results by the way of compressing time and relocating energy. Both of these processes have, from the earliest attempts in preindustrial

days, been shown to involve risk and the additional fabrication of unusable by-products. Epistemic machineries also generate risk and knowledge spill-over, visible in the dangers accompanying an information overflow. One notable challenge for the emerging knowledge society will be to handle and transform these risks and informational by-products. Borrowing insights from natural ecological processes, the aim is to reduce risk while producing by-products capable of being used later and elsewhere in a beneficial manner (Adam, 1990).

Several authors have pointed to how the notion of epistemic cultures has an affinity to what is not known, to a negative knowledge (Wehling, 2006; Kastenhofer, 2007; Evers & Menkhoff, 2002). Negative knowledge in this sense is not non-knowledge, but knowledge of the limits and contexts of knowing, of errors and uncertainties. Knorr Cetina comments that dealing with negative knowledge is to promote an epistemically oriented "care of the self." Negative knowledge requires a shift "from the analysis of the object to the analysis of the self" (Knorr Cetina, 1999, p. 56).

Risk auditing will always be performed at the edge of the known and thus represents a self-revealing mirror for its clients. Auditors, like detectives, are looking for hidden or otherwise invisible omissions, errors or outright frauds. In this sense they are contributing to the production of new, albeit very specialised and targeted reflexive knowledge. This knowledge has an outspoken duty to assist and correct economic activities. Several of the auditors in the study expressed satisfaction when they could contribute in a fruitful manner by putting up a "mirror" to their clients. Here is one example:

> I feel I have done a good job when the client and I agree that my work has provided a conclusion that will lead to change - when the client realises that the situation is not sufficiently good now, and that they really want to make things change for the better.

The audit represents an inhibiting and speed-lowering factor in the epistemic machineries initiating reflexive learning processes for its clients, and for society on a larger scale. A "knowledge spill-over" is generated to the benefit of the client and also for the authorities who commissioned the audit (Hope & Langli, 2007). Risk analysis and management has not without reason been considered "the singular most important analytical tool of the modern world" (Jarvis & Griffiths, 2007).

It would be one-sided and outright wrong to portray the auditing profession as only contributing reflexively and corrective to the ongoing epistemification process. The increasing influence and spread of accounting and auditing, by some termed "the audit explosion," has in itself also contributed to a questionable amount and multitude of auditing practices (Power, 1994). Risk is a knowledge construct, and exists solely in terms of the knowledge we have of it. For this reason risks are malleable and prone to all kinds of rhetoric and manipulation (Beck, 1992, p. 23). There is little doubt that the widespread auditing activities have promoted an enlarged attention to risk. This means that auditing, and the interventions of its

profession, can be seen in a reciprocal relationship to risk development. It is both performing highly demanded and necessary expert work to reduce risk, and also nurturing the growing focus on risk as part of its own professional strategy (Robson et al., 2007). The promise of security, at demand as soon as risk is given attention, is probably the main legitimising rhetoric connected to the practice of auditing.

CONCLUSION

Throughout this chapter it has been argued that the auditors' learning, optimised temporal design and risk orientation are mutually driving each other. Using advanced information technologies and a streamlined filtering and delivery of knowledge, these professionals take part in a dynamic and productive merging of technologies, practices and learning. Auditors' attention to negative knowledge, to the unknown and invisible, is regarded as a reflective device giving new directions and impulses to epistemic machineries. The paradoxes of epistemic machineries are in this way partly countered by the creation of reflexive knowledge spill-over. On the other hand auditing is recognised as drawn into the paradoxes of machineries by contributing to the creation of more risks, and what can be termed an "audit explosion."

The described circularity of auditors' learning, temporal design and risk can be regarded as mirroring an epistemification process that is currently extending across and transforming all parts of society. The auditors are deeply entrenched into these processes and strive to comply with them in a skilful professional manner. But equally important are the different kinds of regulation, of complexity-reduction and handling of spill-over that can be connected to the auditors' reflexive knowledge production. Being actively engaged in learning, and responding to the spiral of a knowledge society, the auditors in the study reported creating resistance to "the paradoxes of plenty," and aligning their professional learning to human and organisational constraints. This sums up to a picture of an occupational group that has succeeded in taking some substantial steps towards facing today's professional learning and knowledge challenges.

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PART II

ARTEFACTS AND PROFESSIONAL LEARNING

In a trivial sense, professions are defined by their artefacts. The performance of expert work means using a variety of material and symbolic tools for different purposes. Artefacts also demarcate a field of knowledge, and they are belongings that identify the professional. In other words artefacts have an instrumental and a symbolic component, and it is useful to describe them in terms of three dimensions: abstract/concrete, global/local, and complex/simple. These dimensions comprise the central focus of the three contributions of part II. In chapter 6, *The use of knowledge sources among novice accountants, engineers, nurses and teachers* by Leif Chr. Lahn, and chapter 8, *Professional training and knowledge sources* by Kirsti Klette & Jens-Christian Smeby, the term "knowledge sources" refers to both locations of access and locations of how to use. An example should make this distinction clearer. If a teacher is browsing the internet to obtain input for a teaching sequence on the Second World War, we may refer to this as a mediation of practice. The teacher gets access to some information that can count as knowledge. However here this resource does not necessarily serve as a higher order artefact in Wartofsky's sense (see Introduction), since the "how"-dimension of professional expertise is not supported. This has to be accessed somewhere else, and the knowledge source for this "how" translation in this case may lie with the individual teacher. This same dynamic may also be relevant to nursing. However, as pointed out in chapter 8 and chapter 7, *Good professional work in accounting, engineering, nursing and teaching. From practice-based to standard-based quality assessment* by Leif Chr. Lahn & Bjørg Christiansen, novice nurses in larger hospitals enter a system of professional development that turn personal or collegial knowledge resources into productive practices and instances of "good work." In chapter 6, we see that professionals may be confronted with contrasting and possibly conflicting epistemic orientations, for example when nurses look for advice to alleviate the suffering of patients and at the same time make efforts to find medical explanations that justify their actions. The second strategy could be seen as either gap-closing or expanding, depending on the theoretical orientation predominant in the field. It may settle an issue in accordance with global ideas and standards, or have a satisfactory local value. Chapter 7 takes us into a debate on quality assessment in the professions that is often framed as a contradiction between personal judgement and formal rule-following. However, as pointed out in all the contributions to this section, artefacts as "machineries of knowledge

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production" are both enabling and restricting. This generalisation is valid whether we speak of evidence-based practice in nursing, open source programming in computer engineering or on-line accounting systems. However, if the concept "epistemification" refers to a historical process where scientific rationalities take precedence over practical and other discourses, we would expect a growing emphasis on an epistemic orientation towards explanations and justifications. The data in the following chapters does not address this issue directly since they were collected over a short period of a few years, within the framework of a synchronic design at the system level.

LEIF CHR. LAHN

THE USE OF KNOWLEDGE SOURCES AMONG NOVICE ACCOUNTANTS, ENGINEERS, NURSES AND TEACHERS

An Exploratory Study

INTRODUCTION

The concept of epistemification (Stutt & Motta, 1998; Hakkarainen, Pelonen, Paavola, & Lehtinen, 2004) has recently made its way into the literature on technology and society. In a nutshell this concept refers to the massive proliferation of knowledge through new artefacts such as the Internet, global instruments for institutional governance, student portfolios and so on. At the same time the life cycle of what we know has become shortened, forcing us to update ourselves continuously. Through these processes the logic of scientific production and its social organisation diffuse into other sectors of society – like the semi-professions (Knorr Cetina, 2006). As a first step to approaching such macro-issues empirically, we will explore the ways knowledge sources are used in the everyday practice of novice accountants, engineers, nurses and teachers. By knowledge sources we not only refer to books, manuals, web-pages, instruments and so on, but also to oral or written communication with colleagues or clients. These differ in terms of textuality, that is, the extent to which the knowledge sources constitute their own context (of inquiry) or are situated in the given task requirements.

Although there are a number of contributions within the field of human-computer interaction (Heath, Knoblauch & Luff, 2000), the research literature on the use of knowledge sources in professional work is otherwise sparse. Thus our study will be explorative with our interpretational scheme guided by the somewhat nebulous ideas about epistemification. Our focus is on how knowledge sources mediate work performance among novice professionals. We have defined this setting as one of informal learning that can be mapped using "learning logs" as device for data collection.

In order to bring together knowledge, artefacts, work (contexts of use) and practitioners we will introduce the concept "epistemic strategies." It is inspired by Karin Knorr Cetina's (1999) theoretical framework, but differs substantially from her explanation. We differentiate between three aspects of such strategies; framing, connectedness and looping. These will be elaborated upon later. Our empirical evidence is based on short reports or "learning logs" that 32 newcomers spread across four professional groups (accounting, computer engineering, nursing,

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teaching) filled in during a total of 140 work days. This study is part of the larger ProLearn project on the transition between higher education and working life, where the perspective is on knowledge creation in early career rather than the more traditional issue of transfer from formal schooling to practice.

EPISTEMIC STRATEGIES IN PROFESSIONAL WORK: A THEORETICAL NOTE.

The return of the object (Pels, Hetherington, & Vandenberghe, 2002) in recent social theory is a movement that has spread from sociological research on techno-scientific cultures to other fields such as political and educational science (Czarniawska & Hernes, 2005; Nespor, 1994). Knorr Cetina's (1999, 2006) theorising on "epistemic cultures" is a prominent contribution to this literature. Unlike those who inscribe performativity into knowledge by using the term "knowing" (Gherardi & Nicolini, 2003), Knorr Cetina sticks to "knowledge," but combines it with "object" as "knowledge objects" or "epistemic objects." She places this concept at the centre of her theoretical edifice, pointing to a dialectic between on one side the unboundedness or "unfolding" character of professional expertise in a complex world, and on the other its embeddedness in a symbolic and material infrastructure or system of artefacts that stabilise practices.

To Knorr-Cetina the constructive relationship between a collective subject such as a "community of practice" (Wenger, 1998) and knowledge is not a direct one, but is mediated by materiality and semiotic objects. In other words cultural tools are change agents and intervene in processes where humans interact. Knowledge objects are relational along several dimensions. They mediate between the professional and her work and are themselves transformed in this process of articulation. We are not speaking of stand-alone (material) objects, but communities of objects that refer to each other and combine in different shapes. They "make relational demands and offer relational opportunities to those who deal with them" (Knorr-Cetina, 2006, p. 32), and thus transform our definition of ourselves. In the professional field boundaries between domains of expertise are redefined. New object relations are created through the mobilisation of expertise to handle emergent and complex problems such as economic crime (Puonti, 2003) and neonatal intensive care (Brown & Middleton, 2005).

In her studies of how "machineries of knowledge production" are coming into being, Knorr Cetina (1999) extracts a set of epistemic strategies that work together in conjunction. Practitioners enter into unfolding or explorative loops when they are attracted by a problem that engages a "heterogeneous amalgam" of material and symbolic resources or, in our vocabulary – a complexity of knowledge sources. A new awareness is created that reframes the task at hand and turns it into something different (and analogous). It adds to previous actions, but diversification is paralleled by integrative moves. Knorr-Cetina applies the term "convoluting" to this process of putting together resources with different origins. Inconsistencies trigger new framings and unfolding loops. This strategy could be seen as learning by synthesising (Nonaka & Toyama, 2003).

Another strand of argument deals with the codification of professional knowledge and the adoption of knowledge sources to contexts of practice. Unfolding loops may be involved when abstract or transcontextual artefacts are intended to mediate tacit skills. We will refer to this strategy as learning by adoption, which in principle is an unending process since map and terrain differ.

In the present paper we take Knorr-Cetina's vocabulary as "templates" in line with the explanation she provides: "… templates against which to explore the distinctive features of other expert domains and as pointers to possible dimensions in other areas" (Knorr-Cetina, 1999, p. 252). Our study will not be a test of the spillover or epistemification theses. We are approaching these problems through conceptual detours. If computer engineering and accounting are seen as media-rich professions, we may expect a conjunction of epistemic strategies and learning by synthesising. If teaching and nursing represent weakly codified professions, unfolding processes could be conceived as learning by adoption.

METHODOLOGICAL SET-UP

The present study is a part of a larger project "Professional learning in a changing working life" (ProLearn), which examined among other things the professional education of accountants, engineers, nurses and teachers at the University College of Oslo. Under the project, a survey study was administered during the introductory year and the graduation year of a bachelor degree (three years) – and a follow-up when these candidates had been at work for a two-year and a four-year period. Samples of 10 graduates in each group were selected from the survey population for semi-structured interviewing and the recording of learning logs. Focus group interviews were conducted with a smaller sample.

The sub-study of the ProLearn project to be presented here takes its empirical support from the learning logs (see Bolger, Davis, & Rafaeli, 2003). These were designed as short questionnaires without pre-coded categories for answers. All the participants recruited to the personal interviews were given the additional instruction to fill in these forms during two weeks – selecting two optional work days during each week. They were also asked to choose two weeks that would represent differences in seasonal or cyclical variations. The topics addressed in the logs were the following: Deliberations on professional matters, the use of knowledge sources (books, net-based resources, colleagues, experts etc.), additional comments on problem solving and learning. Twenty-two (six accountants, seven engineers, six nurses, three teachers) out of 39 participants agreed to fill in the logs – in either a paper or a web-based version. In general the reports were quite detailed on the type of problems encountered or raised – and the ways in which they were handled. Also the use of knowledge sources was clearly indicated. A total of 138 work days was summarised in the logs.

The coding and analysis of the logs were done in several steps. First the answers were transferred to a data file in Atlas/ti – a qualitative analysis programme (see http://www.valt.helsinki.fi/atk/atlas/atlastu.htm). Secondly a rough categorisation was carried out on the basis of the dichotomies to be presented below. This step

allowed some quantitative comparisons between groups and topics. Thirdly these classifications were taken as an empirical platform for qualitative enquiries along the lines prescribed by grounded theory methodology (Charmaz, 2006). The construction of new codes was cross-checked with summaries of the logs and the personal interviews generated in Atlas/ti.

As approximations to the terminology of Knorr-Cetina we introduce the following categories to be used in our analysis of the learning-log data:

- Framing. One interpretation of "unfolding" is that a lack or gap is introduced that will orient the practitioner towards new entities in the environment. However a problem could also be seen as routine that need not be attended to. One of the central arguments of Knorr-Cetina is that the pervasiveness of objectual relationships introduces a "dissociation" or fragmentation (Bruni, Gherardi & Parolin, 2007) which requires different entities to be put together in new patterns. Of course our novices may choose to behave differently – treating problematic situations as routine and well-known tasks as challenging.
- Epistemic connectedness. As pointed out previously, one of the intentions of the ProLearn project was to describe how professionals use knowledge sources in their work – handbooks, colleagues, procedures and so on. Again with reference to Knorr-Cetina one could expect differences in terms of the number and the character of these sources. The latter may refer to preferences for either objectual or social input – in other words, differences in abstractness. Of course this is a crude distinction that does not give full credit to the theoretical framework of Knorr-Cetina. On the other hand it reflects the dimension of textualisation that several authors attribute to knowledge-intensive working life (Zuboff, 1988; Blackler, 1995). Thus what here is called "epistemic connectedness" could be characterised by two dichotomies: Uniplex (one source)/multiplex (several sources) and objectual (predominantly textual sources)/social (predominantly oral sources). The coding proceeded by classifying answers as objectual or social – dependent on what comprised the predominant sources in each case. If more than one type of input was sought, for example talking with colleagues and reading a catalogue, the answer was considered multiplex. Uniplex was used when only one type of source was accessed – even in the case of several sources of the same type, such as colleagues.
- Looping. In line with the ideas about convoluting and unfolding presented above, we could distinguish between restricted and expanding (unfolding) loopings. The first would be comparing and making changes that appear to close the gap or resolve the problem, whereas the second both stabilises the process and expands it into new enquiries.

DATA PRESENTATION AND ANALYSIS: EPISTEMIC STRATEGIES AND CONNECTEDNESS.

In Table 1 we have summarised the results from the learning logs in accordance with the categories explained above. Although the participants were told to report

on the problems that triggered their minds during the work day, almost all of them mentioned only one case. A few, however, listed several problems each day. If these instances differed on the present dimension, we chose the most frequent code so that each day was either routine or non-routine.

The categories "epistemic connectedness" and "looping" were applied to each problem since their values could differ on one and the same day. Our informants listed a total of 167 tasks. The differences between this number and the problems scored on the categories "epistemic connectedness" and "looping" is due to indeterminacy. In many cases (N=22 and N=88 respectively) it was not possible from the logs to classify them as "objectual" or "social," "restricted" or "expanding."

Not unexpectedly, the number of days coded as routine was low compared to those framed as non-routine. These results may be attributed to the work situation and/or career expectancies. Alternatively they are a function of the logs and their "demand characteristics." Or to put it differently - the instruction to describe a challenging case may cause the informants to pay closer attention to non-routine tasks and situations. Still we feel confident in concluding that the number of situations arousing their curiosity is quite pronounced. The computer engineers report the largest proportion of routine work days (21%) while the nurses report the lowest proportion (9%). If we turn to the qualitative differences between the groups, there are specific features that need to be commented.

In most of the cases, 14 out of 24 days, the teachers define their problems in general terms – only indirectly associated with specific episodes or contexts, for example: "How to differentiate my teaching the next year?" Another feature is the proactive character of these deliberations, i.e.: "How to organise a team of girls in physical education in order to include everyone?" These patterns are quite different from those of computer engineers who responded with general definitions of problems in only three out of 34 cases (days). Their questions were very often triggered by technical solutions that did not work – but they were prepared for some kind of "gap-closing" solution. In 10 situations their definition was less routine: "What kind of third party software can we use to handle our 'business objects?'"

The accountants defined both specific questions in their work and more general topics that referred to future events not unlike the present. An example of the first would be: "In reviewing the cash flow analyses. How is a settlement made without 'cheating,' that is to transfer the amount left over to a new period?" An example of the second is: "(Based on this case) how is it possible to audit poor financial statements with the given time limits and according to acceptable standards?" Similarly the nurses defined their problems in a wide variety of ways. Eleven out of 37 cases could be characterised as situated and interpretive, such as "I had a problem communicating with a difficult patient" or "Which cardial rhythm does the patient have? It is difficult to read the EKG-registrations." Sometimes their concern is formulated as one of comparing the patient at hand with similar cases: "I want to get a picture of a patient with heart disease and other unusual diagnoses."

Table 1. Epistemic strategies in quantitative terms across professional groups

	Framing		Epistemic connectedness				Looping	
	Routine	Non-routine	Uniplex	Multiplex	Objectual	Social	Restricted	Expanding
Accountant	5 (15%)	34 (85%)	18 (47 %)	20 (53%)	21 (54%)	18 (46%)	12 (46%)	14 (54%)
Engineers	6 (21%)	28 (79%)	33 (60%)	21 (40%)	25 (45%)	30 (55%)	17 (65%)	9 (35%)
Nurses	3 (9%)	34 (91%)	16 (43%)	21 (57%)	19 (51%)	18 (49%)	2 (11%)	19 (89%)
Teachers	4 (17%)	20 (83%)	12 (57%)	9 (43%)	6 (43%)	8 (57%)	10 (63%)	6 (37%)
Total	18 (16%)	116 (84%)	79 (53%)	71 (47%)	71 (49%)	74 (51%)	41 (46%)	48 (54%)

In nine out of the 27 cases these definitions were put forward as even more general, drawing the attention of nurses to underlying theoretical knowledge, for example "I would like to learn more about diabetes."

To summarise, these accounts of how daily concerns are defined are in line with our general expectations, but do not accord with the more specific relationships derived from Knorr-Cetina's view on post-sociality and object mediation. Computer scientists work within a fairly circumscribed field of expertise dictated by a logic of troubleshooting (see Barley & Orr, 1997). The teaching profession represents an interesting contrast since its practitioners wonder about questions that have an extended time horizon. Both nurses and accountants are typically triggered by what they do, but are preparing at the same time for some kind of accumulation of knowledge – as cases establishing precedence or specific expertise about medical diagnoses.

"Epistemic connectedness" refers to semiotic aspects (oral, textual, "digital") and diversity of information and knowledge-seeking. Table 1 makes evident that the number choosing objectual or social input is relatively evenly distributed for all groups. The same goes for the dichotomy uniplex/multiplex. In general there is a high correlation between objectual or textual formats and multiplexity – often involving communication with colleagues as supplement to consulting books, on-line information etc. These combinations were most pronounced for novice nurses. When it comes to the teachers, they sometimes (eight out of 30 situations) responded in a way that made it difficult to use our categories. They rehearsed "in their head" different ways of handling the general dilemmas raised in their logs. Of course such strategies were also evident in the other groups, but to a lesser degree.

Turning to the computer engineers, one would expect them to be "online" when looking for information. However in more than half of the situations they go to other people. Although this communication tends to be mediated by technology such as telephones, they seek direct interaction with others surprisingly often. They rely more frequently on only one type of source than the other groups. Given the voluminous literature on computer-supported cooperative work (Harper, 2000), it is surprising to observe that only in one situation out of 55 did the engineers discuss their questions with experts on the web. Typically they ask colleagues for some specific information or general support, whereas the output from the web (very often through Google) is the identification of a procedure or a recipe that was expected to solve the problem.

Moreover, the accountants access new knowledge through a combination of artefacts and other people – in this case colleagues. In contrast to the engineers, who use oral communication to get the information needed, the accountants talk with colleagues when they want feedback on what they do. Thus this personal interaction often evolves into an evaluative one, and the use of artefacts such as legal documents, web-based works of reference, financial reports and so on provides the necessary informational support for decision making. Therefore it is not surprising that they quite often combine distributed knowledge practices.

As shown in Table 1 the nursing group refers to objectual or textual entities in slightly more than half of the situations. If we look into the individual logs

however, we are struck by the large differences. Some exhibit a distinct preference for textbooks, medical catalogues, handbooks with procedures and so on, while others choose to turn to medical experts (doctors) as their primary source. As mentioned above these objects (and persons) are often consulted in order to understand a complex problem – thus resulting in a multiplex approach to information processing.

To summarise this section, it must once again be pointed out that the logs describe the perceived use of "knowledge sources," and not their factual use. Thus it is not surprising if teachers overlook the mediational role of pupils, and our engineers their dependency on the computer. These elements could be conceived as "extended arms" as long as they function in a normal and predictable way. If the results presented in Table 1 are compared with the theses on epistemification, our theory-based expectations do not hold. The differences in media-richness (multiplex and mediated or objectual) are small between the four groups, with accountants and nurses ranking slightly above engineers and teachers. Thus exposure to new technology and object-mediation does not differentiate in the direction predicted. Nor does the variation in routine performance accord with the assumptions advanced by Knorr Cetina on the "dissociative" character of post-social work. The prototype of the latter would be computer engineering, but in our case its representatives are the ones reporting fewest new challenges in their daily practice.

"Looping" as explained above, is tentatively divided into restricted and expanding. The first refers to instances where the professionals identify the needed piece of information and thereby "close" the defined problem. They do not appear to explore new venues, a strategy that would be typical of the second alternative, or the "elaborate" category. In this case a lack of closure keeps the subject working on the epistemic object (Knorr-Cetina & Bruegger, 2002). These distinctions turned out to be difficult to establish on the basis of the learning logs, since we often lacked information on how the problems were dealt with over a longer time-frame. As mentioned above, it was only possible to assign a reliable coding in about half of the cases. In addition there was a clear co-variation between the different categories – so that non-routine broad definitions of tasks and multiplex mediation often indicated an expanding strategy.

In Table 1 we can see that the total score for all groups on looping (processes) is evenly distributed for the two values. However the proportion of instances with expanding processes is very high among the nurses – especially when compared with the computer engineers and the teachers. The nurses often reported that they wanted to learn more about the complexities in a diagnosis or a treatment. Their curiosity was piqued by single cases (a patient) that they saw as unique but partially understandable from similar cases. The nurses then sought deeper insight into this "seeing-as" (Schön, 1983) through medical explanations of patient profiles, specific symptoms, standard and optional treatments supported by theoretical models in anatomy, physiology and so on. Among the teachers, expanding strategies were attributed to situations that called upon them to differentiate between pupils with a variety of needs and resources. Typically they

experimented mentally with a couple of solutions, but our data does not say what they concluded or what they have learned. In accounting the expanding alternative refers to synthesising a complexity of new information, legal, fiscal, financial rules and interpretations of company performance. The engineers who were assigned this category looked beyond the routine definition of a task and performed operations to better understand the conditions producing a "breakdown" (Winograd & Flores, 1986), for example "I have used many sources in my work. Also a simulation program to better understand what has gone wrong. I have not yet arrived at a final solution."

Figure 1 highlights some of the key qualitative group differences in epistemic strategies we can extrapolate from the logs. It should be pointed out that the figure exaggerates dissimilar elements in order to provoke new questions for further qualitative inquiries.

In accounting, the newcomers to the field framed their problems as cases that would have implications for similar ones in the future. The use of artefacts and consultation with colleagues often served as a means of evaluating and consolidating solutions arrived at. In many instances the professionals entered a process of synthesising a large body of information, rules and interpretations into a conclusive outcome – similar to inductive reasoning. Such a strategy may be supported by a rather circumscribed knowledge domain and slow evolution where accumulation through precedence on a casuistic basis is possible.

The computer engineers framed their concerns in rather shorttime-slots, but they occasionally proceeded into more exploratory moves if these could strengthen their ability to prevent system "breakdowns" in the near future. Their use of artefacts such as web-based support, e-mail and telephones was informational in the sense that these sources provided the necessary input for troubleshooting. It is tempting to attribute the short time horizon of engineering work to the rapid evolution of expertise and the prevalence of non-formal learning schemes. However several studies have shown how these characteristics are inherent in the task structure – especially if engineers interact with clients (Diaper & Stanton, 2003). It is likely that epistemic, cultural and work-specific factors are involved.

The nurses in our study demonstrated a wide variety of strategies – both in terms of problem framing and in epistemic connectedness. Their concern was often triggered by a procedure they had to conduct in relation to a patient or a knowledge-seeking drive to improve their understanding of the medical case at hand. The latter interest often caused them to turn to technical literature and clinical handbooks. Typically the nurses elaborated their problems in two ways. One was to find theoretical support for what they observed (indicative). The other was more deductive where they looked into the literature in order to strengthen their argumentative basis for a treatment. Several aspects of the working environment and the professional culture of nursing can be used to explain these findings (see Lahn & Christiansen in this volume). However here we want to direct attention towards the highly formalised, rich learning provisions that may have generated a strong learning orientation among the novices.

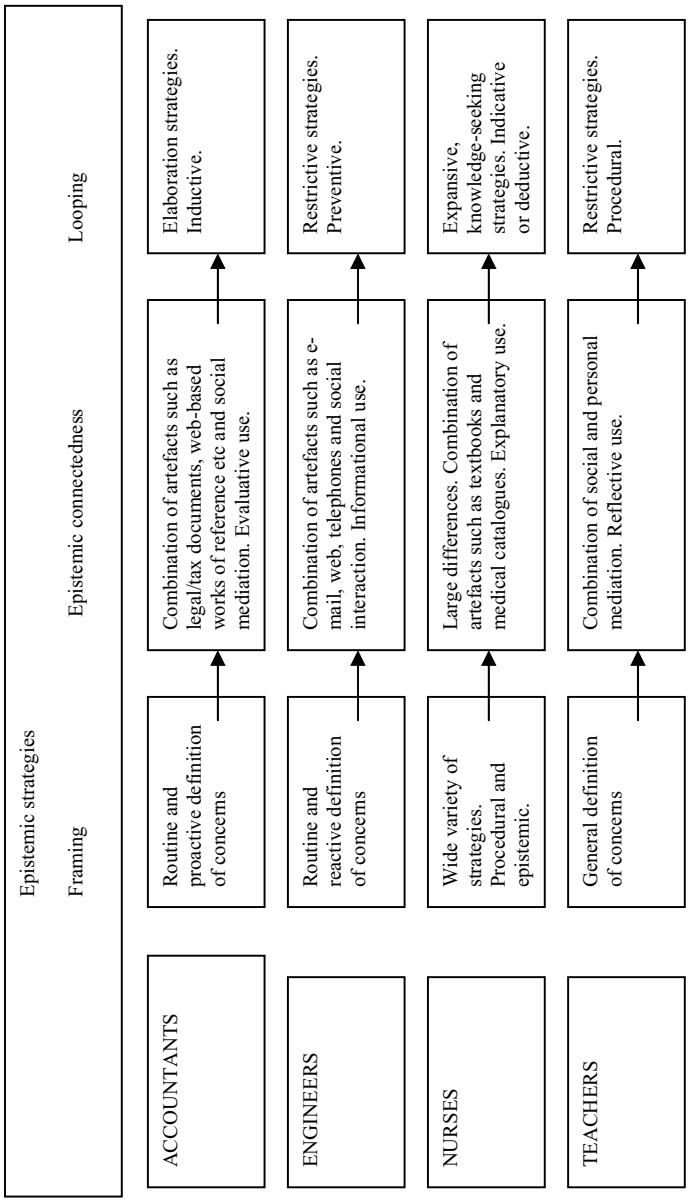

Figure 1. Epistemic strategies in qualitative terms across professional groups

Our reports from the teachers were quite distinct in several respects. The teachers often addressed very general questions in terms of a personal commitment that may interfere when they formulate more elaborated procedural concerns about what to do in dealing with a large number of different needs and resources among pupils. One way to characterise their deliberations is to call them "reflective." As mentioned above they sometimes mentally rotated a couple of solutions. These strategies are not unexpected considering the complexities of the tasks, the broad classification of the teaching discipline and non-formal learning provisions.

The methodological set-up that has produced the above findings is distinctly different from that used by Knorr-Cetina. As mentioned before we have taken the liberty of adopting her concepts as "templates" when studying the use of knowledge sources in our four professional groups. The logs can provide a paradigmatic understanding of epistemic strategies in work situations – that is, we get a view of the affordances that novices are confronted with when handling non-routine tasks. Our data does not include a biographical approach, which could tell us to what extent the reported performances reflect individual strategies.

Thus our "grounded" interpretation of the qualitative aspects of our material leaves us with a sensitising categorisation on how the different professional groups process knowledge sources. Of course the different types of use (epistemic connectedness) and framing strategies suggested in Figure 1 do not tell us whether we are dealing with characteristics of the job content, professional standards, organisational demands or individual preferences. Follow-up studies should be designed to make such disentanglements possible. The same goes for our tentative investigation into the empirical backing of the theses on epistemification and object-mediated knowledge societies. As pointed out above, the amount of non-routine work and the extent of media-rich processing did not follow the order predicted by theory. A number of explanations can be given to account for these results. First our "operationalisations" may not be valid. Second, the predicted transformations are weak compared to other societal forces that shape the professions and their learning context (Evetts, 2003; Eraut, 2006; Greenwood, Suddaby & Hinings, 2002). Third, our methodological design is not sensitive to the differences described in theoretical terms. We will return to these questions in the next section.

CONCLUDING DISCUSSION

The present paper was intended to accomplish three goals. One was to carry out a "naïve" exploration of knowledge sources and their use among novice professionals. The second drew on the theses of epistemification and object-mediated knowledge societies in order to guide our inductive search towards some intriguing theoretical questions. A third concern was to design a methodological tool that could map everyday interactions with knowledge sources in the four professional contexts. Given this diversity of objectives, our project thus far has delimited some alternatives for further empirical investigations. These will be

discussed in the following sections, which also rebalance the theoretical horizon for the analysis of our data.

In recent years the literature on talk in work contexts has been growing (Drew & Heritage et al., 1993; Borzeix & Fraenkel, 2001; Eklund, Mäkitalo & Säljö, 2010). Field-based and observational studies of specific semiotic systems (textual, graphic, numeric) and their use among professionals are also increasing in number (Hutchins, 1995; Kent, Noss, Guile, Hoyles & Bakker, 2007). However there is little research on the various knowledge sources that practitioners access and combine in different ways for processing. We lack work-related studies of reading habits, textual exchange and knowledge sharing through artefacts – except for research on man-machine communication and cognitive ergonomics (Rasmussen, 2000; Hoc, 2008). For these reasons we have restricted ourselves to surveying object-mediation through the dichotomies of oral/written and simple/complex formats. As pointed out above, these indicators were not sensitive enough to highlight potentially interesting differences between the groups. One of the weaknesses with the learning logs is their reliance on self-reports and the short time span that was recorded. Based on this experience, we suggest that the research should "shadow" the knowledge objects, with network analyses and tracer studies representing interesting methodological alternatives, as different trajectories may be identified at different levels simultaneously (Chau & Witcher, 2005; Bruni, 2005). The temporal dimension also needs to be scaled up.

In addition the use of knowledge sources exhibited some clear differences between the groups. These were tentatively labelled as "evaluative" for accountants, "informational" for engineers, "explanatory" for nurses and "reflective" for teachers. This preliminary categorisation should be validated along the lines described above. The same goes for our coding of epistemic strategies. When using self-reported data it is not possible to estimate the degrees of freedom that novice professionals encounter in their work, and we have no clear picture of their preferences in different situations. One interpretation scheme that may be imposed on our results is to understand them as forms of practical argumentation. According to the philosopher Stephen Toulmin (1958), expert communities produce their specific logic when justifying a conclusion. If we transpose these ideas to our study, we can say that our professionals align with specific norms for how knowledge is "manufactured" and accepted as such by the community. The way computer engineers close their problems or forestall future "bugs" would hardly be considered a responsible action in nursing or teaching – although one could argue that mixing rationalities may widen the repertoires of epistemic strategies. Teachers appear to be formulating their problems in rather general terms and simultaneously providing a wide range of procedures that have the potential to resolve certain aspects of the dilemmas faced. Their effectiveness may, however, be enhanced if they pay more attention to instrumental thinking (Klette, 2007). In that case, the relationship between goals and means would be similar to that found in the reports of computer engineers. Among the accountants the elaboration logic may reflect their handling of demanding clients. They need to build up a complex repertoire of cases and perform chain of actions that is similar to "analogical

reasoning" (Gentner, Holyoak, & Kokinov, 2001). However in our group interviews the participating accountants seemed to agree that smaller clients were handled in a more routine way. Thus epistemic strategies are not necessarily specific to each professional community. They are often contingent on other determinants such as clients – or in the case of nurses, the kind of medical services provided. In large university hospitals nurses tended to identify with the domain of medical expertise, and their aspirations were constructed along these paths. Again these interpretations point towards the design of a study that is more context-sensitive than the one described here.

One of our theoretical points of departure has been the theses of Knorr Cetina and others about object-mediation in expert communities. As pointed out above, several objections could be raised against our approximations of their "templates." In addition we think there is a need for a more detailed theoretical understanding of notions such as "object-mediation," "unfolding," "distribution" and "dissociation" that allegedly characterise knowledge production in the professions. Few scholars would disagree with the general maxim that routines tend to "break up" in turbulent environments (Emery & Trist, 1965), and that new socio-technical arrangements and devices contribute to this process. In our study, one of the decisive factors leading to a higher proportion of expansive strategies was the heavy investment in human resource development schemes in which our novice nurses took part. Their interest in medical explanations can probably be traced back to such factors – and to their identification with this field of expertise. If our study had included nurses from rehabilitation and geriatric wards, the picture would most likely have been different. Like the hospital professionals, our accountants were immersed in a variety of "soft" technologies, such as quality assurance systems, that extended their collective memory and thus turned them into updated experts and full members of a professional community. In light of these results one could argue it is no surprise that the novices we have been studying are flexible in their use of knowledge sources. In addition we would expect their performance to be subject to a process of habitualisation (Boshuizen, Bromme, & Gruber, 2004) if different contingencies remain stable. However the vision of an "epistemified" society held together by object relations delineates a pattern of "boundaryless careers" (Briscoe & Hall, 2006) where unlearning and learning is a chronic state of affairs. From a methodological point of view these questions can only be answered if we adopt a longitudinal approach.

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LEIF CHR. LAHN & BJØRG CHRISTIANSEN

GOOD PROFESSIONAL WORK IN ACCOUNTING, ENGINEERING, NURSING AND TEACHING. FROM PRACTICE-BASED TO STANDARD-BASED QUALITY ASSESSMENT?

INTRODUCTION

Professionals are expected to carry out their work well and base their judgment on a system of abstract knowledge (Abbott, 1988). In return they are given a certain degree of autonomy regarding how they perform their work as well as recruitment and training to their field of expertise. What is considered to be good quality, abstract knowledge and self-control varies with the position of the professions on the labour market and their value compared with other occupations. These concepts assume different meanings for each professional group and its members as a result of socio-historical factors and institutional contexts. In this chapter we explore how rank and file novices in accounting, computer engineering, nursing and teaching define "good work," and the factors that enable them to know whether the work is good**.** While the increased emphasis on quality standards may help to harmonise practices between members of the professions, it may also be part of a "branding" strategy or serve to make knowledge more transparent and accountable to outsiders (Power, 1997). We will explore how quality assessment among novice professionals is influenced by standards and procedures. To what extent does quality assessment reflect a scientific rationale – or a "tacit" understanding embedded in the professional community?

As a continuation of the last question we will be focusing on the normative basis for judgments on "good work." To what extent do these reflect a scientific rationale – or a "tacit" understanding embedded in the professional community? In addition we will explore the thesis advanced by Karin Knorr Cetina (1997) and others regarding a "post-social" era: Expert knowledge becomes inscribed in artefacts and infrastructures. It transforms the social organisation of expert work. Thus patient documentation systems or accounting programs may be carriers of new norms relating to "good work" – even when these changes are opaque to practitioners.

Our data derive from interviews, logs and questionnaires to which professionals that are starting their careers have responded. We are assuming that juniors will pay more attention to issues of quality compared to their more experienced colleagues – both as a reflection of the novice's insecurity about technical performance and his or her concern with social alignment. In the next section we

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first look at the different meanings of "good work" from a theoretical angle. Thereafter we present a model of quality assessment that takes as its point of departure the different phases of work processes, i.e. a planning phase, a monitoring phase and a feedback phase. The model also distinguishes between two levels, the *operative level* vs. the *institutional* or *regulative* level, where issues of professional quality are raised (Timmermans & Berg, 2003). The main focus of our study is on the former, that is the manner in which practitioners perform "good work" and know that they are doing so. From there we will expand our analysis to include the more formal measures taken by the community or professional associations to promote and ensure the quality performance of its members.

THE MANY FACES OF "GOOD WORK"

The literature on professional quality represents a diversity of approaches and extends across different academic disciplines such as psychology, education, sociology and management. A few studies try to classify quality dimensions in general terms (Gardner, Csíkszentmihályi, & Damon, 2001a). More rare is a focus on the way judgments about "good work" are made and practiced in the day-to-day setting of practitioners. In this section we will review some of the research on professional quality and its different meanings, after which we will delve more deeply into issues dealing with assessment and standardisation of norms.

In the research literature the term "good work" is often associated with the Harvard-based GoodWork Project (Gardner et al., 2001a). That project employs a multidimensional definition that includes operational excellence, reputation, pride in work, feeling of mastery and institutional goals. Particularly salient elements are selected to describe specific groups. For example when studying "good work" in journalism, creativity and fame are seen as valid categories. With regard to nurses the GoodWork Project (Gardner, Gregory, Csíkszentmihályi, Damon, & Michaelson, 2001b) emphasised "providing quality care" and "achieving the well-being" of patients. This research then attributes such outputs to personal qualities such as respect, compassion, intellectual honesty, accountability, empathy and so forth. Quality assessment in professional work is sometimes described in terms of a psychological self-awareness: as a good feeling or an aesthetic experience (Csíkszentmihályi, 1990) which may be a typical asset for experienced practitioners. They also take an added pleasure in working for a common good.

Although leading scholars within the sociology of professions acknowledge the importance of "person-dependent qualities" in expert work (Freidson, 2001), they concentrate on macro-level issues, such as the dynamics of quality claims made by professional groups and the acceptance of such claims by society (Brint, 2001). Within such a framework Freidson (2001) distinguishes between technical and social quality. The first refers to the skilled performance that produces a highly valued output and the second to a variety of normative requirements that are part of the social contract between the professions and society, for example a sense of a calling, allegiance to an ethical framework, belief in autonomy and commitment to work.

Many of the academic disputes on professional knowledge, tacitness and skill "erosion" have focused on technical expertise. One example is the research on expertise in different occupational fields (Benner, 1984; Sternberg & Horvath, 1999) and its summary in the skill acquisition model of Dreyfus and Dreyfus (1986). They claim that practitioners improve the quality of their work as a result of long-lasting experience in a field. Another proposition often attributed to this tradition, says that the "good" resides in the tacit aspects of expertise. Some would add that it may only become operative and shared through a process of explication or "excavation" (Farnham-Diggory, 1994). These ideas have gained wide currency in the development of knowledge management and quality assessment systems (Von Krogh, Ichijo, & Nonaka, 2000). However the Dreyfus model has been criticised for being linear and uni-dimensional. It may have face validity when we study mature professions in stable environments, such as doctors and nurses in hospitals, teachers in schools, accountants in large financial firms. If we want to explain the complexities of competence development in a changing working life, however, we need a more dynamic understanding (Lahn, 2010). It would be useful to differentiate the notion of professional quality and add institutional, personal and symbolic qualities to those mentioned above. If career patterns are becoming increasingly "boundaryless" (Arthur & Rousseau, 1996), we will expect practitioners to adhere to conflicting definitions of "good work." Their identification with institutional outcomes may grow stronger, meaning that they lose their tie to professional norms. For example they may increasingly assess their job and market value across traditional locations in public and private sectors.

In a society where "what you see, is what you get" or where branding and self-presentation are gaining currency, symbolic aspects of professional quality may be more important than rational concerns. For expert groups such as teachers and nurses the labelling of their practical knowledge as "scientific" or "evidence-based" – irrespective of any use-value – brings them further in their struggle to gain increased recognition (Helmsley-Brown & Sharp, 2003). In a knowledge society there is a widespread belief in scientific validation as a guarantor of quality. This orientation diffuses through a number of formats that also reflect a self-imposed discipline within the professions. They are highly regarded methods for preventing malpractice and poor expert judgment in expanding fields and among growing numbers of members (Freidson, 2001). Since quality is a multi-dimensional concept, and practitioners may combine these dimensions in different ways, there may be a need for the community as a whole to harmonise and canonise its definition of skilled performance (Timmermans & Berg, 2003).

To sum up, it is useful to broaden the distinction between technical and social quality to include personal contentment or well-being, institutional quality and symbolic quality. Although the latter dimensions may be sufficient to characterise the traditional as well as the new roles of professionals, the proliferation of expert groups and their settlement within a large variety of organisational settings and fields of practice justify such an extension. And as pointed out above, standardisation and research-based validation may serve both to calm down significant outsiders and to discipline insiders or members of the community.

ELEMENTS OF QUALITY ASSESSMENT IN PROFESSIONAL PRACTICE

Self-control of quality performance is often referred to as a defining characteristic of professionalism (Freidson, 2001). If so, a key question would be how is this achieved by new as well as experienced practitioners, by professional associations and within the communities of experts. How are the different quality dimensions mentioned above assessed? The simple answer is that novices learn to monitor their performance by "getting the work done" and comparing this with what was expected (Jackson, 2005). The feedback from patients, clients, students and colleagues may also play a role. But professionals are expected to provide more than routine performance. They must have the ability to master difficult problems of a certain kind if they are to be trusted. It is likely that newcomers will ask those more experienced, or seek out different knowledge sources when challenged. Both technical problems and ethical dilemmas could be handled in this way. These instances of quality assessment are typical of actions taken by practitioners informally and continuously during their work days. However occupational decisions and achievement levels may be a function of less mundane and context-defined exigencies. As pointed out before, it is increasingly important for newcomers to create their own careers. Thus they may be less interested in assessing what they do here and now than what they could have done elsewhere. Do I or do we want to continue as generalists or go into more specialist positions? Are managerial jobs more attractive than technical ones?

Both the continuous and the episodic assessments that professionals conduct in their jobs are performed by individuals in specific situations – often in conjunction with the activities of others. Even at this interactional level workers lean on norms and standards that are regulated at a more general level – involving the professional associations in their transactions with each other, public agencies, educational systems or the labour market. For example (public) uncertainties about professional quality may be countered by a knowledge strategy (Karseth & Nerland, 2007) on the part of the professions that puts forth proposals for new educational programmes, licensing and specialisation schemes, agreements on career arrangements or working conditions. For this to be successful, of course, the associations have to convince outsiders that these activities have a quality-enhancing effect on the services produced.

When the core elements of professional jurisdiction are threatened, issues of knowledge and quality are brought to the fore and often subjected to theorisation and standardisation (Greenwood, Suddaby, & Hinings, 2002). Different aspects of professional expertise are transformed in these processes. Timmermans and Berg (2003) distinguish between substantial and procedural standards. The first refers to categories that direct the orientations, interpretations and actions taken by practitioners. These would tell practitioners what kind of problem to expect given a set of observations, and how to solve it. Procedural standards are "coordinating devices" that structure and sequence the actual practice of the practitioners (ibid., p. 67). The question is should these standards be seen as guidelines or orders in a legal sense? How are they regulated and revised? Moreover, there is a growing number of contextual standards that specify the conditions under which a line of

action is appropriate.

Standards and the formalisation of professional quality could be part of a professional strategy, or they may enter the field of practice in a more veiled fashion. One example is the process of computerisation that radically and gradually changes the workplace. Computerisation often entails a standardisation of operations and provides a logic of control that puts an emphasis on documentation. To some extent these systems encourage the development of a uniform professional language that also limits the variety of acceptable interpretations and explanations (Lahn, 1995). There are few studies on how such stealthy processes affect practice in different occupational settings, but we must assume the picture is quite varied. Quality control systems are constructed in accordance with principles of auditing that are well established in accountancy, but they may easily represent a departure from traditional forms of professional development and improvement. At the level of societal transformation they could be seen as carriers of a process of epistemification (Stutt & Motta, 1998; see also other chapters in this volume). This concept refers to the proliferation of scientific validation standards in society through the embeddedness of abstracted knowledge in artefacts, symbolic objects and infrastructures, for example new regimes of "evidence-based practice." Knorr Cetina (2006) suggests that the culture and instruments of science are diffused through this transformation – as a combined effort to push the basis for quality judgments towards a higher level of abstraction

We would expect these changes to make a difference in how professionals perceive quality, and how issues of "good work" are addressed and dealt with. One outcome is that practitioners are more likely to draw on what is viewed as acceptable standards in research communities or generalised knowledge – and tone down judgments based on personal repertoires of cases. Alternatively, experts will be able to remediate their professional experience with the appropriation of new quality standards (Adler, Kwon, & Heckscher, 2008).

We started with a focus on the feedback that practitioners get in their daily work, followed by a presentation of the different views on the relationship between professional quality and standardisation. Some would claim that these elements become linked together by being inscribed into new artefacts and infrastructures at the workplace. If so, we may be confronting a fundamental contradiction. On one hand the unobtrusive introduction of quality standards through computerised work makes these changes less transparent to the practitioners. On the other hand quality assurance systems are carriers of the participative logic of "internal control" and "self control" (Power, 1997), that is, rank and file workers are supposed to take part in the improvement of the systems.

A NOTE ON WORK MODEL AND METHOD

In order to organise the presentation of our data we need an understanding of quality assessment that can incorporate some of the dimensions above. If we use a common model of how people regulate their actions or work processes, we may distinguish between three "control points" (ibid.). First they plan "what to do" and

make some deliberations about "why." Then attention is paid to the performance (of actions) and its monitoring through an interest in "how to do it?." Finally outcomes are evaluated against more or less explicit intentions and reviews of "what is done?" and "why?" In practice these phases, the planning, the monitoring and the evaluative, tend to run together, but each of them can be highlighted through discussions on "good work" or systems of quality assurance. In other words the institutional level makes certain aspects of the operative level salient.

The methodological set-up for the ProLearn project is presented in chapter 1 in this volume which provides a rationale for the selection of professional groups. In addition to their differences in terms of historical and cultural legacies as well as labour market strategies, these groups represent opposites in the way they deal with the balance between discretionary decision-making and the regulation of professional standards (Evetts, 2002). Studies carried out under the ProLearn-project on the "knowledge strategies" in the four professional associations (Karseth & Nerland, 2007) show differences that are closely connected to issues of quality and self-regulation. The professional association of registered accountants is strongly involved in the implementation of international standards of auditing and licensing, whereas the professional bodies of computer engineers are less active in this field. In the case of nursing, the rhetoric of personal judgment and caring is gradually replaced by a fascination with "evidence-based practice" (Timmermans & Berg, 2003) – and thus a more or less implicit academisation of the profession. In the discourses on quality in teaching there is still a dominant reference to "reflective practice" as a common platform, but the plea for a stronger scientific orientation is gaining support (Helmsley-Brown & Sharp, 2003).

PRESENTATION OF DATA

In our presentation of data we will address the different meanings attached to "good work" and describe how these assess quality in their practice. We use the model above as a template in order to be specific about different phases in professional performance: How is uncertainty about routines and problem solving handled? To what extent do the novices pre-assess different lines of action? How is work performance monitored? What is the role of colleagues and others in these processes? How is informal feedback used in the improvement of work performance? We then go on to ask how formalised methods and artefacts influence the quality assessment process compared with practice-based alternatives.

Deliberate Performance

Novices feel they need to be cautious about new tasks since any mistake may have serious consequences. Of course this is most clearly reported among the hospital nurses who are closely supervised by their more experienced colleagues: They report practices of informal consultation, asking colleagues for opinions and advice when feeling insecure or confronted with unfamiliar and fairly risky situations.:

"*I'd rather ask too many questions than too few.*" Nurses said their judgment was enhanced by the willingness of physicians to elaborate their medical expertise as a response to problems nurses encountered in their daily work. The guidance of colleagues also included some probing and instruction when novices tested new procedures. One of the nurses in our sample was not well acquainted with the use of a particular research-based procedure for measuring the level of consciousness among patients suffering from cerebral haemorrhage. Apart from seeking support from the doctor and other colleges, she had read a textbook and scrutinised "the Glasgow Coma Scale scheme."

The nurses frequently engage in a process of self-monitoring that balances feelings of mastery and uncertainty when compared with their own level of clinical competence: Unfamiliar medication or medical expressions encountered in daily work made the nurses consult hands-on literature to verify and develop their understanding. Responsibility for patients with infrequent medical diagnoses prompted nurses to consult medical and surgical methods in textbooks and on the hospital's intranet. The nurses also expressed a need to extend their knowledge linked to a more in-depth understanding of the responsibilities at hand. One example relates to technical equipment used on intensive wards: "*I don't like just to be told what to watch for … Hey, I want to know why! I take a great interest in it* …."

In our material from the computer engineers we find very few statements about priorities or dilemmas in job situations. Thus we do not have much evidence on which to draw conclusions about the way our participants make judgments about the qualities of different alternatives. These deliberations appear to be "embedded" in peer communication: Computer engineers ask senior experts about codes that are more efficient, and some report on how they can disagree about the best method, and how they agree on a common standard: "*let's do it this way!*" They transformed concerns into quality and effectiveness by searching for "knowledge bases" on Google and web-based libraries.

Most of the feedback that our accountants got from colleagues was regulated by routines ("reviewing") and audit systems. These processes focused on deviating practices and error performance, but in some cases doing "good work" included deliberations on the customer's financial situation and discussions of the data needed for the auditing. The following passage refers to this part of accountants' work: "*There is an historic account that we look into: what has happened? Is something so critical that we need to find more evidence, or can we do with the data we have.*" They sometimes use pre-defined guides to organise this type of investigation.

Within the teaching profession it is common to use a variety of sources in planning and preparing for classroom courses. Various artefacts are consulted when preparing for particular lessons, such as "*extracts from the curriculum, the internet, the pupils' books.*"

Quality in schools is promoted by the use of work plans that encourage novice teachers to consider the differentiation of programmes and courses in a new light. One of our teachers elaborated on this, referring to a system with individual goal-

oriented work plans for pupils as a way of promoting quality in schools. Although a couple of the teachers refer to mentoring and supervision as provisions that make them confident in experimenting with new methods, most appear to miss the collegial cooperation that is needed for this to work .

The teachers were torn between conflicting goals, such as the tension between social control in the classroom, the curricular progress of individual pupils and the subject matter timetable. Thus they tried to balance these different quality criteria as they planned their work – and tried to envisage different learning outcomes of their teaching. One of the typical responses from this group was that they missed feedback from above – from superiors. Teachers did not receive any information on priorities and goals – or comments on their own performance as novices.

The degree of deliberation on quality depends on several variables, such as technical uncertainty about goals and their relationships to means – and organisational uncertainty or best practice balanced against time and resource constraints. The collaborative context and the intensiveness of training schemes also make a difference. Even in the face of familiar routine situations, a need may arise to verify and extend one's knowledge and insight. This may indicate a further understanding of problems, concretising of plans, ensuring of procedures, or a need to strengthen a relational capacity. A weak definition of goals is most evident among teachers, who are also rather vague about instrumentalities. They report some uneasiness with the conflict between output expectations, such as individualisation, and the time available in class. The computer engineers represent a contrasting group on these dimensions – especially when it comes to technical uncertainty. They operate with rather clear goals, well-defined means and predictable temporal constraints.

Time is often cited as a variable that affects mindfulness in professional performance. Some of our informants refer to tight schedules as a threat to learning and good professional judgment. In this context, quality control may be seen as tedious extra-work, but it is at the same time believed to reduce the risk of shortcuts and hasty reactions. However there is no evidence of this in our data. A confounding factor may be the fact that novices probably do more anterior reflection on what to do than those with more experience (see also Eraut, 2007). In other words the former work slower, but are also taking fewer risks.

As pointed out above there is a trade-off between efficiency and mindful reviews of alternative lines of action. However the latter may be a cost-saving approach if it helps the professionals to set the right priorities. Newer methods in accounting, based on risk analysis, are supposed to put practitioners in a position to make strategic choices about problematic financial areas – and consequently go deeper into these and pay less attention to the rest.

Another set of elements that may influence the amount of deliberation, is collaborative culture, the intensity of training schemes and the formalisation of quality assessment. However we need to take into account that the diffusion of teamwork and competence development programmes in professional environments may be accompanied by a stronger emphasis on explicitness and negotiated plans. Examples of these trends in our material would be work plans in teaching that are

integrated with new practices (see chapter by Klette & Smeby in this volume). Among accountants web-based artefacts (guidelines, reference texts and so on) appear to have a harmonising effect on problem solving and may possibly promote more explicit professional judgments. The latter is not deeply explored in our study. In general these instruments and systems are meant to improve the quality of work, but a more or less unintended effect is that they may widen the learning opportunities for the novices that we observed.

Monitoring Work Performance (In-Situ Feedback).

Novice professionals monitor their routine performance by using salient information in their environment. Even though teachers in teams may function as models for each other, the main source is the reactions of pupils to their interventions, for example "*you can easily spot pupils that just sit there without paying attention.*" Another strategy is to actively assess the progress made by pupils – that is to "*go from desk to desk, ask pupils what they have learned.*" Sometimes these outcomes were observed through the use of "*small tests*" – or checked with parents. The ability to regulate pupils' behaviour so that "*the social part functions*" also indicated good work. Nevertheless, our teachers felt it was a continuous challenge to gain an understanding of learning outcome: "*Not possible to check, you know by what they know and how much they learn.*"

Both accountants and engineers run self-checks at certain intervals, and continuous commenting is quite common in teamwork. In accounting, such procedures "*run automatically*" as a kind of monitoring, but more demanding judgments also have to be provide on a continuous basis – related to the kind and amount of information needed, for example: "*Do we need more rounds*? *Do we have to gather more reports or get more information?*" More sophisticated problems are encountered when novice accountants must draw a boundary between the information that has to be reported in standard procedures, and that which ought to be reported in order to get a realistic understanding of the clients' financial situation. This was formulated as a conflict between requirements from the audit system and local circumstances. Our respondents claimed that a successful balance of these concerns depended on practical experience and insights into the sector at hand. Guidelines are experienced as insufficient tools for dealing with "*clutter in the books*": "*Then it is practical work that counts.*"

Computer engineers report doing a double monitoring of their work. They have an embedded sensation of how well a program works, for example "*if you can program, the source code speaks for itself.*" In parallel with this routine performance, some effort is put into documentation practices, which are seen as a separate task, but on that is of vital importance to quality: "*For me, assuring documentation is doing a good job.*" On-task feedback from colleagues could also tell the engineer "*whether he is on the right track*" or not. At the same time programmers would stress that "*everyone has their own way of doing things.*"

The novice nurses use written procedures often carried in their pockets or in the patients' folders on a continuous basis as a way of confirming their follow-up of

routines "*ready to use.*" These procedures serve as a tool of validation to ensure quality and support their performance. In general they do not mention the patient as an explicit source of feedback. Their assessment of quality appears to be dependent on whether nursing interventions, however professionally conducted, have an impact on the patient's condition, well-being and improvement. The more involved the nurse has been with the patient, the clearer the confirmation: An informant working on the rehabilitation of stroke patients gets confirmation of his work through the improving condition of the patients. The nurses also refer to their particular responsibility for managing care-related activities as a source of assessing good work, urging them to continuously prioritise the flow of activities on the ward.

Although computer engineers and nurses occasionally work together with other colleagues, they do not normally operate within teams. Of course such a "contingency" would have been different if our sample included more project-based organisations. Teachers and accountants that were working in groups both reported that this structure supported some mutual commenting, and that this communicational monitoring is likely to be more elaborate and systematic than individual reflection-in-action (Schön, 1983). In the case where professionals were collaborating we would expect this interaction to have a rather explicit character, but our study did not provide this kind of data.

To sum up it is safe to say that monitoring has different meanings for our different groups. Among teachers and nurses, an ongoing sensitivity towards the reactions of pupils and patients is highlighted, whereas accountants, in particular, need to have a "split mind" that can step back and look at what they do from the outside. Again the impact of teamwork is quite decisive and tends to turn the monitoring process into a discourse that adds "why" to the "how"-questions. This will also shift its function from control and confirmation towards decision-making and negotiations in a community of practitioners. This reorientation may displace the type of rationalities that are accepted as "good" – in the direction of putting more emphasis on reasons for doing this or that.

Feedback from Outcomes

As pointed out above, our sample of professionals seldom points to "users," customers, patients or pupils as actors that provide explicit and elaborate feedback on how they performed. Usually teachers and nurses indicate in general terms that their relationship with pupils and patients is important when they assess the quality of their work, for example "*When I get some positive responses from the pupils,*" or with regards to patients: "*First of all when they say it. But also if they smile and touch you ….* " Experiencing gratitude from pupils and patients will contribute to the sense of doing meaningful work. However this type of general appreciation may not provide substantial support for quality improvement.

Among computer engineers the occasional responses from customers usually come when something "*doesn't work.*" But sometimes the customers call just to say that everything works fine. The accountants appear to be the only group that

has "users" as active providers of outcome feedback, as customers were assigned to verify and comment the reports.

Most of the informal feedback comes from colleagues, but there are quite distinct patterns between the groups in the detailing and character of this information. The computer engineers receive most of the feedback from superiors. Other colleagues may be used for testing and improving codes, and are referred to when issues such as user-friendliness and code effectiveness were assessed. Among accountants the informal feedback from colleagues is more detailed – on slips, on set-up, on legal interpretations and more – indicating a culture that has a high tolerance for cross-checking feedback. The accountants have standard procedures for collegial audits because "*you're blind for your own mistakes but it's easy to see others*" or "*my cards are looked at all the time.*" They also receive periodic evaluations from superiors.

The teachers receive informal feedback from colleagues in rather general formats and in positive terms like "*It seems quite good.*" A good work climate is stressed as a precondition for informal feedback. In the nursing group this exchange is more specific and deals often with alternative ways of handling a problem or a situation. Nurses miss feedback in their jobs. There is little negative feedback and novice nurses stress the need for "*constructive"* and "*detailed*" comments on routine performance, not only as a response to serious mistakes. As with the teachers, they often refer to a good work climate as a precondition for feedback practices. Since most of our novice nurses worked in larger hospitals, the feedback from doctors was emphasised – a finding that reflects both the position of this professional group in the organisational hierarchy and the field of nursing as partly dependent on medical expertise. Both novice nurses and teachers would like to have increased commenting on what they do, and attributed this need to feelings of uncertainty about the quality of their work in different situations.

The attention that accountants and engineers paid to quality assurance practices certainly influenced their perception of "good work" – in the direction of being more specific than the other professional groups about outcomes and instrumentalities that would support their achievement. Success was also evaluated in terms of deadlines and completion of projects or tasks as expressed by engineers: "*I feel I do a good job when I have delivered within deadline*" or "*every time a project is finished.*" One example from our empirical material is accounting, where our informants referred to Descartes, a new audit management system developed by the Norwegian professional association of accountants and a consultancy firm (see http://descartes.bouvet.no/). The system integrates new methods in accounting, international standards and several computer-based functions such as interactive indexing of client-information combined with self-check-procedures, documentation options, etc

Checklists are common among nurses (double signing for administering medication) and accountants (cross-checking) serving mainly to make the subscriber liable to a series of default actions. In some cases the documentation systems ask for "open-ended" comments on deviations or specific contingencies. Such a practice is quite common among computer engineers and accountants,

which make this type of work rather transparent to distant colleagues. The former often resorted to documented practice as an effective way of copying the solutions of others instead of devising their own from scratch. In accounting, archives were generated in order to compare cases or trace temporal patterns. Among novice teachers student evaluation is seen as a way of documenting practice in a post-reflective mode. However few of our informants used it systematically to assess their own teaching.

Documentation is a function or task that either is loosely synchronised with the work process as such or initiated as a flash-back on previous operations. It is supposed to improve performance in different ways – and a large variety of formats and techniques are used to account for what has been done. Both the production, reuse and use (by others) make this type of work a key element in balancing quality and effectiveness.

The work of our accountants was regulated by quite elaborate quality assurance schemes. Lists were in many cases sent to customers for verification, and each professional attended sessions with periodic evaluation and audits. The latter also included the systematic reviews of client portfolios and reports generated by auditing programs. It must be added that the latter are part of international certification systems that also include requirements for the continuous upgrading of (registered) accountants. Both computer engineers and nurses referred to quality assurance systems that were institutionalised beyond the local level – either as national or international standards. In hospitals this went along with the development of schemes for "evidence-based practices."

HALLMARKS OF GOOD WORK AND QUALITY ASSESSMENT PRACTICES

Not unexpectedly, our novices were primarily concerned with technical quality and the need to be competent in their work. Their feelings of being in control and doing something worthwhile were closely linked – and associated with the need for acceptance by colleagues and others. Thus personal, technical and social values merge into a multidimensional understanding of "good work." There are some differences among the professional groups we studied. Novice nurses working in hospitals had to demonstrate their skills and aspirations as "legitimate peripheral" (Lave & Wenger, 1991) members of their expert community – and to struggle for recognition among medical doctors. Turning to the computer engineers, it was not uncommon to be credited for beautiful programming solutions. In this group we also found that institutional quality is important, since being in a good and challenging environment could be crucial for their future careers. Compared with the other professions the novice engineers entered less clearly defined trajectories on the labour market.

In all the groups new and complex tasks were handled by novices with careful consideration and planning before doing the job. Very often they turned to other colleagues or manuals and instruction-sheets for advice in those situations. Even if they knew what to do, they needed to be reassured about their choice. This strategy was most pronounced among nurses and accountants. As novices they felt a

personal responsibility for updating themselves in accordance with professional demands at work, knowing not only how to perform but also why. The nature of the work (ill patients, financial consequences of errors, learning outcomes of the pupils, visibility of the job, etc.), combined with a personal responsibility for ongoing tasks, made our professionals consult and use different sources of knowledge. In the case of nurses, responsibility for patients with unusual medical diagnoses inspired them to consult medical and surgical guidelines in textbooks and on the hospital's intranet. Interacting with knowledge sources as preparation and monitoring devices is a safeguard in practice (Knorr Cetina, 1999).

One could assume that the introduction of quality control and improvement methods would make our novices more risk-aversive and support a cautious approach to problem-solving. Our data does not allow us to draw any conclusions on this issue, but there may be an indirect effect here. The use of formal tools such as manuals, etc., was often accompanied by an intensification of teamwork that stimulated a more reflective approach to technical tasks. The number of why-questions and alternative interpretations may also have increased, thus strengthening the learning opportunities for newcomers.

The computer engineers contrast with the other groups when it comes to standardisation and quality control. The former are subject to detailed self-check as they proceed in their programming tasks. They look for knowledge bases on the internet in order to "get what they need" by copying solutions that are evaluated and tested. Our informants maintain that their monitoring of work processes is taken care of by the logic of programming, which is thoroughly standardised both in terms of vocabulary and procedures. Specific areas within accounting are clearly moving in this direction, but different professional codes still exist side by side and the formalisation of assessment procedures functions as a control of correct task performances. Quality criteria and their realisation in accounting is not an embedded part of the work processes as it is in computer engineering. A whole new logic is at stake when accountants talk about "new methods": "*earlier we started at the bottom, now we start at the top. It has turned around the way we do our job.*"

As pointed out above, some of the literature on professional expertise has been quite critical to the standardisation of skills, arguing that it will mean an "erosion" of tacit and personal knowledge (Davis, Subrahmanian, & Westerberg, 2005). Our informants did not share this pessimistic vision. On the contrary they were actively looking for formal devices that would help them to improve their work. These preferences may of course be strong in early career, whereas the value of experience tends to be upgraded in later phases (Lahn, 2003). Computer engineers have a pragmatic attitudes towards best practices. They search the web for solutions to a problem or alternative procedures that they can test out in a "virtual space." Within accounting, decisions have to be in correspondence with legitimised definitions and rules, but there seems to be no consensus about whether the calculation of assets in terms of market values is right or wrong. In the teachers' profession "evidence-based practice" and "large-scale assessment" have entered the vocabulary, but our study does not provide any data that enables us to trace any

effects of these discourses at the micro-level. We found that "evidence-based practice" was introduced into the work culture of nurses – especially where medical treatment is a central activity. It was common in other contexts too. However the responsibility for revising methods and guidelines and obtaining research articles was handed over to Advance Practice Nurses and doctors. This is in accordance with reviews in the literature that evidence-based practice turns out to be evidence-based medicine, and that the main sources are articles in journals (Banning, 2005).

Novice professionals need feedback from customers, patients, and pupils to calibrate their skills. However in their learning process they are hesitant to attribute any important role to this information. They view expressions of gratitude and goodwill as aspects of being a patient or clients (Christiansen, 2008). In general patients and clients are expected to trust the knowledge base of professionals and not question their expertise. This may be somewhat less the case if patients define themselves as customers. However their feedback to practitioners is not only about technical quality. More often patients, students and clients may provide useful input on social and institutional norms for skilful performance.

In general colleagues provide more informative and accurate feedback to novice professionals than outsiders. In addition "communities of practice" receive their newcomers with some tolerance for failures and a collective orientation towards on-the-job training. According to our informants the feedback from experienced peers could be negative but constructive. We return to this issue in the final discussion. In the literature on (total) quality management, feedback from superiors is crucial since problem solving and learning from doing are to be stimulated at the operative level – the rationale being that errors tend to escalate as they run through the organisation (Docherty, Forslin, & Shani, 2002). We have assumed that these vertical channels would be quite active when new members are introduced to the workplace, but our informants do not tell us much about such feedback. Teachers appear to lack both a clarification of goals and some evaluation of their work from superiors. Computer engineers have the employer comment their product, but in general work quite independently of any communication from above. In accounting this relationship is put into system as newcomers have regular meetings with superiors to discuss performance outcomes, mutual expectations, problems etc. Most of the nurses in our material work in hospital wards where superiors are part of the team, and where feedback from experts is organised in a systematic way through supervision, demonstrations and meetings.

CONCLUDING DISCUSSION

We started this chapter with a short review of the "Good work" project. One of the characteristics that separates the work of professional groups from that of other occupational experts is that it is difficult (Sciulli, 2005). It may be a question of high qualifications, a way of presenting oneself or a combination. This reminds us that "good" and "difficult" have different meanings. The later may point to either (1) the personal hardships and sacrifices that are synonymous with becoming a

professional, (2) the production of exclusive knowledge that keeps the lay person out or (3) the justification of professional skills as scientific or systematic (Siegrest, 2002).

If professional work is made good on the basis of being difficult, then it is good work to take learning seriously. In all the four groups that we studied, newcomers had to master more than the tricks of the trade. The trade itself or their expert domains were moving, and transformations took place at several levels. This required that our "peripheral members" became a new person as he or she made his or her way into the community of professionals. Such a process is costly (Barnett, 1999), and in the case of our informants it was associated with a number of risk-reducing manoeuvres like consulting manuals, seeking advice from experienced peers, investing a lot of energy in deliberation and planning, and relying on limited numbers of routines. The instantiations of the "audit society" in the four professions also promoted this kind of cautious strategy as qualitatively sound. Such a description diverges from the more pleasurable picture provided by the "Good work" project where reference is made to concepts such as "flow" and the like, that describe the joy one feels when a skill is appropriated. This vocabulary may be more valid when we are dealing with experienced workers – and not newcomers into an occupational domain. The difficult part is not always that joyful.

Professional quality is in principle inaccessible to outsiders – to patients, customers and pupils. The latter have to believe they are in good hands. This asymmetrical relationship defines the kind of feedback that is given and received, a well as how it is interpreted and taken into account. The redefinition of patients and pupils as customers may challenge the practitioners' claims of exclusiveness, but they remain reluctant to relinquish their monopolistic control. A number of dilemmas are raised but not well documented in our study; for example, is there an implicit ranking of outsiders in terms of who provides relevant inputs? Does the rising class of influential customers apply different quality criteria from the professionals?

Professional skills are branded as difficult, high quality and proof through science-based and systematic schooling. Thus the proliferation of quality assurance regimes, standardisation and methods for evidence-based practice does not as such indicate a "spill-over" of rationalities from the research sector to occupational groups. Outsiders and society would expect professionals to be attentive to the communication with their scientific field – especially when skills need to be updated and new knowledge transferred to "communities of practice." We are not necessarily dealing with a "spill-over" in quantitative terms – that is, more use of science-based approaches among practitioners. It may be a question of new forms that strengthen an academic line of reasoning (and justification). However our study does not have data to shed light on this issue. On the other hand it provides an empirical basis for differentiating between three related strands that are subsumed under the term epistemification that we introduced earlier: (1) The extension of schooling into early stages of occupational life, (2) the institutionalisation of systematic thinking, and (3) the proliferation of epistemic

objects.

The "spill-over" of scientific rationalities as predicted by Knorr Cetina and others can be interpreted as a non-dramatic diffusion of objects that are carriers of professional knowledge, universal standards and computer logics. From our study we could illustrate this point with the introduction of the Descartes management system in auditing. It restructures this process – from a linear to a more iterative pattern where more attention is paid to the analysis of risks and financial flows than the balance of statements. According to our informants the use of this system required a more acute attention to the pre-arrangement of the auditing process. They did not think of these changes as science-driven or as a step towards universalistic principles in auditing. On the contrary some of them underlined that these systems required a deeper understanding of business-flows in companies and a "feeling" for the sector since assets are to be market priced and not historically priced. However Descartes represents an amalgamation of different functions, logics and standards where it is difficult to disentangle one element from the others. They adhere together and may restrict the latitude for the practitioners to choose between instruments and ways of doing things. Tentatively we would suggest that epistemic objects which have this textural character (Gherardi, 2006) stabilise a field of expertise or a mixture of fields. If so they become more mobile and diffuse even more widely. "Good work" may be tantamount to the adoption of these artefacts since they say what is correct and incorrect and provide a procedure for making things correct. They promise progress, they underline the need of professionals to be updated and ensure customers and patients the best services available (Joerges & Czarniawska, 1998). The theoretical and methodological lesson to be taken from this example is that experiences of the "good" are less a direct relationship between professionals and their work. Practitioners attribute quality to what they do, dependent on whether it promotes career opportunities, accords with occupational standards and procedures or matches popular images and fashionable models of the "good," "modern," "challenging" jobs. Future studies should look more closely at this dynamic.

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KIRSTI KLETTE & JENS-CHRISTIAN SMEBY

PROFESSIONAL TRAINING AND KNOWLEDGE SOURCES

INTRODUCTION

The aim of this chapter is to examine professional learning among novice professionals focusing on nurses and teachers. Our point of departure is that professional learning is not just a matter of individual motivation to learn or how occupational training and learning is organised and managed. Professional learning deeply concerns the characteristics of the knowledge bases available in the respective professions (i.e. nursing and teaching), accessible knowledge sources, and the extent to which these sources are made available through mediating artefacts in the workplace. In the analysis that follows we therefore contribute to the ongoing discussion on professional learning by examining the relationship between professional training at the work site and available knowledge sources among teachers and nurses.

Social-cultural perspectives have challenged traditional learning theories. Focusing on "communities of practice" (Lave & Wenger, 1991) social-cultural perspectives emphasise community dimensions and local features as essential for learning. Learning through apprenticeship models and community design tends, however, to downplay that learning also draws on abstract and global knowledge and information, which easily travel across space and time (Smeby, 2007). In our analysis we want to focus on the extent and way in which the global and local dimensions of knowledge used by professionals are interdependent and mutually supportive. To what degree are local knowledge sources linked to wider, global knowledge sources? To accomplish this, we will explore potential characteristics and differences in the professional learning of novice teachers and nurses. We start out by looking at the characteristics, features, and use of available knowledge sources in the two professions. We then examine the extent and way in which nurses and teachers are trained during their early professional careers. What are the characteristics of their initial professional training and how may possible differences here be related to the characteristics of their respective knowledge bases and available knowledge sources?

Teaching and nursing share some common aspects. They are both "relational occupations" (Moos et al., 2004), and both deal with human development and improvement. However, the reason why we have chosen to compare novice nurses and teachers is that their knowledge bases differ significantly despite these common features (Grossman & McDonald, 2008; Spenceley et al., 2008). Further,

K. Jensen et al. (eds.), Professional Learning in the Knowledge Society, 143–162.

their professional tasks and organisational setting diverge. While nurses are involved in activities that may have life-threatening consequences, teaching has in general less significant and mostly long-term implications. Nurses, especially those working in hospitals, are subordinated to physicians and collaborate with several other professionals. Teachers work more independently, surrounded by colleagues whose professional backgrounds are on the whole similar to their own Moreover, hospitals are hierarchical organisations composed of functionally specialised wards, while schools are characterised as horizontal and "loosely coupled" (Weick, 1976) systems. These differences are even more significant in our material since the teachers in our samples mainly work in a variety of primary comprehensive schools, while the nurses, especially those included in our qualitative material, work in intensive high technology wards in large hospitals. Our aim in the current analysis is not primarily to compare specific occupational groups, but to compare the different ways in which professional groups connect to a professional knowledge base. We will then explore the implications of this for professional learning and training.

Our analysis takes its empirical evidence from quantitative survey data, qualitative interviews, and learning logs, all collected from newly educated teachers and nurses. First, however, we provide a brief sketch of the overall theoretical framework for our analysis. Our analytical framework is inspired by and draws on perspectives and concepts from Etienne Wenger's theory of "communities of practice" (Lave & Wenger, 1991; Wenger, 1998) and Karen Knorr Cetina's theories of epistemic communities (1997, 1999). These theoretical perspectives are rather broad and focus on occupational learning in general (Wenger, 1998) and take scientists working in the field of high energy physics and molecular biology (Knorr Cetina, 1999) as their point of reference. In our interpretations of the data reference will also be made to studies on professional learning and training in the two professional groups (i.e. teachers and nurses) will be referred to in our interpretations of the data. Together these two analytical perspectives enrich our conceptual understanding when analysing critical factors essential for professional learning and training among teachers and nurses.

ANALYTICAL PERSPECTIVES

A central perspective emphasised in the introductory chapter (see chapter 1) is that professional learning in a knowledge society should not be analysed as enclosed in local communities of practice. Today, practitioners as well as lay people have direct access to science-generated knowledge and information. A move in focus from local knowledge practices to global expert communities beyond the interpersonal and local levels challenges the perspective of learning as "legitimate peripheral participation" (Lave & Wenger, 1991). Building on his earlier work with Jane Lave, Etienne Wenger (1998) offers a framework for the analysis of learning in social contexts that aims at connecting the global and the local features of professional learning. Negotiation of meaning as an experience of everyday life holds a key position in Wenger's revised model of professional learning. In its

essence practice is meaning in Wenger's revised model of learning, and this negotiation is at the same time historical and contextual, global and unique.

According to Wenger (1998), meaning in communities of learners arises from two complementary processes: participation and reification. *Participation* refers to the shared experiences and negotiations that result from social interaction between members within a purposive community. Participation is thus inherently centred around local negotiation processes and will differ from one setting to another. In contrast, *reification* is the process by which communities of practice produce concrete representations of practice such as tools, symbols, rules and documents. The two processes – participation and reification – are complementary in that each has the capacity to repair the ambiguity of meaning that the other can cause. Newcomers are linked to a professional community as they are exposed to modes of participation (for example through professional conversations) and modes of reifications (such as models, books, recipes and other artefacts). Participation and reification must, however, be in proportion in relation to one another so as to compensate for their respective shortcomings:

> When too much reliance is placed on one at the expense of the other, the continuity of meaning is likely to become problematic in practice (Wenger, 1998, p. 65)

Participation and reification are dual, persistent and continuing processes. Their duality is a fundamental component of how professional communities evolve over time, of the relations and formation of identities among participants, and of the broader organisations and infrastructure in which communities of practice exist. Of special interest to us is how professional communities among teachers and nurses engage with and support these dual processes as tools for learning.

An important focus in our analysis is the extent to which newly qualified professionals connect to a global and abstract body of professional knowledge in addition to local communities of practice when it comes to their professional learning and development. Academic science is generally published in specialised journals and esoteric languages which prevent "outsiders" from participating in scientific communication. The transformation and distribution of such knowledge therefore involve strategies of summarising and representing information, mechanisms for translation, and facilitation of this knowledge transfer. Mediating artefacts and tools, represented in feasible and accessible ways, are therefore necessary support mechanisms for knowledge exchange between the global and local site (Foray, 2001; Knorr Cetina & Bruegge, 2002; Miettinen & Virkunnen, 2005). For example, Foray (2001, p. 1554) sees the interface between science and technology, what he calls "science illuminated technologies" (SIT), as central to providing an effective model for knowledge transfer across and within disciplines.

Mediating artefacts and tools are, however, open to further improvement and exploration to a varying extent. A distinction has been made between *instruments* and *tools* that are ready-made "things to be used" on the one hand, and *knowledge objects* that are unfolding and continuous "things in process" on the other (Knorr

Cetina 1997, p. 10). According to Knorr Cetina, the latter are held to characterise the properties of today's knowledge challenges. This dichotomy seems exaggerated, however, when applied to professional learning. Mediated knowledge may be readymade things to be used, having the character of closed boxes or recipes. However, such technologies may simultaneously be things to be used *and* things in a process of transformation as they are objects of continuous development and investigation processes. In the discussion that follows, we keep this ambiguous dichotomy in mind, while we analyse how the two professions connect to and use different knowledge sources. We restrict the term "knowledge object" to knowledge characterised by an open and unfolding feature, while we use tools to refer to knowledge sources that have the fixed and finite character of closed boxes, manuals, recipes and the like.

Inspired by Wenger's (1998) conceptual framework, we further distinguish between collegial and materialised knowledge sources in our analyses. We define collegial knowledge sources rather broadly, including colleagues and other professionals working nearby, as well as experts working further afield. Materialised knowledge sources include textual knowledge sources, such as books and journals, as well as texts published on the Internet. The materialised knowledge sources may, as highlighted above, have the characteristics of open-ended unfolding knowledge objects as well as fixed and finite instruments (Knorr Cetina, 1997, 2006). Knowledge objects and tools are both included in social practices, however. The local knowledge culture is therefore of significant importance with respect to which knowledge tools become knowledge objects and vice versa. An example could be a medical procedure which in some contexts could be treated as a fixed manual, but in others as more open and as a point of departure for interpreting and understanding a concrete case, sometimes leading to new or revised procedures. As emphasised by Wenger (1998, p. 131), the local and global *coexist* and *shape* each other as related levels of participation. Therefore, local knowledge cultures or "communities of practice" may be of significant importance with respect to whether materialised knowledge sources become "open ended" knowledge objects or "closed" instruments and tools.

The analysis that follows will focus on the following questions:

– What are the characteristics and features of collegial and materialised knowledge sources available in the respective professions?
– To what extent, and how, are nurses and teachers trained during their early professional careers, and what are the characteristics of this professional training?
– Are there any correlations between available knowledge sources and modes of professional learning and training?

DATA AND METHODOLOGY

Our study of workplace features accommodating professional training takes its empirical support from quantitative survey data and qualitative interviews and learning logs. The quantitative data are drawn from the longitudinal Database for

Studies of Recruitment and Qualifications in the Professions (StudData) in Norway (http://www.hio.no/studdata). The present paper is based on responses received from nurses and teachers some three years after graduation, in the spring of 2004. The response rate was 54 per cent (N=263) among nurses and 58 per cent among teachers (N=234). The questionnaire was distributed by mail. In the analysis, only respondents who reported that they worked full time (30 hours or more a week) and held a position which required the respective professional education (or a corresponding education) were included.

The qualitative data derive from interviews and learning logs with nurses and teachers selected from the quantitative register. However, as emphasised in the introduction to this chapter, most of the teachers in our material work in a variety of comprehensive primary schools, while the nurses, especially those included in the qualitative material, work in intensive high technology wards in large hospitals. The institutional framing and context for professional training consequently differ significantly between the two groups and this is taken into account in the analysis and interpretation of the data. The interviews cover individual interviews with 10 novice nurses and 10 novice teachers, supplemented by group interviews with three informants from each professional group. The learning logs cover two independent weeks of the interviewees' initial professional training. Informants were asked to fill in a pre-designed form aimed at eliciting their thoughts on professional matters, use of available knowledge sources and comments regarding problem solving and learning during the workday. In total, three teachers and six nurses reported on their workdays through the learning logs.

The analysis that follows is guided by an interest in similarities and differences across data sources and professional groups with regard to how novice training is organised. Discrepancies between the different data sources will be commented upon and discussed. In the presentation, we will first draw attention to patterns and findings emerging from the quantitative data material, and then investigate how the qualitative data sources can expand this picture and provide us with additional interpretations and insight into how the learning of novice teachers and novice nurses is organised.

MODELS AND FEATURES OF PROFESSIONAL TRAINING AT THE WORKPLACE

In the section that follows we present and analyse features of professional training for nurses and teachers as revealed through the quantitative and qualitative data. We start out by presenting types and forms of knowledge sources as reported by the two groups, and discuss their frequencies and distribution. Based on the distinction between collegial and materialised knowledge sources, we then probe in depth how these two knowledge sources are used among novice nurses and teachers. As a second line of investigation we examine to what degree and how the two groups are exposed to organised and systematic training through their work. These analyses will be guided by features of professional communities at the local site, available knowledge sources (i.e. knowledge objects and tools) and how these

are linked to global versus local communities of knowledge exchange and knowledge transfer.

Knowledge Sources in the Two Groups; Frequency and Distribution

Not surprisingly, colleagues were the knowledge source that the newly qualified professionals consulted most frequently when they were confronted with demanding tasks. More than 80 per cent of nurses and teachers consult their colleagues at least once a week (see Figure 1 below). The proportion who consulted external experts is somewhat higher among nurses (10 per cent) than among teachers (5 per cent). Even though the differences between nurses and teachers when it comes to approaching external experts are not that significant, the variation may nevertheless indicate a difference in the division of labour in and institutional solutions for consulting experts among the two professional groups. Rather than indicating differences in preferences regarding knowledge sources, we suggest that these differences reflect variances in the division of labour in schools versus hospitals. Nurses work in their respective units with a variety of professional groups that represent different forms of professional expertise. The units and wards are furthermore linked to other, related units and communities of practice within the organisation of hospitals. Teachers, on the other hand, work within a horizontal infrastructure in institutions characterised by a weak division of labour, where all draw on more or less the same expertise.

The most significant difference in Figure 1 below is that a much higher proportion of teachers use the Internet weekly. Furthermore, a somewhat higher proportion of teachers than nurses consult specialist literature at least once a week.

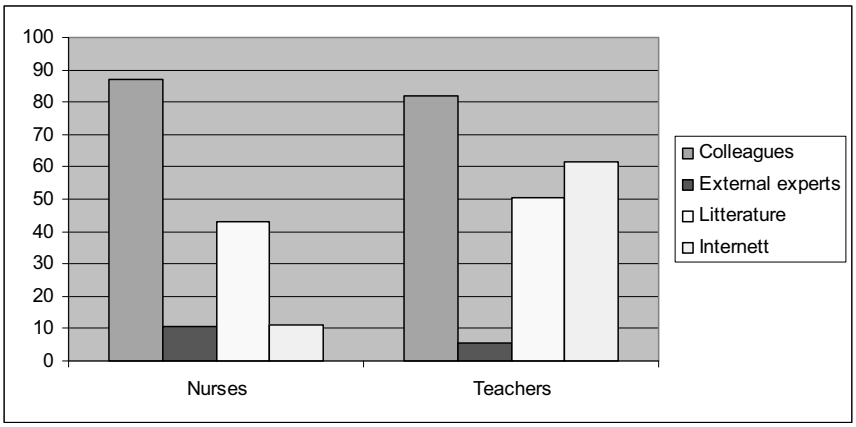

Figure 1. Percentage of novice nurses who reported that they consulted colleagues, specialist literature and the Internet at least once a week because of demanding tasks in their daily work

We have examined the possible correlation between collegial and materialised (i.e. textual) knowledge alternatives in the sense that emphasis on the latter implies less emphasis on the former. This seems not to be the case. There is a significant although rather weak positive correlation between consulting collegial and specialist literature among teachers (Persons r=0.16) and nurses (Persons r=0.18).

With regard to textual sources, there are further significant differences between nurses and teachers when it comes to time used for reading various types of specialist literature and information. Teachers spend significantly more time than nurses reading professional journals and articles (paper and web), specialist literature such as books and works of reference, and professional information on the Internet. In total nurses use 2.2 hours a week for such reading while teachers use 5.2 hours (see Figure 2 below).

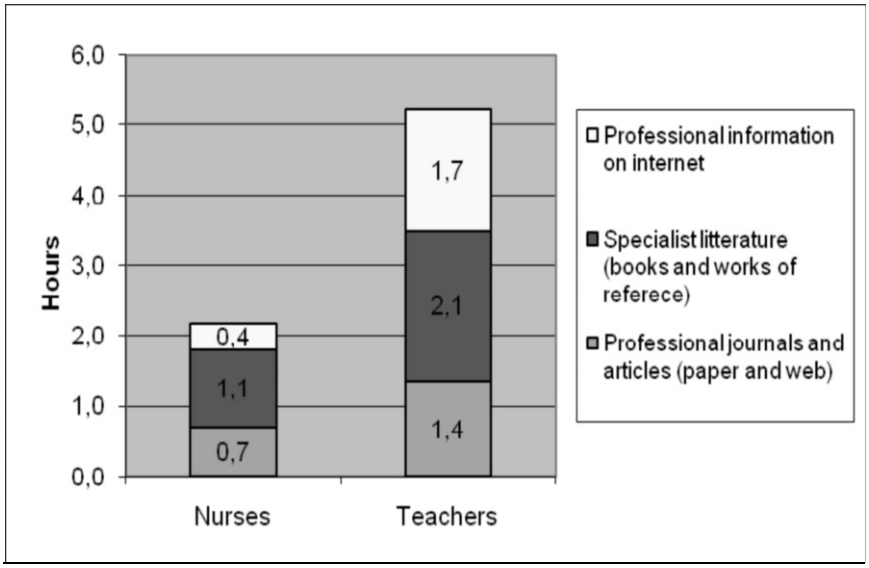

Figure 2. Novice nurses' and teachers' use of time for reading professional information on the Internet, specialist literature (books and works of reference) and professional journals and articles (paper and web), in hours per week

There are only minor differences between the two groups in the use of collegial knowledge sources, while teachers consult materialised and textual sources such as specialist literature and the Internet far more frequently than nurses. This could indicate that teachers connect to global knowledge sources to a greater extent than nurses, but it may also reflect the extent of translation mechanisms between global and local knowledge sources present among the two professional groups, and the characteristics of their professional knowledge base. While knowledge in nursing,

for example, is primarily a basis for how tasks should be solved and carried out in practice, knowledge in teaching is both a means and a goal. Teaching is essentially about linking students up to broader knowledge areas. Shulman (1986, 1987) distinguishes between "content knowledge" (CK), i.e. the subject matter knowledge that is being taught and learned, and "pedagogical content knowledge" (PCK), how to make the same subject matter knowledge teachable for students, as two central parts of the professional knowledge base of teachers. While the first category relates to existing knowledge within the disciplines available on the web and in other books of reference, the latter – how to teach a certain topic to different groups of students – is still waiting to be fully addressed, scholars argue (Shulman, 1987; Ball & Cohen, 1999; Grossman & McDonald, 2008; Klette & Carlsten, 2011). Differences here may illustrate differences in existing accessible professional knowledge sources. Lack of translation mechanisms at the local level among teachers – i.e. procedures and mechanisms able to translate between the different forms of general abstract knowledge and the knowledge relevant for the specific situation – might therefore be a factor of relevance for the discrepancy in the use of global knowledge sources of teachers versus nurses.

In the sections that follow, we will turn to the qualitative data to probe ways to understand how the two groups use the different knowledge sources in more depth. Survey data enable us to identify distribution and frequencies within and across the different knowledge sources. Analysis of the qualitative data will further enrich our understanding of how the two groups attribute meaning to and make use of the same sources.

Collegial Knowledge Sources – Features and Characteristics

Both nurses and teachers use their colleagues and other resource persons in their working environment as key facilitators and supervisors for their work performance. However, the organisational structure at the workplace together with the division and distribution of expertise make colleagues an even more frequently used knowledge source in hospitals compared to schools. Both the individual interviews and the group interview with nurses underscore and confirm the general picture provided from the survey data; the importance and significance attributed to colleagues, and the presence of extended diversified personal expertise as sources for keeping updated and for strengthening their ability for adequate problem solving. The two following quotes illustrate this point:

> Mmm – we ask others, both nurses and doctors. Not necessarily only nurses. But we ask those who are available. Medical surveillance, for example, is located right next door to us. (S 19 [173- 191])

> It completely depends on what the problem is, but let's say that you have a patient who all of a sudden needs dialysis in addition, then you call the department that deals with that, that is, you seek out the specialised knowledge where it's located (…) I call the places where I think they are capable, to ensure this, in addition there are books where things can be

> looked up and then you talk to doctors, so you do get knowledge, but you have to keep asking and digging a bit. (S 26 [233])

Both group interview and individual interviews conducted among teachers also confirm the general picture gained from the survey data that colleagues are the primary source of knowledge.. Experience and age are the most significant criteria when asking a colleague for support, they argue: "Sometimes it helps to speak to those at the school who are more experienced, who have experienced most things before" (L 29 [175-179]). Compared with the nurses, novice teachers do not list a wide range of experts available at the work sites, nor are the latter supported by strong institutional infrastructures. Several of our novice teachers emphasise the low degree and lack of formalities regarding community features at their work site (see also Klette & Carlsten, this book, chapter 4). The novice teachers report that they work mostly on their own, with weak assistance and supervision from colleagues and other expert teachers. Communication with colleagues takes place most often on an ad hoc basis, and concerns practical matters related to specific and concrete tasks, exchange of materials, and conversations about individual pupils. The issue of how to cope with professional problems over time and in a systematic way is seldom addressed at a community level, according to our novice teachers. Paraphrasing Etienne Wenger, we might claim that the absence of feasible infrastructures around the professional conversations serves as a hindrance to bringing these conversations of participation into chains of professional learning. These features of professional learning are contrasted by the nurses, who refer to well-functioning formal and informal community features, organised around communities of practice on the ward, that are supportive of problem-solving and knowledge dissemination and exchange:

> And then every Thursday we have this hour where we discuss different kinds of things, like what's happened in our unit that we experienced as difficult and things like that. Simply, just discussing with my co-workers and asking doctors about questions that I have … (S 24 [91:95])

The above analysis describes rather different institutional modalities and policies for professional conversation as tools for learning in and through practice. While the quantitative data indicated only minor differences in the use of collegial knowledge sources, the qualitative data expand and amplify distinct differences in infrastructures for participation and reification processes between the two groups. While the novice teachers were by and large expected to figure out and develop ways to cope with challenges more or less on their own, newly qualified nurses are enrolled in well-functioning communities of practice supported and backed up with infrastructures and mechanisms of knowledge dissemination and knowledge exchange.

Materialised Knowledge Sources – Features and Characteristics

As indicated from the quantitative data, both nurses and teachers use multiple knowledge sources to perform their jobs. Interviews and learning logs confirm and elaborate on the wide range of materialised knowledge sources used in the two professions. Different materialised sources, such as handbooks with procedures and on-site reference manuals in nursing, or students' textbooks and other books of reference in teaching, are acknowledged as essential for good work in both groups. However, the infrastructure surrounding the assorted knowledge sources together with their applicability and "practical fit," differ between the two professional groups. One distinct difference is the degree to which the knowledge sources are represented in a way that makes them feasible and applicable, to serve as tools and "… ready-made things to be used," to paraphrase Karen Knorr Cetina (1997, p. 10).

Novice nurses refer to a wide range of knowledge sources available at the work site, ready-made and represented in a way that makes them practical for concrete problem-solving and applicable to their work situations. The following quote illustrates a frequently-made remark:

> And there are a lot of in-house procedures, which are found on the intranet and are very well explained in terms of why one does something. What you are supposed to do and what can go wrong and what should not go wrong. ([I] use it a lot, [I] think there are a lot of very good procedures both on pain relief and relief from nausea). (S21 [157]).

Teachers, on the other hand, demonstrate how they search for knowledge sources "in all places," with a lack of accessible and applicable supplies available at their local work site:

> (Interviewer: Access to scientific literature and journals at work?)
>
> I don't think there is, there's probably something here at the school, but it's, I don't think there is very much of it. But it would be great – if we, for example, subscribed to *Illustrert Vitenskap* [name of popular science magazine], that would be great. (L 13 [226:228])
>
> Yes, where do I find the information? Well, we have some books that you can look through, but then you have to make your way through the shelves. (L21 [237:251]).

The lack of ready-made things to be used at the work site is significant when reading through the interviews and learning logs with novice teachers. Our novice teachers emphasise the challenges and the energy spent on making materials and "things to be used" from scratch, over and over again: "You have to make up all kinds of supporting artefacts yourselves," as one of them argues. He illustrates this point by drawing attention to a variety of materials required for his classroom performance such as "…available recipes and methods for teaching eight year olds

to write, templates for learning multiplication, rules for decent classroom behaviour as well as cardboard cut-outs for making Easter bunnies." You just get so tired of going around searching everywhere and anywhere, he continues. Several of our teacher interviewees suggest index files as possible tools that could be useful. The recurrent problem is that you have to start from scratch each year, as several of them state; "… an index file with ideas and manuals would help."

The discrepancy in the two occupations between knowledge demands, on the one hand, and available knowledge tools to be used, on the other, are also underscored throughout the learning logs. Both groups indicate a huge variety of knowledge demands and knowledge requirements during their workdays when filling out the logs. Novice teachers, though, tend to frame and define their problems in terms of rather global and general questions when reporting in their learning logs (for a more in-depth discussion of the learning logs, see Lahn, this book chapter 6). Novice teachers appear to have learned to live with the limited problem-solving strategies and support tools available at their work site. Their learning logs indicate that they are confronted with a lot of general and specific professional problems throughout their working day. However, despite these challenges support in terms of gap-closing tools, artefacts, and practices at the local site is weak. Statements like the following from one of the learning logs (a female teacher working at the primary level) illustrate this:

> With regard to how much I should push tired pupils to work, I have asked colleagues. The mathematics question – how to visualise additions for eight year olds – I asked my boyfriend about, since I didn't find anything in the Teacher's Guide or in the Begynneropplæringen [name of reference work] in mathematics. (L 12 log [17:17])

Nurses, on the other hand, draw our attention to a rich toolkit supportive of problem solving at their work site, including handbooks with procedures, local books of reference, a ward-based intranet resource, and the core manual for medication. Returning to Shulman's distinction between content knowledge (CK) and pedagogical content knowledge (PCK) in teaching, it appears that teachers first consult the former and only to an inadequate degree have access to the latter type of knowledge. While the nursing profession has developed a mediating knowledge base related to the specific tasks on each ward, such tools and manuals are only to a limited degree available for teachers. This lack of a translational and mediating knowledge base between the global and the local level is even more striking if we turn to how teachers versus nurses connect to the Internet as a knowledge source for their professional performance.

Use of Internet in the Two Professions

The quantitative data material draws attention to the fact that novice teachers use the Internet significantly more than the nurses (see Figure 1 and 2 above). Access to computers at their work site may account for some of this discrepancy Throughout the interviews nurses describes access to computers and other web-

based resources at their work site as problematic, as they are often located in the watch-room and other crowded spots or spaces. Teachers, on the other hand, seem to have easier access to computers throughout their office landscapes at schools, although they also make complaints about the amount of computers available. Teachers, moreover, describe how they use internet resources at home as a significant tool for obtaining information about work-relevant topics. For example, our novice teachers use the Internet to acquire information on content knowledge areas such as foreign countries and cultures (e.g. Egypt), authors (e.g. Shakespeare, Ibsen) and other topics relevant for their instructional activities. The blurred division of teachers' working time between teaching time inside schools and preparation time outside schools might further explain the discrepancies in the use of internet resources for teachers versus nurses. Teachers' work time is partly regulated through their teaching obligations at schools and partly through their planning and preparatory obligations, performed mostly out of school (Hargreaves, 1998; Klette, 2000). Our survey data do not provide us with information about the distribution of home computers among our respondents. Interviews reveal, however, that novice teachers use their home computer for professional knowledge-seeking purposes more frequently as compared to the novice nurses.

The interview material indicates that the reason why teachers consult the Internet more often than nurses is not only the availability of computers at the workplace. Teachers' broad and rather general formulations of questions and problems, combined with a continuous and infinite quest for content knowledge applicable to their teaching purposes, force them to use the Internet, Google and similar tools as reference works, together with other general books of reference such as encyclopaedias. Novice nurses, on the other hand, have access to specially designed net resources such as ward-based intranet. If we turn to the learning logs, nurses tend to frame their problems in relatively restricted ways, such as "what procedures should be performed in order to cure the specific medical cases at hand." Teachers, on the contrary, frame their problems in terms of rather global and general themes such as "how to vary my teaching for the next year" or "how to organise the class so that everybody feels included." Due to the general way in which they define their problems, teachers are forced to seek and read information globally, while nurses turn to technical literature and medical handbooks with a more specific focus. A ward-based intranet service also supports novice nurses when seeking information on the Internet. The The specific way in which the two professional groups define and frame their problems,, combined with available and applicable artefacts, puts teachers and nurses in distinct and different professional epistemic communities (Knorr Cetina, 1999; Foray, 2001). One consequence could be that teachers are compelled to read and seek out information from the Internet and other global knowledge sources, thereby employing more time-consuming practices in their search for relevant support.

Professional learning is highly dependent on available knowledge sources and so far we have discussed how the two professional groups have access to and use knowledge sources as part of their work. Equally important, however, is how occupational training is managed and organised at the local work site. How and to

what degree our novice nurses and teachers have received systematic training will therefore be discussed in the section that follows. As in the previous section we start with an analysis of the survey data.

THE DEGREE OF SYSTEMATIC TRAINING

There are significant differences between nurses and teachers with regard to the amount of systematic training they have received in their current jobs (Figure 3). While the majority of the teachers (54 per cent) report that they have received no systematic training, the corresponding proportion among nurses was 24 per cent.

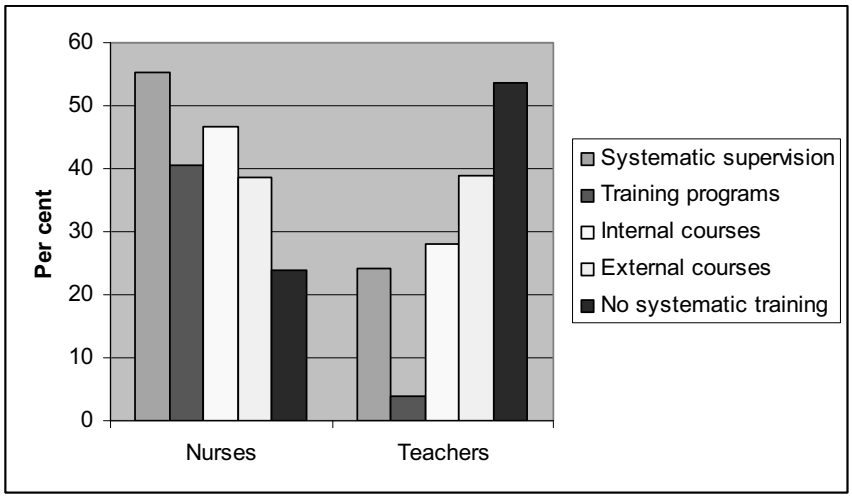

Figure 3. Percentage of novice nurses and teachers who received various types of systematic training in their current jobs

There are also important differences between the professional groups with respect to the type of systematic training they receive. Systematic training programmes are far more common among nurses than among teachers. Moreover, a higher proportion of nurses than teachers have received systematic supervision and it is primarily nurses who have taken part in organised training programmes. Internal courses are also most often reported by nurses; while there is no difference between the professional groups with respect to participation in external courses.

The quantitative data presented above reveal a rather general picture regarding professional training, though with significant and distinct differences between the two groups. How can interviews and learning logs fill in and expand this picture? Interviews with novice nurses support the general picture illustrated above. Novice nurses emphasise how they as newcomers are engaged in extensive training programmes at their work site. Novice nurses refer to the availability of different

types of internal courses, such as courses as part of an internal formal training programme ("clinical ladder programme"), workdays devoted to professional development, and internal courses with the same purpose. Some of these courses take place at an institutional level (i.e. hospital level) such as training programmes in how to use a respirator (see S 24:[147]), while others take place on the ward or in even smaller units. These systems of professional training are facilitated and supported by systems of distributed expertise at the ward level, our nurses report. For example, a nurse may be appointed to have special responsibility for professional competence building among the staff. Together with the head of the ward, these "professional developers" play a crucial role in keeping the staff updated, informed, and exposed to relevant in-service courses, according to our novice nurses. The head of the ward accordingly holds a critical position for linking staff to courses and other relevant seminars, such as research in clinical treatment methods. The statement below illustrates the significant role the head of the unit and the team leader of the unit have for keeping their fellow nurses informed of relevant ongoing research:

> … I think we get fairly good updates on a lot of research that is related to what we do. Especially with regard to stroke patients.
>
> (Q: How does that information reach you?)
>
> Via the leadership. Mmmm. And courses. We have a team that works specifically on strokes, which we get feedback and knowledge from (S 19 [285:293])

The novice teachers, on the other hand, reveal a rather non-structured and individualised milieu when it comes to in-service training, and with almost no formal training activities organised at their work site. Novice teachers describe how they perform their job mostly on their own and with weak supervision and support from colleagues and other resource persons and experts at the school level. They characterise principals and the school leadership as withdrawn and report that there is minimal or no supervision of how they as newcomers perform their work in the classrooms: "… they [the school leadership] are just very open-handed about the whole situation. I could probably have played cards with my students all year if I wanted to," one of the male informants says. Despite extensive learning demands recognised on the basis of their classroom performance, our teachers report that in-service training suffers from a lack of formal and systematic provision and features at the institutional level. One teacher describes how she and her colleagues have been systematically trained in a programme for reading comprehension at her school. Reading comprehension had been selected as a priority area for in-service training at her work site, and they had subsequently agreed on a specific reading programme (LUS) as a tool for professional training. In general, however, initiatives and responsibilities for professional training are left to the individual teacher to decide on, with weak support from collective community structures and

management structures at the local school. On the other hand, our novice teachers describe extensive opportunities to engage in *external* courses. These external courses seem to be poorly tailored to their concurrent work in classrooms and serve mainly as tools for enhancing inspiration and motivation rather than for practical problem solving in their daily classroom work, according to our informants. The courses are described as poorly integrated with their daily work portfolios at the classroom level, and they are also not recognised and integrated as a tool for professional development at the school level. The statement below from one of the male novice teachers illustrates a frequently expressed opinion:

> I think it's quite random. I would like to go to that course, it sounds interesting, and I would like to learn about … yes, the most recent thing now was one of those bilingual test courses. And then the attitude was: yes, that sounds interesting, and then you're allowed to go, but there's no one that checks up on it or really uses the knowledge in a proper way. It's the teachers that drive it forward and not the leadership, I feel. (Group Interview p 22; Teacher I)

As indicated in the above section, the opportunities for internal professional training and courses for novice teachers and nurses point to rather different models of professional learning in terms of formalisation and systematically organised learning provisions. With regard to linking newcomers to a professional community characterised by a dynamic exchange between processes of participation and processes of reification, our two professional groups are exposed to two distinct and rather dissimilar institutional working cultures.

These differences reflect the respective qualities and challenges in the knowledge bases guiding the two professions, *and* differences in policies and infrastructures for professional learning at the institutional level. As indicated earlier, hospitals are hierarchical knowledge institutions characterised by a high degree of division of labour and expertise, which requires mechanisms and infrastructures for knowledge exchange and knowledge diffusion between the many levels of expertise. Schools, on the other hand, are non–hierarchal institutions with professionals that are almost equal in levels of competence and expertise. Secondly, the degree of formalisation and infrastructure for professional development programmes differ dramatically between the two institutional environments. Professional development as a means to secure quality is regulated by law in the health sector. For example, since the late 1990s several hospitals have implemented so called clinical ladders, usually five-year programmes of continuing development in clinical nursing, to stimulate professional development and to attract and retain nurses. Joining a clinical ladder is optional and requires a lot of work from the nurses involved (Bjørk et al., 2007). In teaching career ladders hardly exist, and neither do systematic programmes or infrastructures for in-service training at the local workplace. A considerable amount of resources has been allocated to continuing professional development and in-service training among Norwegian teachers in recent years (Hagen, Nyen, & Hertzberg, 2006; Hagen, Nyen, & Nadim, 2008). There seems, however, to be a gap between how these

resources are aligned with systematic training in the workplace, from the point of view of teachers (Hagen, Nyen, & Hertzberg, 2006).

Challenges and disputes as to how to organise professional development within the teaching professions are not a new phenomenon. Several scholars (Sykes, 1996; Putnam & Borko, 1997; Ball & Cohen, 1999; Timperley & Alton-Lee, 2008) have directed attention to the inadequacies of existing professional training models for teachers. In an overview of professional development models in teaching in the US, Hilda Borko (2004, p. 3) summarises the shortcomings of the existing models, which for the most part are based on external and voluntary courses. She argues that schools, districts and the federal government spend millions of dollars on external courses, seminars and other forms of professional development that "… are fragmented and intellectually superficial" (ibid., p. 3). These professional courses do not take into account what we know about workplace learning and teachers' learning, Borko further argues.

Infrastructures for in-service training are found in rather dissimilar models of professional training in the two groups examined. Institutional policies for knowledge dissemination and knowledge exchange at the work site, available and accessible knowledge sources applicable for practical problem solving, and community structures supportive for sharing knowledge between more experienced professionals and newcomers differ dramatically in the professions analysed. With regard to linking newcomers to a professional community characterised by stimulating exchanges between processes of participation and processes of reification, our two professional groups are exposed to two distinct and rather divergent working cultures.

DIFFERENT MODES OF PROFESSIONAL LEARNING

While the majority of newly qualified nurses have taken part in various types of systematic training this is the case for only less than half of the teachers. Moreover, while professional learning and development is to a great extent considered an institutional responsibility in hospitals, it is optional and a matter of individual concern in most schools. When it comes to the use of colleagues as knowledge sources, the survey data indicate no significant differences between the two professional groups. The interview material points out, however, that the collegial culture in schools is only to a limited degree a resource that helps the newly qualified professionals to cope with their daily, practical challenges. Communication among colleagues in schools mostly concerns practical planning and coordination, discussions about the children's well-being, and where to find different practical things. Even though many teachers today work in teams (Hargreaves, 1994; Klette, 2000; Little, 1993; Rosenholtz, 1989), their collaborative cultures seem to be restricted to coordination and planning activities and are poorly aligned with problem solving relevant for their specific classroom practices. The collegial culture is significantly different among nurses, where colleagues and distributed communities of experts are important knowledge resources, thus also representing a dimension of quality control. Regarding linking

newcomers to a professional community characterised by a productive exchange between processes of participation and processes of reification, our two professional groups represent two distinct and rather dissimilar working cultures.

Turning to the use of materialised knowledge sources, the results from the survey data show that teachers consult materialised (i.e. textual) knowledge sources more often and spend far more time reading than nurses. When teachers consult textual sources they are primarily looking for content knowledge (subject matter knowledge) to use in their teaching, not pedagogical content knowledge on *how* to teach and stimulate pupils to learn a particular type of knowledge and skills. While the availability of this "tool-like" type of knowledge is generally considered as the core of being a professional (Foray, 2001), this type of knowledge is seldom consulted by our novice teachers. One of the reasons for this is that there is not much of this tool-like type of knowledge available (Ball & Cohen, 1999; Grossman & McDonald, 2008). While, in the past, teaching methodology was part of the curriculum in teacher training, this is no longer the case and pedagogical theory is very much based on general pedagogical ideas, only weakly linked to the operational and practical level (Borko, 2004; Haug, 2008; Klette, 2007). This seems to be the case not only in Norway. A Danish study reports that students complain that their teacher training lacks relevance for practice and that they want theories to be more useful and "tool-like" (Laursen, 2008). The development of methods and procedures seems very much to be considered an individual concern. The lack of such types of knowledge in teaching is at least partly due to a knowledge culture that emphasises reflection rather than "tool-like" knowledge. It appears that the critics of "teaching as technology" (Doyle, 1990; Eisner, 1991; Fenstermacher, 1994; van Maanen, 1991) and Schön's (1987) characterisation of professional practice as artistry and emphasis on "reflection in action" have undermined the development of tool-like knowledge and procedures (Carlgren, 1999; Klette, 2007; Timperley & Alton-Lee, 2008). The debate between David Hargreaves (1997, 2000) and Hammersley (1997) illustrates that the need todevelop such types of knowledge in teaching; as well as the inherent value and potential of such development, is deeply contested.

In nursing, on the other hand, the availability of such "tool-like" mediating sources of scientific knowledge is heavily emphasised. One of the consistent lessons in the knowledge utilisation literature is that nurses generally do not rely on journals as a source of information for practice. What seems to be crucial is the availability of up-to-date resource materials, the existence of administrative and research support and the involvement of nurses in designing new information sources and in deciding how they are to be incorporated into the practice setting (Spenceley et al., 2008). Studies also show that clinical nurse educators facilitate the research utilisation process by conducting literature searches and providing relevant research articles to staff nurses (Milner et al., 2006). At the hospitals included in our study, there are clinical nurse educators or research nurses responsible for collecting and summarising updated knowledge with direct relevance for nursing practice in their ward. Moreover, there are procedures, handbooks and manuals that are to be followed when carrying out various tasks.

CONCLUDING REMARKS

The knowledge cultures in teaching and nursing are quite dissimilar and these discrepancies appear to relate to the extent of systematic training provided to newly qualified professionals as well as the use of collegial and materialised knowledge sources. The lack of systematic training in teaching should therefore not just be considered the result of weak institutional leadership. It also reflects existing knowledge cultures and knowledge sources in teaching. Moreover, as shown in our quantitative data analysis, there are positive although somewhat weak correlations between the use of collegial and materialised knowledge sources. While nurses use their colleagues as important resources for professional learning and have developed a repertoire of mediating, "tool-like" knowledge sources and procedures, the more individualistic knowledge culture among teachers is reflected in their collegial relations as well as the lack of mediating tool-like knowledge sources. The comparison of nurses' and teachers' use of collegial and material knowledge sources supports Wenger's argument (1998, p. 131) that participation and reification processes coexist and shape each other as proportional levels of participation.

A central perspective in the theories of Karen Knorr Cetina is the motivational drive for learning related to open, infinite and unfolding knowledge objects. An interesting question is whether the materialised meditating knowledge sources in nursing characterised as tools, things to be used, are closed or whether they also have the characteristics of things in a process of transformation, i.e knowledge objects. In general, the mediating knowledge resources in nursing are treated as tools and as resources for solving practical problems. However, the use of these resources generates questions about and interest in further knowledge. Thus, the clear link between the local mediating knowledge tools and abstract scientific knowledge provides some interesting potential for developing knowledge ties, also at the individual level, that transgress local space and time.

In teaching, mediating knowledge sources characterised as tools and things to be used exist only to a limited extent. Pedagogical knowledge is abstract, open, infinite and unfolding The lack of mediating sources has two important implications: First, they are not "tool-like" and are too abstract to be "things to be used." Secondly, the lack of "tool-like" knowledge and procedures implies that teachers formulate their professional challenges in general and open-ended ways. Since such questions cannot be answered straightforwardly, the questions produce frustration among the teachers rather than constructive learning loops. The knowledge culture among teachers demonstrates that professional knowledge may not only be too closed but also too open to generate productive and fruitful learning loops.

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PART III

KNOWLEDGE TIES AND MODES OF SELF CONDUCT

A defining feature of knowledge societies is that professionals are requested to engage in lifelong learning and to keep themselves continuously updated within their fields of expertise. In contexts where information flows are increasing and knowledge takes on a contested and unstable character, this presents professionals with novel challenges in terms of how to manoeuvre through increasingly complex knowledge landscapes, and how to create relations to rapidly changing knowledge flows that encourage and maintain explorative and creative epistemic engagement.

The chapters in this section explore dimensions of the desire and drive to learn in the context of professional work. What induces professionals to engage in continuous learning? How can we understand the dynamics through which professionals engage themselves in lifelong learning in ways that go beyond immediate task completion? According to Knorr Cetina (1997, 2001), engagement with knowledge is understood as a relational and emotional endeavour in which professionals create emotionally charged ties to knowledge through sets of objects relations. The nature of these object relations in turn becomes constitutive for professional identity as well as for a learning drive that is sustained by the inherent "lack of completeness" characteristic of knowledge objects. In this way, the characteristics of professionals' knowledge ties become constitutive of their opportunities and motives for engaging in continuous and sustained learning at work.

Karen Jensen's contribution in chapter nine represents an early attempt to conceptualise the relationship between knowledge-seeking practices among professionals and the emotional basis of expert work. Using the perspectives of Knorr Cetina on the dynamics of desire in expert work, supplemented by the work of Gilles Deleuze, Jensen applies these perspectives to the four professional groups covered by the ProLearn project with the aim of further exploring how we can theorise the desire to learn in ways that account for motivation beyond short term, pragmatic concerns. Specific attention is paid to processes of accessing knowledge and developing a sense of mastery, which both of these theorists regard as essential to developing and maintaining a desire for continued learning.

In chapter 10, Monica Rudberg focuses on the gender dimensions of identity and desire, and argues that our theoretical assumptions and frameworks for analysing knowledge construction and epistemic engagement must be viewed in light of the gendered nature of the professions. Drawing on the theoretical

K. Jensen et al. (eds.), Professional Learning in the Knowledge Society, 163–164.

perspectives of Toril Moi, Rudberg proceeds to discuss gendered dimensions of knowledge engagement both theoretically, in relation to Knorr Cetina's concept of "wanting structure," and empirically, with reference to the knowledge seeking practices of the professional groups of the ProLearn project. Her analysis suggests that a possible result of knowledge-seeking processes where knowledge itself is the paramount interest, is a degenderising process in which gender may lose some of its relevance in relation to the knowledge that functions as the object of desire.

Chapter 11 by Monika Nerland applies a Foucauldian perspective on workplace learning among computer engineers, to explore how her informants enter particular subject positions enabled by the knowledge dynamics of their professional field, and turn these positions into resources for learning and professional development. Employing the concepts of "knowledge/power" and "technologies of the self," her perspective facilitates an analysis of the governing mechanisms inherent in knowledge practices within computer engineering, and points to how these knowledge relations produce certain subject positions for individuals to take up, as well as tools and techniques through which they may act upon themselves as learners.

Chapter 12 by Karen Jensen and Bjørg Christiansen takes us beyond Knorr Cetina's notion of the creative possibilities inherent in the 'spillover' thesis. It describes the multiple roles and responsibilites of professionals and points to new social missions. Using the perspective of non-knowledge developed by Kastenhofer and Böschen, the issue of knowledge engagement is broadened and the authors trace how professional engagements and strategies lead to the further development of knowledge. Taking nurses as an example, the authors show how the new demands on professionals are broadening their role and increasing the range of capabilities they require.

One of the guiding ideas when developing the ProLearn project was to take a fresh look at the literature on motivation for learning in professional contexts, which has been dominated by cognitive psychology and action theory emphasising individual variation in preferences, risk-taking, internal and external control of motivation etc. What then is the alternative when both knowledge and culture are "reclaimed"? From reading the four chapters above we get a rather nuanced view of how professionals become engaged in what they do and how they enter a "wanting structure" that stirs social binding, curiosity and "flow"-experiences. The authors position themselves within different theoretical discourses which means that what counts as "motivation," "desire," "emotions" fluctuates from one contribution to the other. We believe and hope that the mobilisation of so many voices may be the creative phase in a post-paradigmatic turn and that the need to "reassemble" it all (Latour, 2005) will be the topic for later publications. One of the things that should be considered for a closer look is the concept of "knowledge." Do we place it under too heavy a burden in explaining the driving forces of modern professional life?

KAREN JENSEN

THE DESIRE TO LEARN: AN ANALYSIS OF KNOWLEDGE-SEEKING PRACTICES AMONG PROFESSIONALS[1]

INTRODUCTION

The ability to facilitate knowledge creation and to share knowledge is considered to be among the most important factors in securing the prosperity of modern societies. The concept of the knowledge society was coined to underline this development and to draw attention to the overall challenge posed by living in a society characterized by rapid shifts in knowledge and institutional arrangement. One of the groups affected in this context is the professions. Rather than working within a stable community and exploiting once obtained competence, they are required to keep up with dramatically changing networks and to engage in continuous learning and relearning. Following the lead of sociologist Karin Knorr Cetina, this paper aims to explore these transformations by approaching the professions' knowledge bases as objects of attachment that encourage continuous learning. What motivates persons within professional communities to seek new knowledge, and how is the will and desire to pursue continuous learning to be understood in theoretical terms?

In order to illuminate some of the present conditions and rising challenges in maintaining learning motivation in modern professional performance, we first outline and discuss Knorr Cetina's approach to expert work. We subsequently use this framework as a sensitizing device to analyze data from an ongoing research project "Professional learning in a changing society" (ProLearn).[2] The project studies knowledge-seeking practices among four targeted professions; nurses, accountants, teachers and computer engineers. The results we present are not a description of all sources of professional knowledge. Rather, they focus on the abstract and mediated forms of knowledge that characterize expert cultures.

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SHIFTS IN SOCIAL EXPECTATIONS

As noted by social theorists, one of the key signifiers of the knowledge society is the structure of its knowledge, whose axes shift from local and personal to abstract and symbolic inputs. They argue that although this shift has evolved gradually, it has accelerated in recent years and led to the development of "a new economy of signs and space" (Lash & Urry 1994). The thesis of this economy is one of disembedding; the "lifting out" of social relations and experiences from local contexts and their rearticulation across tracts of time and space. Within this perspective, which focuses on the transformative embodiments of modernity, new demands to keep pace with rapidly developing fields of knowledge present crucial challenges to both individuals and communities. The concept of the knowledge economy thus serves as a fluid sign of reference in recent discussions of changes in social expectations, labelling heightened expectations of individuals' capacities to access this knowledge type and to use it to feed into increasingly rapid cycles of vocational innovation and change.

In recent years a number of solutions have been offered to explain this innovative dimension in expert learning and practice. Classical theories of learning, theorists point out, do not suffice. They tend to be overly cognitive and thus overlook the role that excitement, passion and desire may play in the learning process. They focus on the how and what of learning and overlook the "why" questions that drive the learning process (Engeström, 2001; Miettinen, 2005; Nardi, 2005). In order to grasp this dimension these researchers argue that explorations into the theme of desire and motives are required: What induces people to engage in the project of continuous learning? What makes people strive for something beyond the immediate obvious goal or situation? How can we theorize professional practice in a way that allows for engagement and engrossment - the emotional basis of expert work?

These questions may be addressed by way of the work of sociologist Karin Knorr Cetina. In contrast to more traditional theories of sociality, she emphasizes the affiliation between humans and object worlds as changes in textured intimacy rather than as alienating indicators of abstraction. Viewing the social as embodied practices of object relations serves as an understanding of the knowledge society as more than just increases in scientific belief, technological application and enhancement of expert competence. According to Knorr Cetina, the knowledge society may be read as "a society permeated with knowledge cultures, the whole set of structures and mechanisms that serve knowledge and unfold with its articulation" (Knorr Cetina, 2003, pp. 7-8). This post-social view on object relations thus distinguishes itself by theorizing knowledge in a way that breaks with the arid and overly cognitive view typical of traditional learning theory, moving beyond that of instrumental use and skills development. In the development of her theory, Knorr Cetina (e.g. 1997, 2001, 2003) suggests that transformations associated with knowledge economies may be explored by approaching the knowledge bases of expert cultures as objects of attachment.

CHARACTERISTICS OF EPISTEMIC PRACTICES

According to Knorr Cetina, expert cultures are characterized by a dynamic relation between subject and object. These engagements are deeply emotional in character, she maintains. They are spurred by situations "where the real begins to shimmy" and ambiguities and contradictions make a fictitious turn an imperative in creative performance (Knorr Cetina, 2003, p. 251). Experts, Knorr Cetina maintains, "enchant" their objects by applying different metaphors and reality designs to them; construing them first in one manner and then in another. By envisioning their work through different theoretical lenses a fictitious world is created that is both motivational and binding. An example of this may be found in the story of Barbara McClintock, a famous biologist. Her biographer, Evelyn Fox Keller (1983, cited in Knorr Cetina 1997), describes her scientific endeavour "a love affair with the world" represented in a deep "feeling for the organism." The chromosomes that she studies become her "friends," and she feels sad whenever she walks on grass, because she knows that it is screaming in anguish. There is "excitement," she even uses the word "ecstasy" connected with her knowledge-seeking, but there is also solidarity and care. In this process of enchantment, the expert self is endorsed and extended by the object, paving way for a desire for further engagement and learning.

Knorr Cetina's claim is that the structural and relational forms traditionally found in epistemic cultures are gradually becoming more prevalent in the economies of advanced industrial societies. As mechanisms and structures of knowledge distribution multiply and disperse, essential characteristics of "object-centered relationships" found in scientific settings more or less automatically diffuse into other knowledge-intensive fields of work (Knorr Cetina 2007). Prior to our analysis of how these "spill-over-effects" may be understood as fueling learning in professional communities, some of the relevant ideas and concepts in Knorr Cetina's theoretical framework need further elaboration.

A Chain of Wanting

The guiding metaphor for the binding dynamics of learning is developed from an understanding of sociality with objects as "a match between a sequence of wantings and an unfolding object that provides for these wants through the lacks they display" (Knorr Cetina, 2001). According to Knorr Cetina, it is the craving for a deepened understanding which propels learning forward. Desire is in this sense what makes sociality with objects occur in that "the self as a structure of wanting loops its desire through the object and back" (ibid). This mutuality, or mechanism of what she terms "epistemic takeover," refers to a sense of bondedness with objects that is identity forming. In this relational intimacy of shared subjectivity and of social integration, the feeling of becoming inserted into an object world then appears to take over the mind and self in the sense of an object-centred solidarity (Knorr Cetina 1997, p. 9ff). In this sense, the "dynamic undertow" of the desire to learn is presented as an action of sequence, as a chain of wantings looping its way

through missing pieces of the puzzle in a series of takeovers (ibid.). In order to understand this looping dynamic present in expert work, however, we need to recognize the characteristics of the elements constituting the corresponding relationship between lacks and wants.

Object Relations

Although the craving for knowledge is not at all new, according to Knorr Cetina, it is the objects themselves, increasingly borrowing their characteristics from those in science and expertise that appear to provide the distinctive characteristics for the "object shift" in the contemporary situation (Knorr Cetina, 2001). Knowledge objects are in this sense defined by a lack in their completeness of being. They are characteristically open, question-generating and complex. They are processes and projections rather than definite things, as they have the capacity to unfold indefinitely and render the pursuit of attainability an impossible endeavour (Knorr Cetina, 2001, pp. 181ff). The unfolding nature of knowledge paves way for what Knorr Cetina describes as – a desire to fill out the blanks and make the picture whole. The striving for completeness that interaction with knowledge-objects generates is accommodating a 'looping back and forth' between objects and persons which is transformative. In this regard, however, Knorr Cetina expresses a need for caution in construing object relations as merely uncritical personal wishes or as purely positive emotional ties. Rather, she suggests that the notion of a "lack" corresponds more appropriately to the structure of wanting in theorizing experts' relationships to objects (ibid). To elaborate on the notion of "lack," she primarily refers to the psychoanalytical work of Jacques Lacan; using his idea of wanting as a "lack-of-being" (*manque-â-ètre*) to capture the volatility or unstoppability of desire (Knorr Cetina, 1997, p. 14). In order to explain the dynamics at work here, she draws a parallel to the mirror stage of Lacan, where the young child for the first time experiences the discrepancy between his inner turmoil and fragmentation, on the one hand, and his whole and perfect image in the mirror or in the parents' eyes, on the other. Wanting or desire is in this sense born in a never-ending series of misrecognitions (*méconnaissance*) illustratively suggested as a permanent envy of the perfect image in the mirror.

By applying the idea of the mirror stage, Knorr Cetina follows Lacan in defining desire not as a reflexive structure of consciousness, but as the precise moment of consciousness' opacity. As such, it is when ambiguities and contradictions necessitate a fictitious shift in working with knowledge-objects that the self as a structure of wanting loops its desire though the object and back. The Lacanian contribution to understanding this difference between the 'real' and the 'shimmy' is derived from his theory of language, which contrasts the symbolic with the Real. Since the Real is not a product of language, the symbolization of the Real is never fully attainable. Attempting to overcome this ambiguous lack, desire is fixed in order to achieve consistency through the use of fantasy (Lacan, 1974).

From Lack to Plenitude

In recent years the Lacanian notion of desire as founded on wants and lacks has been contested (see e.g. Butler 1999). As pointed out by Gilles Deleuze (1962, 1972), theories that conceptualize desire as an imaginary force based on "lack" often fail to take account of its genealogy. These theories treat "lack," or what he calls "the negativity of desire," as a universal and ontological truth. However, according to Deleuze, desire has *become* a "lack" by virtue of a contingent set of socio-historical conditions which require and reinforce the self-negation of desire. He argues that negativity, the "lack"-characteristic of desire, is instituted through ideological means in order to rationalize a social situation of hierarchy and domination. "Lack (*manqué*) is created, planned and organized through social production." (Deleuze & Guattari, 1972) As such, he argues, the concept of desire is symptomatic of a prior history of scarcity and repression, and in need of a new and more timely meaning.

Against this background he argues for a move away from the vision of desire as a lack-of-being suggested by Lacan. A theory of desire, he claims, must be based on a more life-affirmative ideal. The key to desire does not lie in the struggle to become adequate to a countervailing world. Rather, it evolves from a sense of mastery in the exchange of multiple ideas and alternate reality designs proliferating energy into a state of excess.

Acknowledging some of the critique against the Lacanian perspective, Knorr Cetina maintains that in the knowledge society motivation to learn does not refer to an increased search for unified truth and unambiguous solutions, but rather to the unfolding of multiple references presented through epistemic cultures creating and warranting knowledge (Knorr Cetina, 2003, p. 251). Although motivation and enchantments has something to do with the "as if" of imagined worlds, "… it has even more to do today with the "and also" – it arises from multiple structural perspectives and levels" (ibid.).

THE PROLEARN PROJECT

In order to attend to epistemic and dynamic challenges of professional learning in a changing society, we designed a four-year research project targeting the four professional groups of nurses, teachers, accountants and computer engineers. A characteristic feature of these groups is that they have emerged from practice-based Norwegian tradition, and therefore do not possess the strong academic habitus characteristic of the more classical professions, such as law or medicine. The persons we have chosen to represent these groups (N=40) all hold a Bachelor's degree from Oslo University College in Norway. The innovative aspects of professional learning involve knowledge driven processes of motivation, initiative and will. Accordingly, we designed our study as a narrative approach allowing the professionals to describe their motivation for knowledge-seeking practice in their own terms. This approach thus enabled us to capture the idea of Knorr Cetina's

motivational theory of "wanting structures;" focusing on a whole series of moves and integrating questions related to desires, motives and attractions.

In order to take advantage of these links, two sets of semi-structured interviews were conducted among recently educated professionals covering their view on knowledge and on motivational mechanisms for learning in a lifelong perspective. A survey of students graduating from Oslo University College in 2001/2002 was used as a basis for selection. Ten persons within each group were chosen for participation based on the following criteria: they were to have been working for approximately two years, their age was to be maximum 32 years and the gendered sample was to correspond to the group's profile in the survey while ensuring that the sample comprised minimum two participants from the gender in minority. Of those who met these criteria, the persons with the longer work experience were invited to participate in the study.

Based on information obtained in a pilot study, the first set of individual interviews was carried out in Spring 2005. These focused on how individuals perceive and cope with changes in professional learning. The preliminary results constituted the basis for the second set of interviews conducted in spring 2006. The latter set of interviews included one group from each of the four professions, consisting of three participants selected from the former individual interviews. Focus group interviews were conducted in order to enquire further into the role tradition and culture play in questions related to motivational structures in the use of expert knowledge bases within the different professional groups.

THE CULTURE OF PROFESSIONS

Our data suggest that all groups have adapted to the rhetoric of the knowledge society, by addressing the need to continuously renew their knowledge base. Visions of knowledge and identification with being a lifelong learner is shown in a comment from Tommy, a young computer engineer: *Just a comment on the fact that a lot of professions need to be willing to change and readjust quickly. I truly believe that this is especially true for computer engineers … I just believe that things change more rapidly there than in many, many other professions*. Stig, another computer engineer explains these knowledge dynamics in much the same manner: *There are just such huge demands on willingness to change. There are new things all the time, and it's like … almost every day that you're being exposed to new stuff.*

The field of nursing in Norway distinguishes itself by having developed a strong culture for innovation and learning, where values related to the use of scientific knowledge rank high. *It's just a culture that you want everyone to learn as much as possible*, says Siri. This wish is clearly linked to their professional knowledge base: *Most of what is changing is obviously research-based … and then it normally works better.* According to our informants the emphasis placed on learning contributes to a culture of expectancy where it becomes natural to envision oneself as a lifelong learner. *We had*, Tine explains, *one of those in-task days, and we got clear examples of how things we are doing are wrong, and how research provides*

many arguments against that practice. And I think people really understood how stupid it was to keep doing that. Ann also confirms the vision of knowledge updating and continuous learning as an integral part of the profession. *[Updating] is part of the trade, she says. If you don't do that you can simply retire.*

Our data suggest that the same holds true for the field of accounting, where an extensive compulsory course system has been designed to ensure access to new rules and procedures: *We are in a profession and in a field in constant change*, says Leif. *New things arrive all the time. [There are always] new rules and laws that we have to relate to, so we are just used to being innovative*. The vision of accounting as a dynamic field characterized by never-ending change is confirmed by Peter: *Accounting takes years to learn, he says, because there are so many processes, and the moment there is a new activity you just have to start over in a way. So even if you have learned to use judgement with experience, you still have to study anew in a way. It means that all the time you have to…upgrade the knowledge already in your mind.*

Even amongst the teachers – a group distinguished by its diversity of opinion and hesitation when it comes to issues related to knowledge-seeking and learning – there seems to be general agreement on the need to stay updated as lifelong learners. Or as Hege expresses it: … *it's just a sign of taking the job seriously, being up-to-date professionally.*

THE DYNAMICS OF KNOWLEDGE-SEEKING

The data provide diverse, rich illustrations on the knowledge-seeking practices of our target groups. They also illustrate the role that affiliation to more abstract forms of knowledge may play in this regard, confirming that the groups in question here are affected by the post-social developments described by Knorr Cetina. The dynamics the students describe as characteristic for their learning processes is reminiscent of that described by Knorr Cetina in regards to motivation for other types of expert work.

Moments of Opacity

Our informants describe their entrance into the profession as an unfolding process. The lack of definite solutions in practical cases generates a "back and forth" looping between theory and practice which is transformative in nature. During this process the informants' perceptions of knowledge are radically altered, paving the way not only for new modes of practice but also to a broader understanding of knowledge as open-ended and constantly unfolding in nature. Elisabeth, a young teacher, describes this process as follows: *When you leave the college of education…what you have in your head is all kinds of theories, right, and then you check with yourself: 'what seems reasonable, what might work in this situation?', and then you use those things in real life … In a way what we're doing is, I mean the theory is fragile in itself, so you have to work intensively with everything connected to that theory to get it to fit, right?* As Elisabeth's case suggests, the lack

of definite solutions to unique cases generates a seeking movement, where theories learned in college are considered in relation to what seems reasonable and what might work in a certain situation. In the sense of Knorr Cetina, the dynamics of looping back and forth can be understood as a way of managing wants in that fantasy and creativity are used to overcome problems when the "real begins to shimmy"; i.e. when professional practice is not aligned with the individual's current interpretations. In this perspective, professional theories are seen as images of perfect mirror reflection generating the desire to learn as a sense of never-ending series of misrecognitions (*méconnaissance*).

Emergent Structures of Wanting

Our data suggest that the looping dynamics are typically triggered by strong emotions directed at searching for missing pieces of the puzzle. As desire is looped through the knowledge-object and back, self-motivation takes on a form of direction, as Elisabeth explains: *It's self-development, that's a really exciting part of it. You learn something new all the time, and another thing that's exciting about it, and that I find a thrill is that you actually, you're put in a situation where you in a way have to resolve a task that can be relatively tricky and a little stressful, together with other adults…You learn new methods, new things all the time, see how it works. So that part you're in charge of yourself, and while travelling you see what works and not. So in a way you construct your own style.*

Many of our informants report experiences of lacking sufficient knowledge as frustrating. However, as pointed out by Knorr Cetina, the acknowledgement of emotional attraction to the lacks displayed in "unfolding objects" may be understood as a first step towards the development of a professional practice moving beyond instrumentalism and towards an establishment of a more permanent structure of wanting. Karen's description serves to illustrate the transformation process implied here: *[Updating] is something you do every day, in a way. That's just the way it is. I was a bit overwhelmed a while ago, thinking 'oh, my gosh how strenuous it is to work with computers', I never felt up to date, but lately I've reserved a lot of my time for reading, and then I finally felt how much fun it was. Then it's really fun.*

The looping dynamics characteristic of professional learning is thus transformed into a "wanting structure," where it is the missing-piece-nature of knowledge objects themselves that indicates direction for professional learning trajectories. Anne describes the dynamics at work here in the following manner: *It's like this, the more you learn, the more you understand that you don't know, and then you want to learn even more, in a way.* Also David relates his desire to learn to what he sees as inherent characteristics of knowledge: *Reading*, he says, *always makes you read even more. And when you read there are all those links to here and there and to all those related things.*

Once established as chains of wantings, learning may take on a creative dimension moving beyond necessity. As Tom, one of the computer engineers points out, comparing and perfecting one's solutions then becomes a game:

Sometimes you find an elegant solution to a problem you may have encountered earlier…if I have encountered the problem before and only come up with an average solution, and then I see someone else who has stumbled upon the same problem, only that he solved it in a much more elegant way I give positive feedback. The example shows an emergence of a playful attitude where the goal is not merely to solve a problem, but to go beyond the given. Striving for style and perfection reflects the potential inherent in a more life-affirmative motive (cf. Deleuze), where a sense of mastery and the playful exchange of ideas guide the learning process. However, our data suggests that cases like these are sporadic and occasional rather than typical of professional learning.

CONTINGENCY, FRAGILITY AND UNCERTAINTY

As pointed out by Knorr Cetina, the desire to learn emerges as a result of a productive interplay between frequent encounters with knowledge and the steadfast commitment that arises from being a member of an innovative-orientated community. Paradoxically, perhaps, our data suggests that characteristics of the knowledge society may contribute to undermine the productive forces that generate desire. Even though the sense of mastery and playfulness exhibited in the case of Tom constitutes a good example of the potential for expanding rooms of learning, it is not typical. Viewed on a whole, the accounts of our informants remind more of a struggle to "make do" and guard against mistakes rather than the playful acts of creative interpretation characteristic of expert groups.

Ambiguities of the Knowledge Society

Knowledge societies operate on the *principle* of direct and unfettered access to information and knowledge, whose availability and dissemination are largely uncontrolled and uncontrollable (Chisholm, 2000). This development stands in stark contrast to prior phases of history where access to information and knowledge was mediated and regulated by individuals and institutions endowed with special attributes and special training. In the case of the professions, this was explicit in what Freidson (1982) describes as the guardian role of professional bodies and associations as well as the overall vision that only those who legitimately held knowledge could pass it on. The knowledge society has for a large part broken with this social order. What Chisholm describes as "a long revolution of socio-political democratization" coupled with technological advances, has weakened the role of the intermediaries, and left individuals alone to struggle with the challenges the knowledge society implies. Our study suggests that for the professions to access and use knowledge precociously and independently may be a recipe for chaos and adversity, much like that portrayed in Goethe's ballad of the Sorcerer's Apprentice.

There are several reasons for this fragility. One is that our data suggests that the groups in question do not possess the critical faculties needed for personal orientation and balance in negotiation with an increasingly open world of knowledge. The sheer quantity of available information and knowledge is

increasing rapidly and conventional channels of exchange and dissemination (print media, professional and civil society networks, travel and mobility) continue to grow in scope, differentiation and scale of participation. Multimedia and new communications technologies multiply this development and add a new level of complexity when it comes to accessing knowledge. As one of our informants put it, in this situation, *you can't always take the initiative yourself, because there is no way you can know the range of everything.*

Another factor relates to the failure of professional organizations to provide guidelines and navigational aids to assist their members in the search for knowledge. Our data suggests that despite some efforts in this direction there is an overall tendency to define knowledge update as an individual responsibility. Although there seems to be a general agreement on staying updated among our Norwegian informants, one of the teachers comments on the lack of professional standards and profession-specific artifacts as a source of frustration in everyday work: *I do think that quite a few are anxious about the fact that the outcome [of professional updating] is so fragile and uncertain. You just have no idea where you're headed at the same time as there are all kinds of practical problems that have to be solved.*

Structural characteristics in the manner in which knowledge is framed and transmitted by the professions in question accentuate the problem of orientation. As observed earlier, the knowledge fields are weakly framed and encompass a variety of disciplines and knowledge domains. This renders it difficult for the professions to access knowledge in a time-efficient manner, and thus ultimately to obtain new knowledge. The words of one of the teachers in our study illustrates the amount of knowledge deemed relevant : … *there is so much more you wished you could learn in social science, in geography, in mathematics…I mean subject-related. It's just so much…world history and the history of Norway I wish I knew better. And I would really like to learn more about all the different religions … I would have liked to have known more about everything really.*

Contradictory Manifestations

Unable to cope with the vast amounts of knowledge required, our data suggests a tendency to regress to modes of practice which are "good enough" rather than expansive and creative. An example of this may be found in utterances suggesting a growing tiredness and sense of resignation. George expressed it as follows: *I think I can say that, if I go back to the time around the completion of my education, I tended to be more curious. In a way that if I read an article, I had the desire to dig deeper. But I don't really have that same kind of curiosity any longer. Now it's more like just accepting what's arriving.* This tendency of disenchantment and regression is especially discouraging in light of the abundance of knowledge available in modern society, in a time where the capacity to go beyond the bottom line is considered crucial.

Tendencies towards resignation are also reflected in a trend to regard learning foremost as a means to ensure social recognition, rather than as a source of

excitement and inspiration for further examination. Trine, for instance, says that her approaches to learning are related to strategies of avoiding embarrassment, so that she doesn't end up just standing there *feeling like a fool* … A former fellow student nurse reports similar experiences which spurred her knowledge-seeking processes at work: *It's more about knowing what you're talking about. I've been stuck in situations where I've given completely wrong information, and that's obviously … terribly embarrassing. You don't want to go through that again.*

Although it is important not to define ethics and desire as contrasting motives or drives, it is interesting to note a trend among our informants to define their quest for new knowledge in terms of responsibility and moral duty. In particular, this applies to efforts to overcome boring or demanding aspects of learning. A quote from one of the nurses in our group illustrates this: … *the responsibility to find knowledge and search for knowledge is mine, but it is obviously not enough if the conditions aren't made that favourable*. This sense of duty is also illustrated in the use of moral language by one of the accountants: *[I would consider learning] about pensions, for example. Not very thrilling, but I know that I need to understand it … I know a bit, but I would like to know more about it, but it's extremely boring to study. I guess it's more appropriate to say that I should know more about it*.

Though these examples reveal that the students have aligned to the values, norms and standards of the profession, they suggest a bottom-line thinking; i.e. a moral yardstick where playful endeavours of embetterment are overshadowed by motives related to duty, coping and guarding against mistakes.

RETAINING THE DESIRE TO LEARN

Knorr Cetina's theory offers an interesting framework through which to describe expert work, and the multiple ways in which social and knowledge relations intertwine within this field. Her claim is that as scientific production and social organization diffuse into other sectors of society, the knowledge practices of these communities will follow (Knorr Cetina, 2007). Although the motivational aspects of her framework seem promising as a device to enhance understanding of modern approaches to professional learning, our findings still indicate that the "spill-over-effects" suggested by Knorr Cetina are far from automatic.

A premise in the development of a dynamic of knowledge-seeking is a well-developed epistemic infrastructure. A key function of such a structure is not only to reduce complexity to a comprehensible level, but also to avoid oversimplicity by showing that real phenomena are not as ordinary as generally assumed. By focusing on chosen themes and by proposing simplifying models, well-organised disciplines create varying and conflicting reductions in order to secure validity and improvement. If these processes are recognized, simplifications need not lead to reductionism, but rather to a more mature understanding of how boundaries and distinctions, connections and combinations presuppose each other.

Acknowledging some variations within and between the selected occupational cases in our study, the results direct our attention to the creation and utilization of

profession-specific learning materials and tools in order to ensure an emotional basis of lifelong learning. However, in order to come to terms with this issue, there seem to be a need for further inquiries into optimal characteristics of these materials. How can the unfolding character described as essential by Knorr Cetina be secured? What format characteristics are required in order for these tools to function both to limit our search, and to induce us to step out of this limitation into something beyond and better? Given the overwhelming presence of information in the knowledge society, how should learning materials be designed to accommodate the sense of mastery essential to the development of a more life-affirmative motive?

Another challenge in perceiving the professions as expert cultures is related to the elusive nature of the concept of desire itself. As pointed out by Deleuze, desire is never coincidental: "You have to create it, know how to create it, take the right directions …" (Deleuze & Parnet, 1987, p. 91). Knorr Cetina emphasizes the asymmetrical affiliation with knowledge objects as the main co-relational factor in the "chain of wanting" in expert cultures. For the professions, the desire to learn is not only directed by knowledge itself. In our study we find motives to be closely integrated into a multiplicity of emotional expectations manifested as a sense of professional duty and the quest for social recognition. Within all groups we find evidence suggesting that they have adapted to the expectations of the knowledge society, and that they have come to regard continuous learning as an integral part of professional practice. The concern is whether desire is directed in a relevant and time-efficient manner, or towards a more instrumental course in "good enough" workplace-contexts.

In advancing epistemic structures, attention should be paid to the multiple means of directing desire by both knowledge objects and community features in professional knowledge-intensive work. Due to its elusiveness, the emotional expectations encompassed by the notion of desire are a dynamic to be continuously monitored by professionals, institutions and organizations alike. In designing and implementing proactive policies to take the necessary changes forward, proper incentives are needed to ensure that the professional groups have the competencies required to deal with enormous volume of information available in today's knowledge society; i.e. how to secure the preconditions of desire.

Anchored within the professions themselves, the bargaining between different voices will ensure opportunities to move beyond the "as if" of instrumental modes of action and towards an "and also"-culture of expectancy (cf. Knorr Cetina). However, without a stronger emphasis on navigational aids and epistemic structures our results suggest that the professions may develop into ambitious but aimless learners.

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GENDER, KNOWLEDGE AND DESIRE – A STORY OF CHANGE?

INTRODUCTION

That different areas of knowledge (both academic and professional) have different gender appeal is a well known fact. This is also the true of the educational profiles of the professions in the ProLearn project, which are more or less gendered and have not experienced noticeable change in this regard over the last few years. The most evident case in point is computer engineering, where the percentage of women students enrolled was 21.9% in 2007, and 21.4% in 2002. Nursing studies have showed similarly little change, with 88.9% women students in 2007, compared to 89.6% in 2002. Teaching is also preferred by women students to a very high degree: In 2007 they represented 71.8% of the students enrolled, and 71.6% in 2002. In accountant studies gender appears to be more evenly distributed than in the other fields and today there is even a slight dominance of women among students at bachelor level.[1] This genderisation of studies and professions is often interpreted as a result of social power relations as well as cultural discourses promoting gendered segregation – and the remedy for this is assumed to be educational campaigns for cross-gendered choices, among other things. Important as such campaigns may be as a cultural counterforce, they often have minimal effect – at least in the short run. This chapter argues that this relative inertia of gender choices must also be related to the questions of identity and desire that, according to some important theoretical assumptions of the ProLearn project (Knorr Cetina, 2001; Jensen, 2007), are involved in knowledge construction itself. If the work of knowledge is part of the construction of identity and propelled by desire, it is reasonable to assume that gender is involved in the process (Bjerrum

[1] See www.utdanning.no/utdanningsinformasjon/statistikk. This is also shown in the gender distribution of professional associations: The Norwegian Society of Engineers, which is the largest union in Norway for technologists, consists of 80% male members. The Norwegian Nurses' Association almost exclusively consists of female members. The Union of Education Norway is also dominated by women (75%) although it varies according to level of teaching (Karseth & Nerland, 2007). The Norwegian Institute of Public Accountants, on the other hand, is dominated by men (65%). However, the tendency is towards a more even gender distribution among younger members as opposed to older ones, reflecting the situation in the studies. This is also reflected in the qualitative study on which this paper is based – the computer engineers are represented by 7 men and 3 women, the nurses by 8 women and 2 men, the teachers by 7 women and 3 men, and finally the accountants by 5 women and 5 men. This gender distribution has been deliberately chosen in order to make sure that the minority gender of the profession is represented in the study by at least two persons in each group.

K. Jensen et al. (eds.), Professional Learning in the Knowledge Society, 179–193.

Nielsen & Rudberg, 1994; Rudberg, 1996, 2009, in press). In this chapter this will be discussed both theoretically in relation to Knorr Cetina's concept of "wanting structure" in the development of knowledge, as well as empirically focusing on three questions: Firstly, what are the *gender differences* (if any) in relation to knowledge and desire in the groups studied in the ProLearn project? Secondly, in what way do these groups *cement the binaries* of gender constructions, culturally as well as psychologically – and, thirdly, what are the factors (if any) that *transgress gendered knowledge* and perhaps also *destabilise gender constructions* in the professions – and as a consequence perhaps in culture at large?

GENDER, KNOWLEDGE AND DESIRE – OR "LACKING THE LACK"

The Austrian sociologist Karin Knorr Cetina applies Lacanian viewpoints to the theory of desire and knowledge construction (see chapter 9, for an introduction). Her question is: "How can we theorise practice in a way that allows for the engrossment and excitement – the emotional basis – of research work?" (Knorr Cetina, 2001, p. 175). She looks for the answer in the mirror stage of Lacan, where the baby for the first time experiences the discrepancy between his inner chaos and the whole and perfect image of himself in the mirror or in the eyes of his parents. It is this experience of lack that initiates all desire of knowing, according to Knorr Cetina. It forms a "wanting structure" where the knower strives to complete and perfect what is lacking – always in vain, of course. In this version of coupling desire to knowledge (wanting structure to existential lack), one would hardly expect any gender differences in relation to the work of knowledge.

However, the theoretical basis of Knorr Cetina's discussion as well as some of the examples she uses appear to involve gender differentiation. Lacan's psychoanalytic standpoint in relation to knowledge and desire has been further developed in feminist theory of science, not least in the work of the philosopher Toril Moi (1999). She takes as her point of departure the empirical exclusion of women as well as the theoretical repression of femininity in Western philosophy. Philosophy (as well as scientific knowledge-seeking at large) is dependent on the Lacanian "lack," i.e. it strives for wholeness and completion. Confronted with this, woman is seen as "lacking the phallus"; what she needs is not knowledge, but a man. "On this logic, the thinking woman necessarily becomes synonymous with the bluestocking, the frustrated spinster of patriarchal ideology: the female lack is never *truly* a philosophical lack" (Moi, 1999, p. 356). Thus, the lack of the woman is the "*wrong* lack" (ibid.). On the other hand, woman is also seen as suffering from a sort of self-sufficient wholeness; she is incapable of abstract thinking because she is content with the way things are, without curiosity to know why. Moi refers to the dichotomy presented by Hegel: men are like animals, women are like plants. This implies that woman is not only characterised by the "wrong lack," but also by her "lack of a lack" (ibid., p. 357).[2] Thus, theories of knowledge

[2] The wish to know (Wisstrieb) in its most archaic form is, according to Freud, connected to the secrets of body and reproduction in the child's development formulated in the most naïve but according to *(continued)*

construction have often made the desire for knowledge-seeking into a highly gendered story.

Some of the examples given by Knorr Cetina herself seem to introduce the same kind of genderisation of knowledge.[3] In the article "Sociality with objects" from 1997 she uses two leading scientists as illustrations of the desire for knowledge: The biologist Barbara McClintock and the statistician Karl Pearson. Before he turned to science Karl Pearson wrote a romantic novel inspired by Goethe's Werther, in which Nature with a capital N is identified with twelve village maidens, whom he catches in their evening bath, "with loosened hair falling to their waists, splashing and sporting in the pool before me …." And now he asks his beloved Ethel (who has obviously rejected him, just as Werther was rejected): "O Ethel, was it a sin for me to gaze on Nature in all her unveiled beauty? (…) Ethel, it could be no transgression, for the thought remained pure" (cited in Knorr Cetina, 1997, p. 21). In Pearson's case, this desire to merge with Nature was frustrated by life itself (Ethel disappeared), and Pearson turned to science at the age of 35. His biographer (Porter, 1996, cited in Knorr Cetina, 1997) refers to this change as a change from "conatus cognitandis," an urge to know through merging with the world, to "conatus interruptus," where seeking knowledge represents a painful and for ever incomplete union. In contrast to this rather sad story, the story of McClintock has a happier ending. Her biographer, Evelyn Fox Keller, even calls McClintock's scientific endeavour "a love affair with the world," shown in a deep "feeling for the organism." The chromosomes that she scrutinises become her "friends," and she feels sad whenever she walks on grass, because she knows that it is screaming in anguish. There is "excitement," she even uses the word "ecstasy," associated with her knowledge-seeking, but there is also solidarity and care (Fox Keller, 1983, cited in Knorr Cetina, 1997).[4]

Freud *most* fundamental of all questions: "Where do the babies come from?" (Freud, 1923) The preoccupation with such questions (equally distributed between the sexes) has been called an "epistemophilic project" (see Rudberg, 1996), and is assumed to be especially emotionally loaded for the little boy. The bodily differences between himself and his mother not only unsettle his existential (bodily) security (small boys also want to become a mummy); this difference also instigates incestuous impulses towards mother with the father's possibly mutilating wrath as a consequence (castration). The sexual difference in itself, mother's "missing part," seems to underline this possibility. Therefore, identity construction and knowledge work as part of such construction will for the little boy imply efforts at differentiating himself from whatever is considered "feminine" and at the same time construction of rationality ideally void of passion. One could perhaps say that the little boy is passionately seeking passionless knowledge. The little girl, in contrast, seems less engaged in this passionate curiosity, once the anatomic fact has been established as a given, not being possible to alter.

[3] The absence of gender in Knorr Cetina's work is very evident: In her major work, *Epistemic Cultures* from 1999 – a book of over 300 pages – gender is mentioned only once, in relation to flirtation and joking relationships in the investigated laboratories.

[4] McClintock's story might also be a case in point for the alternative theory of the desire to know, represented by Gilles Deleuze's emphasis on a more life-affirmative and positive interpretation (1972, referred to in Jensen, 2007, see also chapter 9). The sense of positively reinforced mastery of the world of both material and ideal objects is obvious enough in small children. And, although this is admittedly a sketchy thought at this point, this theoretical approach might also shed some light over historically important gender differences in relation to desire and knowledge.

These are almost word for word the formulations made by feminist theoreticians suggesting the specificity of a female mode of knowledge-seeking within the framework of object relational theory. In this version of psychoanalytic thought the development of gender is seen as related to the boundaries that the small boy has to draw between his mother and himself in order to become a (male) knowing subject. This theoretical orientation has resulted in important critiques of the gendered character of especially positivist science (see for instance Fox Keller, 1986; Bordo, 1987), where delineating and categorising activities have been interpreted as more or less defensive efforts to solidify a frail masculine identity. The alternative is for these feminist scholars to refuse the male vision of the subject/object division, and instead to adhere to a "commingling" of the two and an empathetic feeling for the object. "Feeling" should be part of science, not excluded from it. According to this theory (at least in its feminist version) the little girl is seen as less defensive in her knowledge-seeking than the little boy – and as a researcher allegedly more tolerant of holistic (e.g. qualitative) vagueness; subjective feelings and objective rationality are not necessarily contradictory entities in the construction of knowledge. In this case, the "lack of lack" that has been said to be the source of women's incapability for true knowledge-seeking is turned around and made into an asset and enriching factor for scientific thought.

This enrichment through a "female mode of knowing" has also been suggested by feminist sociologists, taking as their departure the everyday world of women. Since this world is fragmented, episodic, and impossible to plan it makes the concepts of knowledge-seeking in other fields (for instance in science) inapplicable (Smith, 1987; Widerberg, 1995).

In the everyday world of women, the "knower" does not correspond to the "centre" of the rational agent that has often been presupposed in traditional theories of knowing. On the contrary, in this context the "knower" is a decentred subject that is attentive to and links together the actions of others in order to make a predictable and manageable environment for *them*. According to one of the major advocates for this theoretical proposal, the sociologist Dorothy E. Smith, there will be a need for no less than a "Copernican revolution" (1987, p. 97) in sociology (which is her field of knowledge) for this mode of knowing to gain ground in academic research. She therefore proposes a "sociology for women" (which must not be confused with a "sociology of women"), since the "ruling" discourse in sociology is male, although disguised as gender-neutral and universal. In her view it is impossible to imagine a corresponding "sociology for men," since that would imply a genderisation of the field of knowledge that would be unacceptable for the "rulers."

In a discussion of object relational theory (but her argument is in many ways applicable also to the proposal of a "sociology for women") Toril Moi (1999) agrees to the undoing of the split between emotion and reason proposed by the above feminist critiques of "male science": "(S)uch a change will make science – or intellectual work in general – more accessible and more attractive for many women." (Moi, 1999, p. 349). However, she finds it problematic to label this "new mode of knowing" as "female," as such a labelling also contributes to the

cementing of gender binaries in intellectual endeavours and scientific work. In her view this "mode of knowing" would make intellectual endeavour not only more suited to women, but also a "superior" way to do science, i.e. also suitable for men. Idealising the image of the unified (plant-like) femininity – devoting oneself to liberating the "female voice" (cf. Gilligan, 1983) – is counterproductive, according to Moi. Such "liberation" would at worst only thrill male fantasies of women as apart and exotic, she argues, quoting the conclusion of the French philosopher Michèle Le Douff: "We will not talk pidgin to please the colonialists" (Moi, 1999, p. 358). The drive of knowledge-seeking *does* imply "lacking," and the unequal gender distribution of the "right" kind of lack is an historical fact, possible to alter through a struggle against gender binaries and not by essentialising such binaries (whether biologically, psychologically or sociologically).

Has this struggle had any results so far? Whether it is the feminist struggle or other historical changes that are involved, it is fair to expect some important changes in relation to the genderisation of knowledge. In our parts of Western society we no longer live in the kind of patriarchal family that was the background for the Freudian conceptualisation, although it is important to underline that psychoanalytic theory of development primarily involves a child's fantasies and images of its parents, not necessarily the everyday versions. Historical changes also affect the proposals of object relational theory: the fact that mothers start working quite early in the child's life, and that the father participates more directly in childcare imply that the boundary question is no longer as problematic as before (see Bjerrum Nielsen & Rudberg, 1994). And finally, is the everyday world of women – the background for important sociological feminist theories of knowledge – still a recognisable entity? Let us look at some of the data from the ProLearn project in order to discuss some of these issues further.

GENDER, KNOWLEDGE AND DESIRE IN THE PROLEARN PROJECT

What, then, are the main results as regards motivation and desire of knowledge in the ProLearn project?[5] In an article presenting some of these results, Jensen (2007) takes as her point of departure the concept of wanting-structure briefly outlined above. One of the questions asked is whether there is an "epistemic takeover" in the professions, i.e. an emotional bonding between the knowledge object and the knowing subject – often presented as an "engulfment" or a forgetting of oneself. In academic research the open-ended character of knowledge objects paves the way for a longing for a "filling out of the blanks" in correspondence with the Lacanian theory referred to above. According to Jensen there is some evidence in the study that this kind of emotional bonding also paves the way for a professional knowledge that moves beyond necessity and develops along a creative dimension. In these cases one can see that elegance and playfulness take the place of one-sided instrumentalism and satisfaction with "good enough" solutions.

[5] In the forthcoming parts of the chapter I make use of the interview questions relating to "motivation and desire" as well as "emotional engagement."

However, this creative attitude seems to be in short supply in the investigated groups. Jensen points out that one reason for this, paradoxically enough, is that a "knowledge society" itself undermines the possibilities for playful experimentation because of the overflow of information and the scarcity of professional guidelines for handling the information: "Viewed as a whole, the accounts of our informants remind us more of a struggle to 'make do' and guard against mistakes rather than the playful acts of creative interpretation characteristic of expert groups" (Jensen, 2007, p. 497). The result is a tendency to "regress to modes of practice which are 'good enough'," in which the energising dynamics, where intimacy with the object of knowledge in itself generates the wish to know more, might not take place. As one remedy against this tendency Jensen therefore suggests that professional organisations take responsibility for the creation of profession-specific learning materials in order to "ensure the emotional basis of lifelong learning" (Jensen, 2007, p. 500).

These findings will guide us in the further analysis, applying a gender perspective to the parts of the material relevant for investigating motivational aspects of knowledge-seeking. In what way – if any – are these conclusions made more nuanced if such a perspective is applied? We must remember that the groups are in themselves quite small, and that the gender distribution within the groups does not allow for any bombastic empirical conclusions. In this chapter these tentative findings will first and foremost form a foundation for a theoretical revisiting of the relations between gender, knowledge and desire.

KNOWLEDGE-SEEKING IN A GENDER PERSPECTIVE

Desire or Coincidence?

The first thing that strikes us is that the gender differences are actually quite small. When it comes to early interest in the knowledge object (in a broad sense) of the profession they are practically nonexistent. The only group that clearly stands out in this respect are the male computer engineers, all but one of whom claim to have had a history of engagement. There is in fact a discursive term to describe this used by both women and men in this field, namely "boy room culture," which one either has had or lacked. In contrast, the female engineers appear to have chosen the profession quite arbitrarily: one of them tells us that she did not even use e-mail until a year before she started her engineering studies; another that she finds it soothing to read journals in paper copies instead of on the net. In other groups the gender differences are negligible: Nurses and teachers have all been more or less interested in "working with people"; accountants often (and regardless of gender) refer to their choice as more "rational" than emotional.

Self-Driven or External Demands?

Thus, the choice of profession is often arbitrary, but what happens once the various groups are in their various fields? How active are they when it comes to

knowledge-seeking, and what sources of motivation (intrinsic or external) do they refer to? Again the male computer engineers stand apart – here only one (the one who also chose his professional career arbitrarily) shows no sign of interest in further developing his knowledge. All the others claim that such self-development is rather "self evident": "Most people who work here have, obviously, a genuine interest in computers," one of them says. Some of them are almost religious in their wordings: "I am the Linux evangelist at work," says one of them, with some self-irony. Another man suggests that it takes a psychologist to understand his drive for knowledge, "but as long as this drive is there naturally, I am glad and happy." The impression is that the search for knowledge is both driven by the tasks (necessities) and is pleasurable. This is for instance illustrated by the fact that many of the men do not differentiate between work and leisure – one of them talks about a "touch screen" at home where he will be able to control light, music, temperature and you name it. Again the gender differences in this group are obvious: the three female engineers describe themselves as rather passive and at least one of them is frustrated by the lack of structure in further education in the profession. This is in contrast to the men, who often enjoy the freedom of looking for answers themselves.

For the other groups (nurses, teachers and accountants) the gender differences are not as noticeable, but some of them may still be worth following up. The nurses of both genders experience much more pressure than the engineers to attend courses promoting further development in their field, but the female nurses appear to follow this up more than the men. The women usually describe themselves as "in the middle" when it comes to such activity – but some of them are "very active" and want to "know why" all the time. Two of the female nurses are actually more interested in "doctor's stuff" and one of them has thought about becoming a doctor herself. They also remark a little ashamedly that they do *not* read the magazine published by their professional association regularly.

Most of the female teachers describe themselves as active or rather active when it comes to seeking further knowledge. They ask colleagues, make use of the Internet and the library, as well as attend a wide array of courses. One of the more dutiful interviewees has meticulously written down all the courses she has attended and tells the interviewer details about dates, programmes and durations. Another one tells us that she could "read pedagogy all day long." The male teachers answer in a somewhat different way, and appear more or less disillusioned: "To be quite honest, much of the joy in working has disappeared since I started to work in a permanent position." The reason for this is that he had previously wanted to "revolutionise schooling," but no longer believes in that project. Another one also shows signs of resignation – and says jokingly that he only takes courses when he is "tired and want(s) to take a day off." He is also angry about the change in schools, where people who were passionate about their subjects like the "old carpeting teacher with snuff under his upper lip," have vanished along with aesthetic subjects in general. Male teachers appear to have had expectations of the profession that have not been fulfilled. Maybe the women had no "revolutionary" intentions, and therefore are more content with what schools have to offer.

Nevertheless, there seem to be some gender differences in this professional group that are not apparent at first glance.

What does emerge both at first glance and as a topic for further scrutiny is that the accountants are a highly active group when it comes to knowledge-seeking. This is of course related to the compulsory elements in the profession, where authorisation depends on the ability to follow up. But this group also exhibits some gender differences: All the male accountants are active, both in relation to the courses on offer and by independent study. Only one female colleague is active, on a scale from "one to six" she gives herself "a seven, actually." The others in their own eyes lack ambition; one says that she was more curious at the start, but now she takes things as they come.

Summary: Gender and Knowledge-Seeking

To summarise, we can say that in relation to knowledge-seeking there are few gender differences in general terms (ten men and 11 women describe themselves as active, with all the problems of interpretation that this term implies, since there are different levels of activity required in different groups). However, some gender differences could be seen when focusing on the individual professional groups: Male computer engineers and male accountants stand out as almost uniformly active. For the women, the activity level is greatest among the nurses. Are there also differences when it comes to different kinds of activities? The computer engineers are almost exclusively intrinsically motivated, i.e. independently seeking knowledge and expected to do so, while the accountants are just as uniformly externally motivated. Both female teachers and nurses associate their activity mainly with outer incentives and courses, but they are, as we shall see more clearly in the following part of the chapter, also motivated to seek knowledge by their everyday work situation. Thus, there does not seem to be any clear-cut gender difference in the motivational sources for knowledge-seeking, although women appear more often to associate external demands with the concept of "activity."

DESIRE IN KNOWLEDGE-SEEKING

The professional groups often separate the theoretical knowledge that they obtain at arranged courses from the "knowledge in practice" that they develop in their work. This separation is actually made in all the groups. All the interviewees emphasise that knowledge is better constructed when one stands face to face with challenges and puzzles that have to be put together in new ways in order to solve a specific problem. If we take a look at the emotional engagement among the professional groups, we can conclude that desire for knowledge development often goes hand in hand with this preference for "hands-on" knowledge.[6]

[6] "Hands-on" solutions are not the same as "good enough" solutions. But an alternative interpretation may be possible in relation to the "good enough" solutions, too, making them less problematic in relation to knowledge-seeking processes. Such solutions, although they admittedly do not reach out for *(continued)*

But let us put the question of desire more specifically: What gives the professional groups a "kick" in their working life in general, and what is experienced as quite boring? What are the gender differences (if any) in the emotions inspired by the professions? For all the groups and both genders, variation will be associated with something positive and routine with something negative. But as a positive concept, "kick" will obviously be more or less appropriate to work life for all the different professional groups.

The male computer engineers all get "kicks" (except the lone exception who did not have a life-long interest in the subject). The men get kicks out of programming, new developments, variation, "strange things and gadgets." One of them tells us one of his mottos: "I can fix everything. The impossible only requires a bit more time." They look forward to going to work "immensely," they love pondering over problems and seeing results. Getting feedback from others is secondary to seeing that things "work," even though it is also of some interest that the customers are satisfied. Among the male computer engineers, the positive words used to describe their relationship to the profession are manifold: "living technology," "a very good feeling," and "a whole lot of fun," "amazingly challenging," "charming," "deeply satisfying," "proud."

The female computer engineers get less of a "kick"; only one says a little hesitantly that she has experienced it when she teaches people who are not so good at computers. She appreciates satisfied costumers and feedback from colleagues most. Another female computer engineer says that she has not had a kick for a long time, and that her strength is probably her loyalty to the projects she works on. In contrast to the technological euphoria of male colleagues, she admits that she does anything to "angle" the project "away from the technological." Boredom is associated with stupid users who ask the same question ten times over, and with being "a pc-doctor." This goes for both genders, although there is a certain contradiction in some women's descriptions (cf. "teaching those who know less"). Maybe it is part of the dominant (male?) computer-discourse to dislike users, because working with them is not accepted as sufficiently creative.

Among the nurses the reverse situation is seen: the male interviewees do not experience much "kick" per se, but the female nurses have stories full of positive triggers: These situations are connected with intensive care and emergency medicine. This is probably due to the selection of nurses in the study, which was dominated by nurses in emergency wards. Some of the nurses actually apologise for what one of them calls a "macabre" wish for excitement and challenge – the worse off the patient, the greater the kick when he recovers! "There is a kick all the time," one of them says, but modifies herself: "It could go wrong." Another one

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further knowledge and are thus satisfied with "less," could be a way to preserve one's energy in an everyday situation where a multiplicity of problems demand more or less immediate attention. Such an alternative interpretation could also be relevant in a gender perspective, since this way of handling the complexity of demands often has been associated with the everyday world of women (Smith, 1987; Widerberg, 1995). However, in this material we cannot detect any specific gender differences either in the activity of knowledge-seeking or in tendencies to seek "good enough" solutions.

connects her kicks to heart failure, a third one to "really ill patients," "it is horrible to say, but it is of course exhilarating ("kjempegøy") when a patient comes in with oedema in his lungs." "There is a little magic ("hokus pokus") every time, because you never know how it will end." This action-seeking is combined with a type of investigative curiosity, which one of the nurses finds similar to "detective work."

Most of the nurses like to work with people; some of them explicitly contrast their daily tasks with "working in an office," which they would not enjoy. However, it is not primarily the nursing or the relational aspect that is emphasised – most of them actually find nursing activities such as watching over patients, distributing medications, providing information to the doctor – in short the role as executor of others' diagnostic decisions – quite boring. Only one of the nurses actually gets a sort of kick out of caregiving, proffering an almost poetic description of what others find to be the most tedious activities: "There is nothing that feels as good as when you have cared for the patient, and he lies in a clean bed, yes, with clean clothes on and freshly shaven. That is fun. That gives me a lot." But all in all, the desire for action and the need for independence are what make nursing interesting to these women.[7]

Some of the male teachers say that they get a "kick" from teaching, "then and there" in the classroom. One points to the positive feeling one gets from "making children happy," for instance when one is able to teach someone who has never learned anything before. Another one does not feel at home with the concept of "kick," but describes how the day is over "in a jiffy" when he is together with the pupils. For the female teachers, too, it is the interaction with the pupils that is associated with meaningfulness, happiness, humour and significance. One of them actually misses pupils during the weekend, another one lies awake thinking about them at night. In sum, they all show a great involvement in their pupils, more so than involvement in the subjects that they teach. This probably has something to do with the level they are teaching (most of them are teachers for primary and lower secondary school). The subject they talk about is therefore mainly pedagogy, which many of them are interested in (cf. the courses taken). Women and men are thus in agreement about the positive sides of teaching. They also concur when it comes to what they consider the most boring parts: staff meetings (especially about other levels and their excursions), marking heaps of rather mediocre Norwegian compositions, and office work in general. For this group (as well as for the nurses)

[7] Maybe that is why they do not seem to respond to the new "nursing science" as would be expected, at least not the "ethics of care" represented in it. The "evidence-based" part of that science is obviously more appealing to them, and maybe that is why some of them would rather do "doctor things." In a study of 15 nursing students over a three year period, Jensen & Lahn (2005) get a different result from their interviews. The nursing students exhibited a unanimous contempt for the "nursing as a vocation" tradition in the vein of Florence Nightingale, but developed a strong sense of identity in the course of their education, orienting themselves to the ethics of care. It is, however, as the authors also say, hard to know if this is an allegiance to the dominant discourse of the school or more deeply rooted. It might therefore be significant that the material for our study includes nurses in work positions, and specifically in emergency wards.

there is an explicit contradiction between working in an office and working with people. The worst part of office work is the new demand for testing and reporting. The accountants get quite surprised when asked if they ever get a "kick" from what they do – it has probably never occurred to them to describe their work in that manner. There are many tasks, one of the male accountants says, for instance instruction of co-workers and special assignments that are more fun than others, "but no kick." Another says that the "economic thing," "to have the figures in order" is the most satisfying, but "not actually a big kick, he-he." The female accountants do not recognise the "kick" referred to by the interviewer, either: one feels "useful," another never gets bored because the people she meets respect accountants. There are no big gender differences in this group in relation to positive emotional engagement in the profession (and it would be wrong to assume that there is no such engagement), and there is also consistency in what is considered boring: routine work and auditing receipts ("bilagsrevisjon").

Summary: Gender and Passion in Knowledge-Seeking

How can this diversity be summarised? It is worth noting that the definition of what is *boring* is essentially the same for all professional groups and varies very little between the genders within each group: The main complaint is about routine and lack of variation. So what about the positive emotional engagement, the "kick"? With the exception of the accountants, all the professional groups see themselves as experiencing some sort of kick, at least once in a while. There are no general gender differences evident in this either. There are, however, two groups that appear somewhat more passionate about their activities than the others, namely the male computer engineers and the female nurses. The male engineers make use of highly positive language in the description of their never-ending search for solutions to intricate puzzles. The female nurses also show great involvement, more in emergency work and intensive medicine than in care and nursing, but this is in part due to the selection of interviewees in the project. In their descriptions of what excites them, they identify more with the doctors than the nurses.

KNOWLEDGE, GENDER AND DESIRE – FILLING THE "LACK"?

What is most striking in this study is the *relative absence* of gender differences in both activity and motivation for knowledge. There is a small tendency indicating that women associate at least the *concept* of "activity" with arranged courses and external demands, but it would probably be going too far to suggest that they are generally in greater need of structure for learning than men in the same groups. The male accountants, for instance, are very "structure-bound" in their activity, and more so than the women. In the case of the teachers, the situation is the reverse. The most important gender differences noted are *within* professional groups that are highly gendered: The female computer engineers stand out as less active and engaged than their male counterparts, and the male nurses as less active and engaged than their female counterparts. Being the minority gender in a group

heavily dominated by the other gender appears to have implications for the knowledge-seeking process. At the same time the dominant genders of these groups show striking *cross-gender similarities*: The male computer engineers and the female nurses are the representatives in the study who "ponder problems" and play at being "detectives" more than the others, and appear to do so to the same degree and with equal intensity. How can we use the theoretical viewpoints presented earlier to try and understand these findings? Let us start with the main finding – the relative absence of gender differences.

Modern Versions of Pearson and McClintock?

As pointed out before, the gendered history is historically malleable and thus, the stories of desire and knowledge-seeking will also be subject to change. Both psychological genders are (possibly in their own ways) desirous of and striving to gain knowledge, and it is not hard to see that societal and cultural norms have historically placed those strivings into different positions. Women have been denied access to knowledge arenas, and the cultural norms denying women active desire and linking them to a position of neediness are equally salient (Rudberg & Bjerrum Nielsen, 2005) This, however, is also changing, as is women's access to education. In our society (Western, Nordic) women today are not only knowledge-seeking, but are also accepted as subjects capable of desire to a much greater extent than their mothers were (Bjerrum Nielsen & Rudberg, 2007). This also implies that the binary element in the theories of gendered knowledge-seeking, where it was virtually impossible to reconcile "male" and "female" ways of knowing, must be re-examined.

The "woman's world" argument of gendered knowledge-seeking (cf. Smith, 1987; Widerberg, 1995) is a case in point. It is not hard to see that this everyday notion is no longer such a distinctly female affair. Even though the division of labour between men and women when it comes to household tasks and child care is far from equal, the borders are more blurred, with potential consequences (according to these theories) for more similar modes of knowing. In the academic world, the Copernican revolution that Smith (1987) talked about might not yet have occurred, but at the very least a significant "reform" has been underway. In numbers the female knowledge-seekers actually have the upper hand in most academic studies, although they are still underrepresented in the highest positions. More importantly, the genderisation of the "male" academic position that Smith found almost unimaginable has to some degree become an acceptable discourse. There might not yet be a "sociology for men" (even though some male researchers might feel the need for it as a defence against alleged feminist attacks), but there is a substantial body of gender research *about* men, conducted *by* men.

In conclusion, it is fair to say that we have not discovered any modern versions of Karl Pearson and Barbara McClintock in the material. One reason is of course that they were active in quite different areas of knowledge (academia vs. professions) from our groups. But perhaps even more important is the change in both gendered

desire and gendered knowledge-seeking that has taken place since their time. The "depassionisation" of Pearson, where "conatus interruptus" replaced "conatus cognitandis" – establishing distance and boundaries instead of merging with the object – may be seen in some of our male respondents. But it is equally often seen among the female respondents, at least within the same professions. The solidarity and care of McClintock are obviously still part and parcel of many female knowledge-seekers' repertoire, shown for instance in the insistence of "working with people" rather than in "an office," and in the fact that they think about pupils during weekends and at night. However, this tendency is common among their male colleagues as well. The blurring of boundaries that is often seen as an important (and more or less disturbing) characteristic of the knowledge society itself (cf. Jensen, 2007), is also evident when it comes to the gendered desire to know. The binary knowledge constructions seen in Pearson and McClintock appear to be as outmoded as their gender constructions themselves.

Knowledge – a Degenderising Story?

Let us finally take a look at the gender differences that are noted in the material, differences that at the same time involve some interesting cross-gender similarities. The major differences were between men and women in engineering and nursing. One explanation could be that being part of an environment heavily dominated by the other gender makes gender more salient. This argument is of course not new (cf. arguments for girls' schools as a way to liberate girls' intellect) – and its mention conjures up an uneasy feeling of reiterating conservative gender segregationalist propaganda. But there seems to be some obvious truth to it, namely the commonsense fact that it requires *gender* to be *genderised*.

For the female computer engineers a recurring cultural image is the "boy room," a place where she does not feel at home. For the male nurse there are no such easily interpreted metaphors in the text, but the overall history (and narrative) of the tradition will evidently make him stand out as Other. For the male computer engineers and the female nurses, gender is not as salient (at least not in this context), disturbing or energy-consuming – and knowledge-seeking might therefore be allowed to develop in its own desire-loop. But we might have to take the analysis one step further: What are the consequences for gender once this "loop" is established?

Many women in academic research have felt the problems of being "genderised" in discussions, sometimes as blatantly as the situation described by de Beauvoir (1961, p. xv, cited in Smith, 1987, p. 53):

> In the midst of an abstract discussion it is vexing to hear a man say: 'You think thus and so because you are a woman,' but I know my only defence is to reply: 'I think thus and so because it is true,' thereby removing my subjective self from the argument.

The reaction of Dorothy Smith to this way of responding is also interesting: According to her, de Beauvoir should not hide her gendered position, since *all*

arguments (male and female) are gendered. In the specific historical context this might have been a relevant critique of a tendency among academic women to subordinate themselves to the "male" premises and standards for arguments and truth. However, it is not hard to follow Toril Moi's (1999, p. 260) "defence" of the position of de Beauvoir either, as she points out that academic knowledge-seeking relies on our joint acceptance of standards for intellectual arguments, which includes not reducing ideas to persons or gender. My point here is to suggest that this conflict might actually have resolved itself. By being allowed as (gendered) knowledge-seekers into a process where knowledge itself (as well as its gendered aspects) becomes of paramount interest, gender might paradoxically lose its relevance in relation to the question of "truth" that all passionate knowledge-seekers are seeking (i.e. "lacking").

The hypothesis here is that degenderising might in fact be a result of knowledge-seeking itself. Adding a twist to Knorr Cetina's concept, we can say that male engineers and female nurses – members of two highly gendered groups – both seem to experience something of a "takeover." Epistemic takeover is, according to Knorr Cetina (1997, p. 20), "becoming inserted into the object (…) and of the objects taking over her mind and her self." With the insertion into the object, the forgetting of oneself, gender might in fact also "vanish," however much it was involved in getting to that position. Certain historical conditions must evidently be fulfilled – for instance as regards destabilised power relations in relation to gender – for such degenderising effects to occur. Is the situation today such that it is reasonable to understand the gender similarities between and within most of the professional groups in this way?

Even though the picture is far from clear-cut, the blurring boundaries between genders, both in their psychological history and their everyday life, could be argued to be important factors in destabilising gender. Looking at the still-traditional recruitment patterns to high school streaming, university and professional education, as well as to working life, it seems that a lot of "queering" is still needed in this area. The blurring boundaries will at least make new and gender-crossing choices possible. Whether the choices will actually be made is another question, and how this queering will become the everyday reality of tomorrow is hard to say. Even though desire is a socio-historical fact, it will most probably not be moulded by pedagogical endeavours alone. But maybe knowledge itself – professional or otherwise – will contribute in its own way to this degenderising of the desire to know?

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SELF-TECHNOLOGIES IN WORK-BASED LEARNING

INTRODUCTION

The emphasis given to learning in today's society presents challenges not only to professional communities and educational institutions, but also to individual practitioners. The contemporary notions of learning as 'lifelong' and 'life-wide' position learning as a key activity over the lifespan as well as in life as a whole, including private and leisure activities. The individual is placed at the heart of the debate and presented for ideals in the dual form of demands and opportunities. A space of reasoning is created in which practitioners are asked to embrace the notion of the continuous learner as a core narrative of identity construction.

The current trends have made researchers point to how notions of learning are linked to political and economic issues and serve as powerful means of governing by producing new kinds of identities for individuals to take up, as well as knowledge and tools to support individuals in these efforts (Usher & Solomon, 1999; Chappell et al., 2003; Edwards, 2004; Olssen, 2006; Tuschling & Engemann, 2006). Rather than presenting concrete requirements for knowledge engagement and learning, there is a general expectation that individuals will engage in learning on a discretionary basis and assume responsibilities for their future life chances. Following Nikolas Rose (1999), this mode of governance operates by the principle of recognising individuals' capacities for freedom and agency and by making efforts to route this energy in specific ways. Rose (1999) states that "to govern is to act upon action", and points to how it entails efforts to "shape actions, processes and outcomes in desired directions" (p. 49).

In professional life, these trends are reflected in the general attention towards securing practitioners' opportunities for continuous professional development. Professional learning is not about participating in collective learning activities or meeting formal requirements only. It is also about deliberate practices of self-conduct in which professionals engage in processes of improvement on a discretionary basis. These practices are interlinked with knowledge in interesting ways. The organisation of knowledge in professional communities forms a space "between" the general political efforts and individuals' practices that, in addition to routing actions in certain directions, also provides individuals with positions from which to act as well as with tools and opportunities to transfer regulative forces into productive means of self-formation. Particularly in expert cultures like the professions, the structure and organisation of knowledge comprise a significant apparatus for learning and identity formation. How practitioners enter the positions

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provided and turn these into resources for learning and professional development is a question in need of further investigation. The aim of this chapter is to explore these mechanisms in the context of computer engineering. How do the positions offered to practitioners in this field incorporate opportunities and demands for learning? And how do practitioners regulate their learning efforts to meet current demands and shape their future as professionals?

The group of computer engineers is an interesting case for several reasons. First, rapid shifts in technologies and work structures contribute to individualising the responsibility for long-term competence development. Previous research has revealed how this profession is generally characterised by high mobility and by an absence of set career paths (Davies & Mathieu 2005; Loogma et al., 2004; Ó Riain, 2000). Studies of IT workers indicate that practitioners in this field make quite different choices and move along different professional trajectories (Billett et al., 2005). Thus, the responsibility for creating and maintaining a professional course is, by and large, allocated to the individual. Second, the technological turnover generates demands for flexibility and capacities for handling change. In some ways, the production context of computer engineering resembles that of "moebius strip enterprises" (Guile, 2007) in the request for being able to reorganise quickly to respond to changing market conditions. As a consequence, the learning demands resemble what Castells (2000, p. 1) has called "self-programmable labour"; that is, "labour which is sufficiently flexible, technically equipped, and well trained to be able to adapt itself throughout its professional life to different tasks, contexts and requirements". These demands for being both flexible and technically equipped cause tensions and dilemmas for practitioners to deal with (Loogma et al. 2004) and call for extensive skills in reflexivity and self-management.

In order to explore this self-governing dimension of professional learning, the chapter adds a dimension to the perspectives on knowledge cultures and practices explored in previous chapters by introducing the Foucauldian concepts of "power/knowledge" and "technologies of the self". It should be noted, however, that Knorr Cetina (1999) has included this way of thinking in her analysis of the epistemic cultures of biology and physics. Here, she describes what she, with reference to Foucault, calls "the structure of the care for the self" as an important aspect of knowledge production in high energy physics that concerns the conduct of experience involved in understanding, monitoring, and documenting the course of an experiment (Knorr Cetina, 1999, p. 55 ff). However, while her focus was on self-understanding and self-observation in the context of collaborative knowledge production, this chapter will investigate the role of self-technologies in practitioners' ways of engaging in work-based learning.

Interviews and learning logs collected among computer engineers in the Prolearn project form the empirical basis for the discussion. While the knowledge culture of computer engineering is more thoroughly described in chapter 2 in this volum, the present chapter focuses on how the general subject positions provided in this professional domain are entered and enacted by individuals in terms of practising self-technologies. First, however, a perspective on knowledge and self-technologies will be delineated.

KNOWLEDGE RELATIONS AND TECHNOLOGIES OF THE SELF: A FOUCAULDIAN PERSPECTIVE

The ways in which knowledge is organised and collectively dealt with in professional work form mechanisms that route actions and modes of perception in certain ways. In the perspective of Michel Foucault (1980), these processes are understood in terms of formative and mobilising relations of *power/knowledge.* Through this dual concept, Foucault reverses the idea that knowledge is power, and sees power as relational, productive, and enabling energies that are always incorporated into knowledge. Knowledge and power circulate together and form coalitions of energies that allow thoughts and actions to come into being while, at the same time, guiding them in certain directions. Thus, his interest is oriented towards the microphysics of knowledge relations that allow certain things to happen, to be legitimate, and to appear as desirable:

> In thinking of the mechanisms of power; I am thinking rather of its capillary form of existence, the point where power reaches into the very grain of individuals, touches their bodies and inserts itself into their actions and attitudes, their discourses, learning processes and everyday lives. (Foucault, 1980, p. 39)

Knowledge is understood in terms of active dynamisms that enable us to look at, understand, and engage with the world in particular ways. In this way, a linkage is created between the prevalent knowledge arrangements that constitute a field of work and the practices of individuals.

In educational research, the perspectives of Foucault have often been used to examine how power operates to restrict individuals' possibilities for action and human freedom. However, in his later work, he provides a notion of individuals as active agents who, by means of critical inquiries and deliberate conduct, engage in practices of self-formation (see, for instance, Foucault, 1994a). Such practices comprise actions and reflections by which individuals gain self-knowledge and skills in the practice of relating to and improving themselves (Infinito, 2003). They are shaped through models and tools provided by the culture, in the dual form of opportunities and constraints. These tools may have liberating and self-formative potential, provided that the individual is sufficiently integrated into the actual circuits of power/knowledge relations so as to not be constrained by these circuits but rather empowered by them (Tobias, 2005).

In Foucauldian terms, the practice self-formation is conceptualised as practising *technologies of the self.* Such technologies are tools and rationalities which

> permit individuals to effect by their own means, or with the help of others, a certain number of operations on their bodies and souls, thoughts, conduct, and way of being, so as to transform themselves in order to attain a certain state of happiness, purity, wisdom, perfection, or immortality. (Foucault, 1994b, p. 225)

Technologies of the self refer to assemblages of knowledge, instruments, devices, systems of judgment etc., which take ways of being human (or, in this case, being a

professional) as their object. They may take the form of conceptual or intellectual technologies, like the notions of career, professional responsibility, and self-esteem (Grey, 1994; Lemke, 2001), or the materialised form of devices like personal webpages, diaries, and Curriculum Vitas (Krejsler, 2004). The practice of self-technologies does not take place in a vacuum; rather, people conduct themselves against a cultural background and within certain codes of appropriateness and requested subjectivities. For instance, within the contemporary notion of humans as "enterprising individuals" who are considered responsible for their own success and happiness, the practice of self-technologies involves regulation of ambitions, calculations, initiatives, will, and desire (Rose, 1998; Peters, 2001). Rose (1997) describes the phenomena as a matter of elaborating certain techniques for the conduct of one's relationship to oneself, which may imply ways of knowing oneself, ways of mastering oneself, and ways of caring for oneself. Such techniques are, however, always practised under the actual or imagined authority of some system of truth.

In the context of professional work, technologies of the self are related to learning and professional development and are shaped within the dominant discourses of the profession. Collective attitudes towards knowledge and models of engagement provide practitioners with tools and positions from which to act, and encourage participation in learning activities that are congruent with the demands of the knowledge domain. Thus, work-based learning may be understood as self-directed practices within a specific area of expertise in which the general demands of the learning society are filtered and shaped through the given professional practice. While the general discourses of contemporary society aim to mobilise practitioners to engage in continuing learning, the professional community provides tools for specific kinds of engagement through the ways in which knowledge is mediated and with which it is generally dealt. This will again give shape to the "epistemic trajectories" (Lahn, 2010) through which practitioners negotiate their competencies, form their professional lives, and engage in the more general discourses of lifelong learning and professional development.

The following sections employ these perspectives as an analytical framework for exploring work-based learning among computer engineers. First, the general subject positions provided in this professional practice are encapsulated. Then the technologies in operation when practitioners conduct themselves as learners are examined more closely. Finally, the described ways of monitoring and engaging in work-based learning are discussed as regards possible implications for individual practitioners and for computer engineering as a professional domain.

OFFERED SUBJECT POSITIONS IN COMPUTER ENGINEERING

According to Foucault (1972, p. 122), the configuration of a field of knowledge "defines the possible position of speaking subjects". Such positions incorporate prevailing knowledge relations in the given domain and provide individuals with tools and access points from which to act and to make sense of the relevant practice. In computer engineering, as in other professions, the subject positions

emerge from an assemblage of discourses and knowledge relations. Three positions seem especially powerful in constituting the basis for self-governed learning: the positioning of the engineer as inquisitive and playful, as an instant and dedicated problem solver, and as his/her own career manager. These will be outlined below.

The Inquisitive and Playful Practitioner

The profession of computer engineering places a high value on inquisitive minds and on an attitude of playfulness. The core narratives of successful engineers draw a picture of practitioners who enjoy their work and who attend to technological challenges with curiosity and pleasure. This image is also reflected in the data collected in the ProLearn project. Either in confirming manners (as usually among the males) or as a basis for deviant stories (as among some of the females), the story of the "young technician" was a recurrent theme in almost all interviews when practitioners were asked about their choice of profession. In a group interview, the three participants (here named A, B, and C) all seemed to agree that engineers are distinguished by a certain mind-set:

A: In a way, you have a certain type of personality when you are an engineer. A desire to develop or to produce things, or …
B: I agree.
A: … understand how things work
C: Yes …
B: To *create* something is the central issue …
A: Yeah
B: … in being an engineer.
C: Yes, it is.

This way of thinking also plays out in the context of professional education. A main task in the final year of the bachelor programme is to carry out a 'real' engineering project in cooperation with a technology firm or another enterprise (General Plan for the Bachelor's Degree in Engineering, 2003). One engineer, who during this period was placed with a firm that produces online games, describes how he and his fellow students were asked to use their playfulness in carrying out the project: "'You could actually do whatever you'd like'. That's what the guy from the firm told us. 'Just make it fun, besides that you can do whatever you feel like doing.'" This request to have fun also seems to be valid in working life. 'Playing' with the technology is regarded as an important way of exploring new devices and possibilities. Computer engineers often explore technologies 'off stage' by means of a trial-and-error approach. Such activities may even have a formal status in the work setting, as expressed by this engineer in the context of handling a shift in programming languages:

> We have not planned to organise courses in C#, since it is very close to Java, which almost every one of us knows. Instead, we are provided with some time now and then to play with it and to try to figure out how things work.

For the professionals, the emphasis on playfulness and curiosity may be seen as a request for engaging in learning as explorative activities. Moreover, this aspect of the engineering culture incorporates a notion of learning as lifelong and life wide. As also argued by Davies and Mathieu (2005), showing interest in technology in their spare time is one of the implicit requirements for making a career in computer engineering.

The Instant Problem Solver

Another powerful positioning is related to the notion of engineers as problem solvers. Like engineering cultures in general, the practice of computer engineers is characterised by a dominant pragmatist way of thinking. This implies a high value placed on the application of knowledge in dealing with practical problems, a focus on validating theoretical principles through activities of inquiry, and an overall emphasis given to making things work and getting the task done.

The task-based organisation of work and the emphasis given to standards and codified procedures make workplace learning a matter of identifying appropriate standards and codified knowledge to be applied in short-term sequences of problem solving see also chapter 2 in this volume). Work is often organised as series of problem solving (Bucciarelli and Kuhn, 1997; Downey, 1998) either in terms of correcting malfunctions that occur in a technological system or in terms of developing new functionalities in accordance with given specifications. In this context, the professional is asked to embrace the position as an instant problem solver who is capable of naming and framing the nature of the problems at hand (Schon, 1987) and accessing the knowledge necessary to solve them within defined time frames.

In addition, there is a request for an experimental attitude and a set of strategies for exploring the matters at hand beyond what is given. As noted by Bucciarelli and Kuhn (1997, p. 211), engineers typically "go about making up scenarios about things and principles, physical concepts and variables and how they relate". However, while such activities require creativity, the aim of the scenario making is to achieve closure by arriving at a solution that is "fixed, repeatable, stable, unambiguous, and internally consistent" (p. 212).

The Reflexive Career Manager

A third positioning in this professional field is related to the individualised responsibility for learning and career development. Grey (1994, p. 481) notes on a general basis that the "new project of self-management" opens for occupational careers to play a particular role in modern societies since they offer a "relatively well-defined scenario within which individuals may develop, express and create

themselves". Moreover, as part of the project of the self, career constitutes "labour process discipline" in certain ways (Grey, 1994, p. 481). For the computer engineers, however, the shifting demands and instability that characterise the working field may disrupt the presence of 'well-defined scenarios' and leave it to the individual to create and make sense of his/her own professional biography. As a result, work life learning among computer engineers is tightly interlinked with career movements and career management. This is also reflected in the ways in which the Norwegian Society of Engineers (NITO) attempts to support its members by offering career consultancy services. On its website, these services are organised under the joint heading 'courses and career' because, as NITO states, "career is about being a lifelong learner throughout working life" (www.nito.no).

This position may, however, come into conflict with the above-described position as a problem solver. One engineer describes tension between the needs of the employer or customer and his more long-term interests in securing a future career: "I regard my career as consisting of at least two tracks … one in the [name of firm] where I am currently employed … and one more lifelong career. And the two of them do not always have shared interests."

The logic of problem solving and the notion of career management serve as two dominant technologies that call for self-governing activities. That is, they allow the practitioners to effect certain operations "on their bodies and souls, thoughts, conduct, and way of being" (Foucault, 1994b, p. 225), at the same time as they provide orientations and repertoires of action that appear contradictory.

ENACTING THE POSITIONS: THE PRACTICE OF SELF-TECHNOLOGIES

As shown above, engineers are positioned within a space of multiple and conflicting demands which need to be negotiated and balanced. This section will explore how this plays out in the practice of self-technologies.

Attuning Interests in Learning to the Requirements of Current Working Tasks

First, the emphasis given to problem solving and to making things work produces awareness for the specific demands in work situations. One effect is that most engineers avoid a total commitment to certain systems or technologies, as they will have to attune their interests in accordance with task specifications. Thus, although relating their identities to technologies, they seem to resist the exclusive identities encouraged by, e.g., corporate-based networks in favour of a more pragmatic approach. This comes into view in this engineer's account:

> It is probably the privileged engineers that are in a position to state clear preferences and express a football-team-like feeling for systems. And they are perhaps located in [higher] educational institutions, where you find the guys wearing Penguin T-shirts and … you know? There you may have such an atmosphere. But, like in my kind of work, you could never express such an attitude.

Since a general expectation is to attend to the wants of, e.g., a customer, a rigid position is difficult to maintain without bringing oneself into a lot of frustration. Thus, work-based learning is, to a great extent, mediated through the nature of the problems at hand and requires a flexible attitude towards different technologies. Moreover, as expressed by this interviewee, the engineers feel obliged to carry out their work in a way that is consistent with the given specifications, and within the set time frames:

> … there is no opportunity in my job for avoiding doing what has to be done. If one way of approaching the task doesn't work, you just have to find another solution. (…) As a rule, I never go home before the work is done, to put it that way. It is my responsibility to find solutions.

Thus, problems that occur in the course of the working day are given priority over other concerns, and the practice of self-technologies involves ways of being committed to their ascribed responsibilities and working tasks. The rapid shifts in technologies imply that the practitioners often need to adapt to the requirements of the available technological systems, more than the other way around. This may cause tensions in relation to other demands. For instance, a general concern is that strong identification with certain technologies and standards may serve to limit practitioners' opportunities for career mobility (see also Loogma et al., 2004).

Regulating Ways of Reasoning

Another feature of knowledge relations that is inherent to professional work is that they provide logic for understanding and making sense of the tasks with which one is confronted. Hence, the self-technologies operating in learning practices are related to the embracement and enactment of certain styles of reasoning. One effect of the emphasis given to problem solving and to playfulness in computer engineering is that systematic and inquiring ways of thinking are regarded as a core skill. While software developers, e.g., need to know the syntax of the language they are utilising, they must also, as expressed by this engineer, be able to think in certain ways:

> … a recurrent skill is related to ways of thinking. That is, the logic [of programming] is persistent. If you are a poor programmer in Java, then you will also be a poor C# programmer, because it has to do with your way of thinking, even if you know the syntax well.

The standards for good thinking are related to understanding the operative mechanisms of the given technologies, as well as the systematic approaches to inquiring which actions to carry out. When asked about what characterises such ways of thinking, our interviewees highlight the need to "think in best practices" and apply a "generic" way of thinking. The idea of "thinking in best practices" is described in the following way:

> I don't know if I can explain it in other ways than … when you face a new challenge, you will solve it in ways that are so good, so generic, so recyclable and effective that it could have served as a 'best practice'.

The values related to 'best practices' provide mental models that guide the engineers in their work and contribute to articulating learning needs. Further, the regulation of reasoning includes predictive thinking and an overall concern for constructing technological systems in ways that allow for future changes and adjustments. This request for simultaneously considering present and future possibilities is also manifested in other strategic actions that will be described below.

Monitoring and Engaging Oneself in Technological Advancements

As the working days are dominated by sequences of instant problem solving, the engineers need to activate other techniques to keep up with the advancements more generally and to care for their long-term career interests. A major strategy is related to monitoring advancements in the technological field. When the practitioners come in touch with new stuff as part of their problem-solving activities, they simultaneously employ techniques for staying informed about what is happening. One engineer describes it like this:

> It is extremely important to … have an idea of what's happening. So, you keep an eye on it, but you don't really go into it. Perhaps you try it out for ten minutes or so, just to see what it is, and then you put it aside. But then you know that the next time I face this kind of question I will have a closer look at it. (…) So, very often, at least as I experience it, you try to see what's coming up in say the next six months. And after a while, when you have finished what you were working on and stand in front of new tasks, you may put it to use.

Hence, this kind of self-regulation involves directing one's attention towards possible future scenarios and actively engaging oneself in such scenarios. Moreover, the concern for keeping informed also involves monitoring activities when off work. Quite a few of our interviewees mentioned a number of websites that they visit regularly in order to get to know about new inventions. Furthermore, the engineers who have not yet decided how to specialise their competence express a concern for trying to stay as up to date as possible on a broad basis, in order to "keep all doors open".

Securing Access to Learning-Intensive Tasks

As stated previously, self-technologies are, among other things, about the regulation of initiative, will, and desire. In this respect, the rapid shifts in software and systems and the general concern for career management generate techniques for deliberately positioning oneself in relation to working tasks, responsibilities,

and learning opportunities. One way of doing this is to express interest in participating in new projects that involve opportunities for learning about technological advancements. Although such participation may have an optional character, especially in larger companies, our interviewees are eager to use these opportunities to develop their competence. Sometimes, the positioning involves groundwork and self-regulation in terms of calculation: "You need to do some work behind the scenes, in order to get access to the right projects and to lead your career in the direction you would like it to take…and, of course, your competence development". Strategies of positioning oneself for access may also take the form of more formal learning efforts. The engineers described how they deliberately attend courses that will "look good on the CV", even if the topic is not relevant to their current work. The courses may be provided by the employer, or, increasingly common in this professional field, may be linked to certifications issued by the larger technological companies. One engineer working as a consultant describes how he obtained certifications as a strategy for achieving contracts in the future:

> When I started I didn't have any network – people who could promote or hire me. So I spent a lot of time reading and obtaining certifications. When everyone has a formal education of at least three or four years, certifications become important; especially those issued by larger companies as, for example, Oracle, Microsoft, and Sun.

As these examples illustrate, the engineers' efforts go beyond the settings of local work and present problem solving. Their practice of self-technologies is directed towards workplace learning as well as towards engagements in learning off work, and they deliberately make efforts to turn the outcomes of these activities into future possibilities.

Reflexive Use of Learning Strategies

The tension between the requests for devoting oneself to current problems and, at the same time, keeping an eye on future career opportunities is manifested in the ways in which the engineers go about attaining new knowledge. The double demands engender a double set of learning strategies, which seem to be subjected to deliberate conduct. As one of our interviewees explains; "You learn in a completely different way if you just intend to get something to work, compared with situations where you need to know it well" (A, Group interview). Surface learning is related to direct implementation of information-like knowledge or to situations in which the knowledge is not expected to maintain its validity in the longer perspective. Such learning is described as a matter of knowledge replacement:

> … what you learn is more like a method for achieving new knowledge, for in the next turn to erase it … or, for not to imprint it in your 'hard disk' [brain] forever. You learn it, use it, and when you don't use it anymore you put it

> aside. And then the knowledge dies after a short while, and is replaced with new knowledge when you need it.

Furthermore, this 'replacement of knowledge' is related to metacognitive skills. One engineer describes how he is aware when he tries to learn something that he will have to relearn it after a short period, and he relates this to core skills acquired during education. As he puts it;

> I believe we are able to learn within extremely short time perspectives. More than the factual knowledge, you learn a certain way of engaging in learning. In a way, you learn to create units or shelves where you can store knowledge rather quickly.

When the engagements in learning are related to in-depth knowledge that is believed to have more permanent relevance, the efforts take a different character. In such situations, it is considered important to gain knowledge not only about what works, but also about how it works, and about the general principles underpinning the technology. Here, the learning strategies are described as much more systematic, comprising activities as reading academic literature, working on purposely composed exercises, and testing possible solutions in offline environments. Our interviewees seem to be reflexive regarding which strategies should be enacted in different situations. An important dimension in their self-management as learners is thus related to deciding what should be learned for which purposes, and to match the strategies employed to the character of the learning task.

Embracing the Identity as a Self-Driven Learner

Finally, the practice of self-technologies is related to the regulation of ambitions and identities. As a general description, the engineers in our study all seem to have embraced the position as a continuous and self-driven learner. This comes into view not only among the software developers but also in the context of system administration, which one could expect to be somewhat less learning-intensive than the developer field. Here is an excerpt from an interview in which one system administrator was asked what makes her sustain her efforts to learn:

Engineer:	If I wished so I could just sit there, you know, looking stupid, or surfing on the net all day long. Nobody tells me 'Now you got to do this and that'. It is my responsibility.
Interviewer:	Can you tell me then, what makes you access new knowledge and engage in learning?
Engineer:	Well, you want to get things to work, you know. And just learning. Learning about new stuff. (…) There are so many things I feel I don't know enough about, or do not understand properly. I start to get an overview now, but there are always

> lots of details that I want to sort out. The flows of things to learn are just endless.

A recurrent theme in our interviews is that the practitioners hold themselves responsible for keeping updated. In their ways of realising this ideal, they become involved in processes related to choosing a direction for specialisation, which again involves processes of identity construction. Although graduating from the same educational programme, our interviewees articulated a range of career preferences when we met them after a couple of years of working life. These included preferences for management tasks, database administration, software development within certain technological frames, employing the professional knowledge within systems for public health information, and devoting oneself to the needs of a particular (non-technological) firm. Obviously such choices involve the practice of self-technologies in terms of negotiating subjectivities within socially offered positions. Learning in working life is partly about being able to make deliberate career choices and to critically reflect upon these. This involves aspects of freedom and liberation, but is, at the same time, premised upon and made possible through the knowledge relations that constitute the profession.

CONCLUSION

As argued by Knorr Cetina, an important aspect of knowledge cultures is the ways in which they position participants and constitute the space of possible experiences. Hence, as she articulates it, "Views of culture that ignore the conduct of experience are just as limited as views of practice that squeeze symbols out of the picture" (Knorr Cetina, 1999, pp. 10-11). The discussion in this chapter has revealed how knowledge discourses and relations inherent to computer engineering produce certain subject positions for individuals to take up, as well as tools and techniques through which they may act on themselves as learners. In computer engineering, work-based learning is related to inquiry-based activities, which are driven partly internally by the problem setting at hand and partly externally by technological shifts. Opportunities to participate in activities that offer new experience become a core issue, thus the engineers make deliberate efforts to position themselves for such engagement. At the same time, the individualisation of responsibilities in this field relates continuous learning to issues of career management. The learning professional is constructed in a contradictory position where he/she is requested to both commit to the learning needs in current working tasks by embracing the position as an instant problem solver, and to manage his/her own working career by engaging in broader activities of continuous learning.

At the same time, the positioning of subjects in professional discourse does not determine practice. In order to be influential, the discourses depend on individuals who embrace the subject positions offered and enact them in creative and locally relevant ways. The engineers in this study seem to deal with the paradoxes with which they are presented by activating several sets of strategic actions that run simultaneously. They make efforts to solve their everyday technological problems

while, at the same time, monitoring the long-term effects of the work and the advancements that are being made in the field more broadly. Furthermore, they often deliberately position themselves in relation to tasks and learning opportunities, and seem to be reflexive regarding enacting different learning strategies. Thus, more than resisting the positioning and trying to redefine the relations of power/knowledge in which they are embedded, they generally embrace the positions offered and do their best to fulfil the multiple demands. This gives the professional practice an intensive character.

As a consequence, the enactment of self-technologies involves practices of boundary setting and of balancing between external demands and personal capabilities. Here, we can see power mechanisms in play in the ways in which ambitions, desires, and concerns are regulated. Although satisfied in the present, quite a few engineers express their worries as to whether they will be able to deal with the time pressures and multiple demands in the longer term. They stress the importance of caring for their personal life as well, and of finding a tempo at work that is possible to live with. The opportunities for doing so, however, seem dependent upon the degree of flexibility in their working situation, and upon their capabilities for reflecting on the forces that serve to constitute the professional demands. In this sense, the capacity to develop a critical awareness of the assumptions that underlie practices is a core issue (Edwards et al., 2002, p. 533) to which the study of self-technologies can contribute.

As a general impression, however, the engineers in our study seem rather satisfied with the current state, and express a feeling of being in the front and of working in a very innovative sector. This may be related to the subject position as creative and playful practitioners, which influences the engineers' relationship to themselves and their knowledge domain, and produces an overall idea of having fun at work. Moreover, this enthusiasm seems to be supported by the general organisation of knowledge in this field. In everyday work, the access to the newest advancements in technologies and the contact with other spheres of practice that are closer to substantial innovation seem to provide the engineers with the excitement of novelty without really producing it in a strict sense. Interestingly enough, the subjectivities of computer engineers seem to include a self-perception that rejects stability and routine-based modes of living, despite the fact that many working tasks are about achieving stabilisation and security. This somewhat humoristic statement from a group interview, in which the engineers described how they frequently turn to the Google search engine to solve present problems, may stand as an example of the paradox of the stable and the inventive:

> Google is the rescue! I mean … if you don't find the answer you are searching for by that approach, then it is really time to get married! [*All laughs*]

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KAREN JENSEN & BJØRG CHRISTIANSEN

NEW PATTERNS FOR EPISTEMIC ENGAGEMENT IN NURSING

An Exploratory Study into the Policy and Practices of Non-Knowledge

INTRODUCTION

This chapter examines knowledge work carried out by practising nurses with a focus on their efforts to develop, validate and secure knowledge. It takes as a point of departure that the logic of science comes forward in new ways and seeks to focus attention on the safeguarding of professional knowledge as a core responsibility. More specifically, the chapter examines how practising nurses take on extended responsibilities for dealing with "non-knowledge" in and for professional work, revealing various ways in which this is done in different knowledge settings. Used in this context, the concept of non-knowledge refers to the practices by which different expert groups recognise knowledge challenges and implement strategies for specifying, explicating and further detailing what they do not know. The main questions we raise are: what kinds of knowledge work are performed by nurses in their efforts to deal with non-knowledge? How are the roles and responsibilities distributed between settings? What role do the strategies employed by nurses play in the emerging political dynamics of non-knowledge? In a wider context, the chapter explores what the concept of non-knowledge can contribute to studies of professional practice and an analytical framework for epistemic strategies.

In the mandate given to them by society, nurses have traditionally been responsible for establishing and applying standards of good practice. As an occupational group that has responsibility for core services, nurses' knowledge and competencies are vital to the accomplishment of their work as well as to maintaining public trust. Rapid changes in knowledge and specialisations in today's hospitals require high-skilled performance and place the onus of accountability for the quality of work directly on the professional groups involved. However, a growing body of research suggests that securing and developing knowledge and standards for professional practice is an increasingly complex challenge. At the same time, access to information and knowledge is greater than ever, and the pace of knowledge production generates a diversity of advice originating from a variety of sources that live and circulate simultaneously. The different kinds of knowledge may be in conflict with each other or may address different parts of a problem without straightforward clarification of how these parts

K. Jensen et al. (eds.), Professional Learning in the Knowledge Society, 211–228.

should be integrated. Moreover, there may be gaps in knowledge and best practice and areas in which knowledge is scant and in need of improvement. Hence, rather than providing secure answers to nurses' problems, the dynamics of knowledge and information often generate risk and uncertainty. The knowledge work of nurses has thus increasingly become embedded in the wider dynamic of knowledge and non-knowledge.

In the lights of this, nurses are being given roles and duties that may go beyond traditional notions of mandate and encompass responsibility for knowledge in healthcare more broadly. One example of this, in the context of patient care, is the interest in reporting initiatives that is emerging in many countries. A number of studies have shown how the role of nursing in healthcare safety and quality initiatives has intensified over the past decade. This has been fuelled largely by an expanding research literature on the value of nurses' identification of blind spots in knowledge, epistemic clashes and adverse side effects in technology (see Harris, 2009; Rowley and Waring , 2011 for a description of this development). Another aspect of the evolving situation for nurses is the increased complexity in knowledge production and circulation, which requires practising nurses to take part more proactively in the generation and safeguarding of collective knowledge within their specialist fields. Thus, at the same time as they must deal with new demands in the context of patient care, nurses are also being given additional responsibilities in other settings.

The contours of these expanded roles and responsibilities emerged during the final phases of the ProLearn project, which analysed the knowledge relations of clinical nurses in Norway over a period of six years. One finding was that while nurses were engaged in identifying knowledge gaps and areas for improvement in certain settings, they were involved in further developing knowledge in others. However, the ProLearn project had its prime focus on what Lahn (chapter 6 in this book) describes as the context of use and therefore provided limited insight into these latter practices. For researchers to reveal the different manifestations of these responsibilities, an approach is needed that looks at professionals' engagement with knowledge beyond the frontline work with clients. Although the direct work with clients is at the core of professional practice, it is just one of several settings in which practitioners engage. Practices where knowledge itself forms the object of exploration, irrespective of the specific client's immediate needs, are likely to take place in other settings.

To gain insight into these new ways of working and knowledge engagements, we expanded on the ProLearn research in two ways. First, we conducted an exploratory follow-up study among clinical nurse developers (hereafter termed CNDs) working in the same wards as our interviewees in the original study. CNDs are often described in the literature as knowledge brokers, that is, groups who move between different settings (Vogel & Kaghan, 2001) and gain capital from their "double peripherality" (Star, 1991). Thus, these groups may provide insight into how the multiplicity of roles and responsibilities of nurses play out in relation to specific knowledge problem constellations. To achieve this, however, we need a conceptual approach that can differentiate between different types of knowledge

practice as well as account for how professionals become involved in these new engagements. The challenge, in short, is to develop a heuristic to explain what nurses "do" in various settings, and how their practices vary in relation to different knowledge challenges. Moreover, from a wider perspective, we need to understand the sources of the new demands that are simultaneously broadening the role and increasing the range of capabilities required of nurses.

This chapter is structured as follows: in the next section we briefly review Knorr Cetina's "spill-over" thesis, showing how it has been taken further by Kastenhofer and others. Then we describe how the concept of non-knowledge has been developed as an extension of Knorr Cetina's work. Thereafter, we use this concept to illustrate nurses' new roles and practices related to non-knowledge. To contextualise the examples for readers not familiar with the nursing profession, we provide a brief summary of the wider knowledge dynamics that have brought a focus on more bottom-up ways of working. Three data extracts from the study are presented. We conclude by using our findings as a basis for discussing some possible avenues for further research.

NEW KNOWLEDGE DYNAMICS AND SOCIAL MISSIONS

Taking a social constructionist perspective, Knorr-Cetina depicts professional expertise as a relational and constantly shifting entity, generated, formed and re-shaped according to the altering dynamics of social institutions, changing societies and symbolic economies (Knorr Cetina, 2006). A core driver in these change processes is what she terms the "spill-over" of epistemic culture from the traditional research communities to other areas of social life (Knorr Cetina 2002 and Knorr Cetina & Preda 2001). She argues that the prevalence of science-generated knowledge in today's society brings with it a diffusion of knowledge as such as well as the whole set of practices and mentalities that come with its existence. Not only are the products of science dispersed – that is, science-generated knowledge in different material and symbolic forms – but the modes of practice characteristic of scientific institutions are being spread as well. People within different areas of work are engaging with knowledge in ways that historically have been associated with science communities. For example, by exploring knowledge issues beyond what is already known, by questioning their validity and testing their feasibility, and by systematically investigating and describing the environments in which they operate. With respect to professional work, this adds an epistemic dimension, and as knowledge increasingly becomes mediated by abstract and symbolic inputs – with more advanced knowledge objects being introduced into professional practice – a creative and explorative dimension emerges. This creates a new context for professional work (Knorr Cetina, 2001; Guile, 2009; Nerland & Jensen, 2010; Edwards, 2010) and leads to a possible redistribution of epistemic labour. Such "epistemification" is parallel to the new mode of knowledge production, which implies that scientific production now spreads into other sectors of modern society, opening up multiple participations in

knowledge (Gibbons et al., 1994; Knorr-Cetina, 2007; Nowotny, Scott, & Gibbons, 2001; see also chapter 10 in this book).

Kastenhofer (2010) further develops Knorr Cetina's notion of "spill-over" and draws attention to how the logics of science come forward in new ways, entailing not only new knowledge but also a re-allocation of epistemic responsibilities for knowledge in terms of social missions for the professions. Her argument is twofold. One aspect is that knowledge, information and resources in general are increasingly dependent on the capabilities of rooted work cultures; that is, cultures with competencies in how to engage with, confront, produce and further develop knowledge and information. Thus location matters to advanced knowledge flows in terms of ensuring their usage and further productivity. The other aspect is the capacity to develop strategies for dealing with non-knowledge through the *in situ* observation of practitioners and bottom-up ways of working. In short, we may now be experiencing the materialisation of a new social contract between knowledge and society – one in which the professions are asked to take on new roles as "watchdogs", "whistleblowers" and "proactive agents" in maintaining a balance in the type of knowledge that is made available. These roles involve identifying knowledge challenges and exploring and promoting research into current "blind spots", epistemic clashes and areas that have not yet received the attention they need. Hence, while highlighting the epistemic dimension, Kastenhofer (2010) offers a perspective on how professional missions are being adjusted and re-negotiated in relation to the altering dynamics of knowledge.

PRACTICES AND STRATEGIES OF NON-KNOWLEDGE

In a follow-up to their more general descriptions of transformations and change drivers, Kastenhofer (2010) and Böschen et al. (2006, 2010) add a twist to Knorr Cetina's concept of epistemic cultures. At the core of the epistemic culture approach is an interest in seeing how knowledge is produced, circulated and approached in distinct ways, in different knowledge communities, as well as in revealing the interrelated dynamics; "how we know what we know" (Knorr Cetina, 1999). As a counterpart to this, Kastenhofer and Böschen et al. elaborate the settings and practices related to how we perform work and how we acknowledge, further communicate and openly challenge issues related to non-knowledge. A culture of knowing also implies a culture of not knowing. Thus there exists a range of various epistemic cultures that differ not only in how they make knowledge (Knorr-Cetina, 1999) but also in how they deal with non-knowledge (Böschen et al., 2006). Moreover, studying these culturesand their related practices is important in the light of the increasing social and political focus by different stakeholder groups on non-knowledge.

However, studying non-knowledge requires outlining and acknowledging different modes of framing the unknown; there is a range of possible variations in knowing about not knowing. First, practitioners may vary in their awareness of non-knowledge – which extends from full awareness of non-knowledge (we know what we don't know) to complete unawareness (unknown unknowns). Second,

there may be different degrees of intentionality, which reveal a contrast between the completely unintended (non-knowledge) and the active, fully conscious refusal to engage in certain knowledge. The third dimension in perceiving and constructing the unknown refers to the temporal stability and persistence of non-knowledge (Böschen et al., 2006, 2010).[1]

Böschen et al. argue that the further development of a research design to explore cultures and their related practices of non-knowledge should rest on empirical investigation of the type of expertise in question, as this may have different social missions and hence knowledge challenges, to be addressed. Based on their analysis of a variety of scientific practices, they provide us with the following three ideal cultures of non-knowledge: a control-oriented culture, a complexity-oriented culture, and a single case-oriented culture. The first has a focus on the not-yet-knowns, on gaining control and on avoiding disruption. The second is characterised by a high degree of openness toward unanticipated events as well as uncontrollable and context-sensitive settings. The third can provide knowledge and experience about particular geographic or social contexts, which may be misrepresented by decontextualised scientific knowledge.

To fully understand the relevance of these approaches, Böschen, Kastenhofer et al. (2006, 2010) argue that it is of paramount importance to acknowledge that all three epistemic cultures of non-knowledge are equally valid in general terms. Thus the three types cannot be arranged on a scale of "reliability-unreliability" but represent different "orientations" that have to be evaluated according to the specific case and context in question. All three entail certain strengths and weaknesses. The control-oriented approach has been predominant and focuses on the not-yet-knowns and the "known unknowns". It emerges as an effective provider of reproducible knowledge but runs the risk of creating a non -knowledge situation by drawing attention away from contextual factors. The complexity-oriented approach acknowledges "unknown unknowns" and continuous non-knowledge. It seeks to avoid blind spots in perception but may produce "weak evidence", which has limited predictive power and is dependent on a restricted horizon of expectations. The single case approach is most likely to refer to a sort of (scientific) unknowability. It is also open to conceding to intentional ignorance (unwillingness to know) for example, when expertise is repeatedly ignored or dismissed as "anecdotal evidence". It can, however, account for the observation of complex case histories and can lead to new knowledge.

NURSES' EXTENDED ROLES AND RESPONSIBILITIES

As a community of experts, the nursing profession spans different organisational levels and encompasses a range of knowledge settings and agencies that all have to face up to the challenges of non-knowledge. In the following sections, we illustrate this by employing data from the study of clinical nurse developers referred to in the

[1] See also Smithson (2008), Gross (2007), Proctor (1995), and Weinstein (1978) for a further discussion of these distinctions.

introduction to this chapter. The examples we use are related in different ways to the task of developing or selecting procedures for various aspects of clinical work. Clinical procedure represents the systematic way in which knowledge is to be enacted in professional care. At the same time, the identification and development of clinical procedures goes beyond application and involves the exploration of non-knowledge. This work comprises a set of knowledge challenges in which different concerns and forms of knowledge coalesce.

The presentation of data takes the form of short vignettes or stories designed to sketch relevant contexts and indicate how nurses' work with procedures can be seen as a fruitful engagement with non-knowledge.[2] The first vignette uses the national call for a clean- up of clinical procedures to illustrate a control-oriented approach. The second takes the emergence of a new national model for bottom-up ways of developing procedures as an example of a complexity-oriented approach. The third uses dissatisfaction with existing procedures in the treatment of newborn babies to demonstrate a single-case approach. The examples and data extracts are selected to illustrate three distinct but related aspects of nurses' work with non-knowledge. First, the way in which these approaches imply distinct challenges and invoke different strategies to deal with them; second, the way in which professional knowledge is further developed and shaped through the nurses' efforts; and third, how nurses' new ways of working play an increasingly important role by enhancing the strengths of the different approaches.

However, we begin with a short description of the nursing profession with a particular focus on the emergence of new models for procedure development in Norway. Starting with the establishment of national and international nurses' associations at the beginning of the twentieth century, efforts to create a science base for the profession gradually moved on towards university-based education (Wingender, 1995). More recently, the requirements for a scientific knowledge core for professional practice have been formalised in an overall agenda for evidence-based best practices (Nieminen, 2008; see also Lahn and Christiansen in this volume). The Cochrane Collaboration plays a key role as a mediator in this respect, as do macro-epistemic organisations, such as professional associations (Holeman et al., 2006; van Achterberg et al., 2006; Karseth & Nerland, 2007), through their efforts to create specialist languages, conventions, interests and epistemic standards that serve as connection points between nurses on a global scale. Hence, an extended evidential culture, geared towards validation and control, has emerged. Efforts to "scientise" different aspects of nurses' work form a core discourse today (Laiho, 2010 & Purkis Bjornsdottir, 2006). However, this is adopted and attended to in different ways by organisations and professionals. While evidential cultures create forms of knowledge that "aspire to become a

[2] A more detailed description of the study the data are drawn on is provided in Christiansen et al. (2009).

global standard" (Featherstone & Venn, 2006), these need to be recontextualised to become relevant in local settings. This generates new roles and practices in the profession. Moreover, new strategies and arrangements emerge that seek to maintain a space for dealing with knowledge developed by practising nurses and for promoting more bottom-up ways of working. This is reflected, for instance, in the emergence of new models for the development of clinical guidelines (procedures) on a local and national scale, involving new actors and agencies[3] (political and professional).

EXAMPLES OF PRACTICES AND STRATEGIES FOR NON-KNOWLEDGE IN NURSING

This attention towards new responsibilities in relation to working with procedures was also visible in our studies. In the interviews, the CNDs regularly recounted that many of the nurses had, in some way, been engaged in activities related to procedure development. They described how nursing practices involved various ways of accessing and circulating knowledge. These reflect the strengths and weaknesses described by Kastenhofer and Böschen in their work. Thus in the vignettes below we address the following questions: what strategies are employed by practising nurses to deal with non-knowledge? How do these enhance the strengths of the different approaches? In what ways is specialist knowledge extended and moulded by the nurses' activities? Analytically, we trace the epistemic practices in these settings from the ways knowledge was circulated and engaged with. The concepts of testing, exploration, validation and documentation are used as sensitising factors with respect to the different strategies.

Localising Knowledge

The first vignette takes as its starting point a repository of standardised procedures. The wider framework for this was a national call for a clean-up in procedures. In 2009, a survey aimed at getting an overview of procedure development and management in Norwegian hospitals was conducted. The results were described as "startling" and revealed a total number of 38,115 procedures in 30 hospitals around the country (Dagens Medisin 26.11.2009). Moreover, the quality of procedures was found to be poor; many were outdated and others simply could not be followed. Some hospitals even had completely different procedures in different departments for the same treatment. The findings also revealed that recommendations for practice were sometimes built on research papers of poor quality. The culture for knowledge sharing in and among hospitals was described as not well developed.

[3]That this is common should be understood in the light of the high level of education among nurses in Norway. A survey conducted in the spring of 2009 among members of the Norwegian Nurses Organisation (the main professional organisation for nurses in Norway) showed that 60% of the nurses had some form of further education and 21% of the nurses had more than one clinical specialty (Dæhlen & Seip, 2009).

The conclusion was that procedure development and management in the hospitals was in a terrible state and that collective efforts were needed to secure good practice. To contribute to this process, the hospitals in question purchased a repository commercially produced by the Norwegian Nurses' Organisation, in conjunction with the publishing company Akribe. The repository was created as a means of circulating best practice within and among hospitals in Norway. The 300 procedures it contained had already been validated, written and signed by a team of national experts and were believed to adhere to the statutory framework, national standards, professional guidelines and research-based knowledge. The fact that these procedures were already signed by trusted agents meant that the local group did not see it as their knowledge challenge to validate them but rather to explore the environments in which they were to operate. The nurses asked:"What are the influencing factors related to the potential implementation of the various procedures?" "What can we do to make the procedures work?" "What changes will this imply and are these desirable?" The nurses knew from their own experience that procedures tend to behave differently in different environments and that they needed to take contextual factors into account. Thus, from the perspective of non-knowledge, one could say that it is a "known unknown" they explore here.

In their work with selecting procedures, the nurses engaged in "imaginary testing" as a means of exploring their potential consequences. Both existing and prospective practices were involved in the testing process. The sequence of this process allowed staff representing different units in the hospital to bring forward local variations, routines and personal experiences and to discuss what might be done to ensure a smoother facilitation of the procedures. As one of the CNDs explained:"It is not just about a procedure. It touches on the organisation of our entire unit and how things are arranged. Not least the training." The final practice in this sequence was to tick boxes indicating whether the procedure was rejected, accepted as presented, or in need of additional information. The processes of exploring the possible implications of implementing the procedure as described in the repository, of adding nuances from local work experience, and of materially defining the status of the procedure with respect to use in the hospital, enabled these practices to contribute to the further development of each procedure. If accepted, a procedure would be circulated in the local work setting for use and exploration by the nurses. If it was rejected, a note would be made by the CNDs and sent to Akribe. This was a vital part of a feedback loop which was built into the design of the repository and which enabled the national team of experts to make improvements (see Moen & Nes, 2010 for further information about this repository). In each case, work done in this setting provided a means of ensuring good practice compared with the multiplicity of somewhat arbitrary procedures that had sparked the need for the national clean-up. Furthermore, by explicating the conditions under which the recontextualisation of knowledge may be achieved, the process of testing enabled the nurses to enhance the potential of Akribe to circulate best practices.

Through exploring their local environments, established routines and conventions are opened up for investigation and renegotiated. For example, how the training is

organized; the internal division of labour, resource allocation, formal and informal codes of conduct; lines of authority; their goals, tasks and duties; their relationship with other actors etc. Hence, the nurses' practices served as a means to proactively address challenges related to the implementation of knowledge and to direct attention to underlying challenges in the local infra-structure. More generally, they enhanced the potential for historical ways of working, not least with respect to the way the nurses training was arranged. However, using external procedures as a starting point also creates a restricted space for epistemic engagement. The routing of the decision-making process toward choosing between alternative options offers limited opportunities for exploring other problems experienced by the nurses in their daily work.

Identifying Gaps in the Existing Infrastructure

The second vignette describes the "Ullevål model" (named after the Ullevål hospital in Norway in which it was first launched). It was introduced quite recently and represents an emergent and more bottom-up way of working in which procedures are developed from below in the local hospital setting. Rather than restricting the nurses' engagement to knowledge generated by others, the Ullevål model encourages practising nurses to suggest new procedures for inclusion in the repository based on their perceived lack of knowledge and the absence of collective guidelines. Thus the knowledge challenge goes beyond working with existing procedures. Instead, the nurses are invited to bring forward questions not addressed sufficiently within existing frameworks or repositories. This encourages a focus on "blind spots" in practices and what is lacking in procedures rather than towards existing knowledge provided by external agents.

The work on procedure development here is largely based on nurses signing up to participate. As one CND explained: "It is nurses who volunteer to work, who want to participate, often led by a clinical nurse developer or a nurse with competencies in research." The exploration of specific questions is linked with the nurses' wider engagement in a problem area and thus has often been discussed in other forums before being entered into the Ullevål model. For example, such efforts may have been carried out within what the nurses call workplace learning forums. These learning forums have been designed by the hospitals to create a meeting place where professionals can discuss questions encountered in the course of their daily work and thus provide a setting in which the nurses can distinguish between personal learning needs and knowledge gaps in the greater infrastructure.

The Ullevål model itself has a longer history. It was initiated in 2002 by a group of evidence-orientated enthusiasts working as CNDs. The CNDs discovered through their presence in the wards and various forums that the nurses were constantly engaged in discussing knowledge gaps and inconsistencies in practice encountered during their work. Examples of such knowledge gaps described by our informants included: whether existing procedures for pain relief were valid also for newborn children; the discovery of inadequate guidelines for intravenous administration of a particular medication in a hospital; and the recognition that

nurses performed the same tasks in different ways. The CNDs thought questions such as these would be perfect for practising nurses to explore through a bottom-up evidence-based model and they worked out a proposal which turned out to be a success. In this model, the work on procedure development was organised in small interdisciplinary groups of nurses who were trained in evidence-based ways of working. The model was expanded first to include nurses from other departments and subsequently to include other healthcare personnel, before becoming a template for a national model for procedure development which was established in 2009. In this approach, knowledge is organised as a network coordinated by the Norwegian Knowledge Centre for the Health Services[4] and distributed through the national health library.

The model was organised in accordance with a five-step model inspired by Sackett (2000). First, the group meets to discuss their clinical scenarios and formulate questions. A PICO[5] form is used to categorise and transform the problem experienced into a research question by employing established classifications and concepts from the medical domain. The next step is to search databases for relevant information to determine how to deal with the problem. Lists of possible databases are provided by hospital librarians. The epistemic practice here is about mapping existing research to provide an overview of evidence relevant to the problem and documenting the methods used for this purpose. The third step is to evaluate the quality of the identified materials. The model recommends that group members should read all the articles they have found in order to be able to discuss their content and quality. Here, a new form is used to judge the quality and level of the evidence mustered in support of each article. The epistemic practice is marked by validation and facilitates the closure of the problem by synthesising the best knowledge available. In the fourth step, the procedures that emerge are written up and signed, which confirms that they are ready to be circulated in the community. The fifth step refers to institutional routines which state that all procedures should be evaluated and updated biannually, leading to new literature searches and validation processes.

While the aim of procedure development here is to enhance evidence-based practice in nursing, it also forms a practice in itself. Through the practices described above, the nurses explore knowledge for local purposes and, by validating and documenting their investigations, they transform problems into new procedures. The process extends to different locations: typically it starts in the wards through the observation of a blind spot or it could be a simple query concerning the way things are done. The problem or knowledge challenge is passed on through confidence pathways which also serve as sites for relevance testing. Through the step-by-step methodology in the model, problems are opened up for exploration and related to wider knowledge developments within the field. The

[4] See Stromme et. al., 2009 for more information about the history and further development of the model.

[5] P = population, patient or problem, I = intervention or exposure, C = comparison, O = Outcome. This form facilitates a structured consideration of the type of patients, illness, interventions, and intended effects.

forms and templates used in the model provide an agreed definition of the weight of the evidence and, together with the convention of dating procedures, serve to specify the "horizon of expectation".The fact that all searches are comprehensively described and that this documentation is included in the appendix to the finished procedure allows others to see the limitations inherent in the knowledge produced and to continue the work at a later date. Hence, the establishment of this model puts into place a system that acknowledges complexity and anticipates the emergence of not-yet-knowns and unknown unknowns on a continuous basis.

"Finding a Way Out"

Nurses may also pursue knowledge questions and access extended knowledge settings in other ways than within the organised groups described above. The interviews we conducted provided insights into how they took on responsibility for knowledge on a discretionary basis and sought external sites and opportunities for engagement. One of the CNDs described how the group she worked with struggled for years to find alternative ways of taking blood samples from newborn babies without causing unnecessary pain. This type of care, as she explained, generates a range of questions and knowledge challenges. This is because many of the established procedures have been developed and found valid for some segments of the population but need to be reconsidered for this group. However, conflicting concerns and recommendations occur when the nurses try to resolve their questions. The existing practice in the hospital in which she worked was to take blood from the babies' heels although the problems this entailed were well recognised. In this vignette there was an epistemic clash. From a clinical perspective, medication had to be given priority and therefore the veins in the babies' wrists could not be used. However, from the viewpoint of pain management, the nurses were concerned about the long-term psychological consequences for newborns. The nurses recognised the relevance of both perspectives and did not play one epistemic approach off against another but saw it as their challenge to find a way out. With thisobjective they raised the issue several times with the doctors working in their units and with other specialist groups but no one seemed to have a better solution.

However, the nurses could not and did not leave it at that.They invited specialists from other hospitals in the regions and they established networks where they would send each other "freebies" (information about best practice). They participated in conferences arranged by their respective specialist groups and took exploratory field trips to other hospitals in Norway and other parts of Scandinavia. One of our interviewees recalled how at one of these events she and a group of nurses coincidentally came into contact with colleagues from another hospital in Norway who had found a solution to the newborn problem by using the veins in the head: "The newborns are almost naked on their heads anyway, so it is really easy to find good veins. Come and see and we will show you how it can be done."

Our interviewee continued by describing how she and her colleagues visited this hospital to observe the technique and how they found it "brilliant": The babies

were relieved from so much pain that they could sleep during the entire procedure and there were no marks after the syringe. She recalled how they subsequently took on the task and collaborated in developing and documenting a procedure for this technique by drawing on Cochrane and other resources. Thus, what started as an "accidental meeting" was taken forward in a structured manner. Here, the specialist communities, their conferences and their terminologies formed important extended contexts through which knowledge was circulated.

Seen from the perspective of non-knowledge, this vignette also demonstrates how nurses'systematic engagement with it can enhance the potential of the single-case approach and how they can potentially exert an impact on future research agenda-setting processes. In the case of the newborns the nurses, through their active search for alternative forms of practice, opened up new pathways for exploration. Furthermore, they were able to meet the requirements to establish a new procedure based on information gathered over time from multiple sources. Another aspect of this vignette is that, through their travels ,the nurses took their problems to new sites and engaged additional people in conversation. As one of the nurses explained: "we were so relieved to see new research on this topic …. We got the procedure signed, and now in our department, we don't use the heels anymore for sampling blood from newborn babies." One CND expressed the situation both succinctly and positively: "I think the 'newborn Norway' is really pulling together now."

CONCLUDING DISCUSSION

Taken together, the examples discussed above show that the nursing profession is infused with strategies for framing and dealing with non-knowledge. There exists a variety of forums, instruments and routines to collectively explore the complexity, diversity, uncertainty and limits of knowledge. Moreover, the active participation of practising nurses appears to have become an increasingly important part of the machinery for dealing with non-knowledge at both the local and the national levels. Hence, the nurses in the hospital settings we studied assumed responsibilities for selecting, validating and safeguarding knowledge, for analysing and documenting incidents and activities, and for engaging in the exploration of opportunities for improvement. However, these practices should not be viewed as occurring in isolation; rather, they are mobilised by different actors, levels and organisations. The work and roles of the clinical nurse developers, the Norwegian Nurses Organisation (NNO) and the different specialist communities form epistemic agencies at the meso level, the efforts of which form an infrastructure for extended epistemic engagement.

To gain insight into what nurses "do" more specifically in these engagements, and into how their actions reflect different epistemic strategies, this chapter has employed the concept of non-knowledge. This concept is not new; references to non-knowledge are also found in the earlier writings in science studies. For example, Merton (1987) and, not least, Knorr-Cetina, have pointed out that the production of knowledge depends on "specified non-knowledge." However, in the

wake of the continuous spill-over of science, various scholars have called for perspectives that would enable a more systematic study of the unknown (Kastenhofer, 2010; Böschen et al., 2006, 2010; Frickel et al., 2010; Proctor, 1995). Rather than "viewing the unknown as the underbelly of what we do know" these approaches seek to understand the absence of knowledge as the result of structural and cultural forces and to reveal different ways in which these challenges are dealt with by different groups and agencies (Kempler et al., 2011, p. 478). In our analysis of nurses' practices, we found the concept of non-knowledge described by Böschen et al. (2006, 2010) and Kastenhofer (2010) useful as a framework for studying nurses' new roles and responsibilities. We discovered that the three approaches posed specific challenges that resulted in different strategies by way of response. We also identified ways in which professional knowledge was moulded by the nurses' activities and how new ways of working enhanced the potential of each of these approaches.

First, in the case of Akribe we saw how nurses engaged in practices related to "testing" as a means of exploring their local environments. They do not assume that procedures operate in the same ways under different conditions. Thus it is a "known unknown" that they explore and they are concerned with specifying and detailing the potential consequences of the procedures in their respective units. Both existing and prospective conditions are taken into account in the process of testing and,as the nurses explore their environments and negotiate which procedures to accept, they make distinctions and specifications that allow them to take on a proactive role. Adding information and ensuring appropriate training may facilitate a smoother re-contextualisation of knowledge for the purposes of daily practice. Moreover, their explorations may reveal underlying challenges that need to be worked on irrespective of the procedures. Hence, they have an effect beyond the given task of working with procedures and provide an opportunity to rework and renew their infrastructure on a more continuous basis.

Developing knowledge-based practice by "producing knowledge from below" – through arrangements like the Ullevål project – engage nurses in practices related to validation and documentation. By encouraging a focus on gaps and blind spots in the existing infrastructure, the nurses' collective engagement with knowledge in this context contributes to the unfolding of the problems under investigation. Moreover, through the practices of validation, their engagement offers opportunities for practice to be adjusted towards wider knowledge developments. Here, the step-by-step organisation and templates etc. of the model help to specify and make explicit the limitations of knowledge. Thus by acknowledging "unknown unknowns" this vignette reflects the complexity-oriented approach.

Lastly, the case of the newborns illustrates how nurses are able to solve problems and engage in exploratory practices, and through these actions expand their engagements to reach well beyond the boundaries of their workplaces. Maintaining openness towards new ways of working enabled the nurses to move beyond prevalent conflicting assumptions about best practice. Unforeseen events are taken seriously and solutions are deliberately sought in order to drive knowledge forward. Here, not only is a new technique found but knowledge is

enriched in several ways by the nurses' collaborative efforts. We see how new communities and networks are mobilised, for through their travels the nurses garnered the arguments of their own group as well as the authority of invited speakers to strengthen the call for more research. This vignette deals with a difficult situation in which expertise has been underdeveloped and illustrates how a single case approach, if pursued with determination, can generate new knowledge.

All three cases show, in distinct ways,how professional knowledge is further developed and shaped, as nurses work to combine very different, even conflicting, resources in their respective enactments of knowledge: local practices and values, organisational traditions and policies, disciplinary knowledge bases, regulatory standards and transnational knowledge. They also demonstrate how nurses employ different strategies to specify different forms of non-knowledge requiring distinct forms of attention. Moreover, non-knowledge is in all cases treated as specific, temporary and reducible through epistemic practices, and the existence of unavoidable uncertainties is opened up and dealt with.

Viewed together, the cases illustrate the ways in which the analysis of non-knowledge can enrich empirical understandings of three broad aspects of contemporary nursing. First, it allows us to see the multiple responsibilities for knowledge that professionals have today. With this perspective, the issue of knowledge engagement is broadened far beyond a focus on personal and creative engagements and we can trace how their engagements and strategies lead to further development of knowledge. Thus participation becomes far more than a crude reliance on duty - instead it is a matter of recognising what may be far-reaching consequences of building relations and of understanding delicate responsibilities. Second, the approaches described by Kastenhofer and Böschen are helpful not only in distinguishing between different knowledge challenges and practices, but also in highlighting the role they play in stabilising and renewing knowledge. Third, and closely related to this, the question of how a practice becomes reconfigured or transformed is addressed at the nexus between nurses' efforts and the wider machineries of knowledge construction.

In the light of the above we offer two pathways for moving forward. First, to reveal the strategies of non-knowledge carried out in various ways in different professional settings, a further development of concepts pertinent to these differences is needed. We have suggested that the concepts of testing, validation, exploration and documentation are relevant to discovering what nurses "do" with knowledge in relation to three knowledge challenges and we have seen how their practices reflect different epistemic strategies. A further elaboration of concepts should rest on empirical research in different professions and should lead towards the development of a heuristic for knowledge practices in professional work. Second, more studies are needed to explore how the politics of the professions and other agencies interact. In this study, we found that the new ways of working with procedures was – to some extent – triggered by the nurses themselves. For example, through the establishment of the Ullevål model the nurses were able to showcase themselves as a competent and viable community and this had implications in terms of local as well as national policies. At the same time, we

also saw that becoming a member of the new national networks requires no small investment of time and resources. Nurses from specialties and institutions that lack the resources to engage in these new ways of working are currently excluded, for example, from the field of home care. In the current memorandum for the national model, to qualify as a member, institutions and units have to commit to submitting two new procedures annually for distribution through the new networks. This serves as proof of their innovative potential and as evidence that their field represents a viable user community. This presents a challenge in that it maybe biased against sectors that have been historically under-resourced. However, more detailed studies of how these differences are dealt with by different actors and agencies and how these interplay are needed. The works of Knorr-Cetina have been criticised for lacking both an institutional and a political dimension and hence for not being able to grasp the complexities of professional knowledge and work today. By way of contrast, the work of Kastenhofer and Böschen and the further elaborations into non-knowledge more broadly, go some way to extend Knorr-Cetina's contribution. Together these approaches allow us to see how multiple actors and agencies influence professional practice. As we have proposed, one of the crucial sites where questions of power, knowledge and non-knowledge come together is beyond nurses' work with procedures and in the domain of research agenda-setting. Here intense coalitions and conflicts are forged to gain access to the resources that ultimately shape what knowledge is acquired and what remains unknown. From a wider perspective, a focus on what appears to be new patterns of epistemic engagement among the key actors in the field – research institutions, directorates, professional organizations, publishing companies, committees and other agencies, public policy-makers and practitioners – encourages reflection on what kind of knowledge travels between those who are producing it, those who carry out quality control through practices of non-knowledge and those who act as decision-makers. This is important as such knowledge informs binding laws and policies and is implemented in society through educational institutions as well as through practitioners who affect ordinary citizens directly. Studying the circulation of knowledge and the institutional preconditions that structure it provides an approach that contextualises how professional practice is embedded in and affects society at large.

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