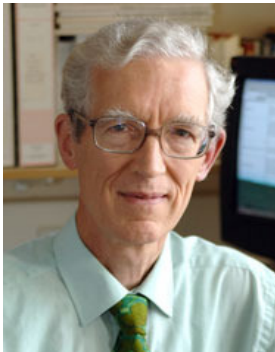


## DRAFT CHAPTER A7

# Understanding Complex Performance through Learning Trajectories and Mediating Artefacts

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### Proposition

This paper seeks to address the challenging problem of how an individual's understandings and capabilities may be represented and communicated in a social context by treating representations as mediating artefacts, whose meanings are clarified and to some extent reconstructed through the conversations they elicit. The significance for higher education experiences that are supporting students in their development of knowledge, capabilities, qualities and dispositions that are relevant to being an effective professional is that mediating artefacts play an important role in the representation of what has been learned, understood and applied in work place contexts. Important mediating artefacts that are used in the work place need to be considered, in accounts of work place learning and achievement and embedded in mediating artefacts like reflective diaries and reflective reports, that higher education uses to enable students to represent the development students have gained through work placement.

### Epistemology and Terminology

Both knowledge and learning can be examined from two perspectives, the individual and the social. These can be considered as analogous to the particle and wave theories of light. An individual perspective on knowledge and learning enables us to explore both differences in what and how people learn and differences in how they interpret what they learn. A social perspective draws attention to the social construction of knowledge and of contexts for learning, and to the wide range of cultural practices and products that provide knowledge resources for learning.

In universities knowledge is primarily associated with publication in books and journals, and subject to quality control by editors, peer review and debate. This *codified knowledge* is then given further status by incorporation into educational programmes, examinations and qualifications. The model of knowledge creation is that of an organised, socially constructed knowledge base, to which individual authors and groups of co-authors add new

contributions. Each discipline has editors and referees controlling the *acceptance of publications*, using agreed criteria. Journals use the criterion of *truth* according to the norms of the community from which they draw its readership. Some people in higher education regard these criteria as problematic, but those outside higher education are more likely to be concerned about its relevance.

Practical work in science, engineering and vocational education involves learning knowledge that has been shown to work, but cannot be fully described in books; and *cultural knowledge* that has not been codified, plays a key role in most work-based practices and activities. There is considerable debate about the extent to which such knowledge can be made explicit or represented in textual form; but the evidence suggests that its amenability to codification has been greatly exaggerated (Eraut 2000). What does appear to be generally acknowledged is that much *uncodified cultural knowledge* is acquired informally through *participation in working practices*; and is often so “taken for granted” that people are unaware of its influence on their behaviour. This phenomenon is much broader in scope than the implicit learning normally associated with the concept of *socialisation*. In addition to the cultural practices and discourses of different occupations, one also has to consider the cultural knowledge that permeates the beliefs and behaviours of their workers, suppliers and clients.

Whereas codified cultural knowledge is frequently discussed in terms of its truth and validity, uncodified knowledge is discussed in terms of its ownership, location and history. Who uses this knowledge, where and when? Both types of knowledge may be investigated for their range of meanings, and this is where the interaction of social and individual perspectives is particularly enlightening. The theory of *situated learning* postulates that the personal meaning of a concept, principle or value is significantly influenced by the situations in which it was encountered and the situations in which it was used. Hence the personal meaning of a concept or theory is shaped by the series of contexts in which it has been used. Given today’s rapid mobility, the sequence of such contexts is probably unique to each individual practitioner; and this may lead to them acquiring slightly or widely different meanings. Even codified knowledge is personalised to some extent.

I chose the terms *personal knowledge* and *capability* for the individual-centred counterpart to cultural knowledge, and defined it as “what individual persons bring to situations that enables them to think, interact and perform” (Eraut 1997, 1998). This enabled me to investigate the effects of personal knowledge without necessarily having to represent that knowledge in codified form. The rationale for this definition is that *its defining feature is the use of the knowledge*, not its truth. Thus I argue that personal knowledge incorporates all of the following:

- *Codified knowledge* in the form(s) in which the person uses it
- *Know-how* in the form of *skills and practices*
- *Personal understandings of people and situations*
- *Accumulated memories of cases and episodic events* (Eraut, 2000, 2004)
- Other aspects of *personal expertise, practical wisdom and tacit knowledge*
- *Self-knowledge, attitudes, values and emotions*.

The evidence of personal knowledge comes mainly from observations of performance, and this implies a *holistic* rather than *fragmented* approach; because, unless one stops to deliberate, the knowledge one uses is already available in an *integrated form* and ready for action.

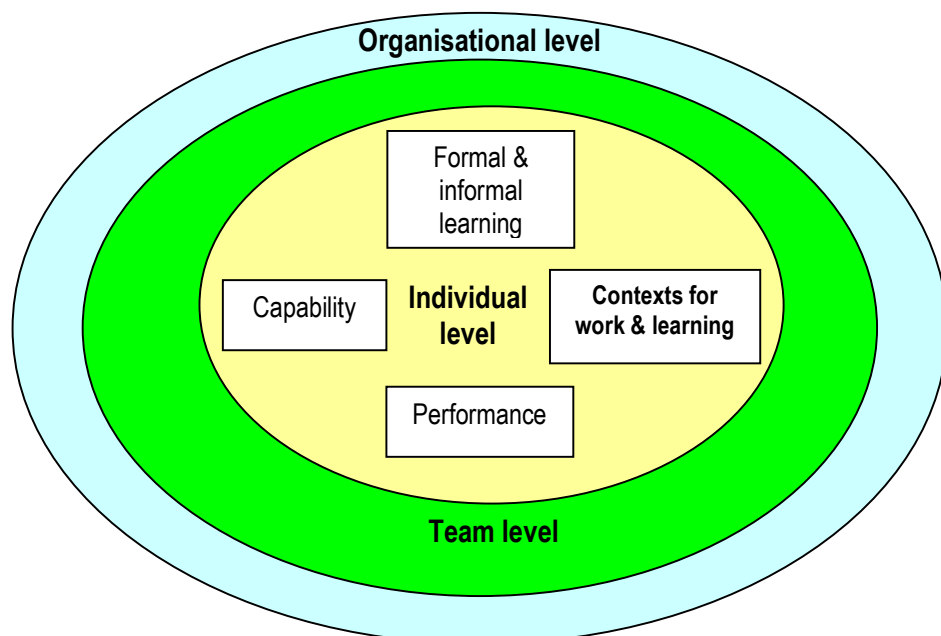
I have introduced the term *capability* in addition to that of *personal knowledge*, because it enables me to discuss the knowledge and learning of *teams* and *organisations* as well as that of *individuals*. The four factors in Figure 1 below are defined as follows:

- At the individual level I define *capability* in terms of *personal knowledge*, i.e. what persons bring to a situation that enables them to *think, interact and perform*. At team level, I define *team capability* in slightly

narrower terms as enabling a group to *interact and perform*. I would also argue that the evidence for a team's capability has to come from *performances attributed to the team* as a whole, rather than to individuals within it, and to the *shared understandings* that create a team, rather than a group. I define *organisational capability* narrower still, limiting it to those *decisions, actions and understandings* that are attributed to the organisation as a whole, rather than to individuals or groups within it. In each case I would limit such attributions to *well-informed observers*, external to the entity being observed

- The distinction between capability and performance is that *capability is normally inferred from a series of performances* and should not be judged on only one performance, whereas every performance is *context dependent*. Hence performances in more complex and difficult contexts should not be expected to be as strong as those in easier contexts. This applies at all three levels.
- Learning at individual or team levels may be *formal or informal*, but it would be very difficult to imagine informal learning by an organisation, rather than particular members of that organisation, especially because it would be very difficult to attribute learning that was not necessarily planned or conscious.
- The *context* for an individual could include people, events and practices at the level of working group, department or the whole organisation; but their relative significance could vary greatly both between organisations and within organisations. In general the most significant aspects of the context for an individual will be determined by those with whom they have the most contact and those who may be the most likely to exert power over them. However, it will be the understandings of the context that matter most; and in times of rapid change those perceptions may be dangerously narrow.

**Figure 1 Key aspects of workplace learning**



The four factors are always affecting each other. Capability is obviously influenced by learning but current capability also influences the ability to learn. Capability is required by job performance but is also developed through job performance. The context in which the individual is working and learning influences how their

capabilities are perceived, how they perform and how they learn. An individual can be seen as highly effective in one setting and not another. Individuals are in a dynamic relationship with their work setting being both influenced by it and being part of it themselves and through their relationship with others.

However, this dynamic relationship is often missing from competence-based assessment, and issues related to team and organisational levels get little or no attention. If we want learners to develop a social identity and contribute to society, we have to demand more than the acquisition of knowledge and achievement of individual tasks and assignments. We also want to know about how they have used their competencies in group contexts and how they tune their work to fit the specific needs of their customers, clients or colleagues. This would involve developing their capability and working relationships as well as their required competencies.

### **The Representation of Knowledge**

There is a wide range of discourses for representing knowledge in the literature; and my review of them will seek to characterise them according to three criteria:

- Their portrayal of codified knowledge
- Their treatment of processes, skills and methods
- Their attention to the conditions and context of use

Serious attention to thinking processes was first given widespread attention by Bloom et al's (1956) Taxonomy of Objectives (cognitive domain), whose authors were university based psychologists. This was extended by Bloom, Madaus & Hastings (1971), who used a two dimensional grid, one for content and one for processes. This focused more on high schools and the process dimension varied a bit according to the content. Assessments of this work can be found in Eraut (1989), who examines the practical implications for education and De Landsheere (1989), who discusses a wider range of taxonomies and includes the affective and psychomotor domains.

One important advantage of these taxonomies was that they were comprehensible to teachers without any knowledge of psychology. There were, however, some weaknesses in the discourse of objectives. Teachers' interpretations of the required level of work depended on their intended context of use, thus challenging the assumption that such objectives could be separated from their contexts. A more serious practical problem was that even the most precise definitions did not prevent disagreements about the appropriate mark or grade for a learner's performance or piece of work. This does not invalidate the taxonomy, but it challenges the notion that assessment-based discourses can create agreement without prior discussion of how samples of submitted work or observed performance would be marked.

Another variable is the conditions under which assessed "performances" take place. Formal examinations are subjected to strict time limits and usually, though not always, to the absence of notes or reference books. Ambitious candidates will have done most of their analysis before the examination; but that means preparing for a wide range of possible questions and hoping that a sufficient number of them will appear. The same problems are even more significant in workplace assessments, where variations in time, level of support and access to resources are much greater, and assignments to particular placements or internships are likely to provide different mixtures of learning opportunities. In either case there is an element of chance, and the assessment process may not give examiners an adequate representation of each student's capability. We return to this in section 4 on Learning Trajectories.

Jonassen (1993) reviewed a wide range of methods for representing this "structural knowledge", such as network diagrams, concept maps or pattern notes, and methods for eliciting and using them. These forms of representation have three main purposes:

- To help learners to represent the *structure of their own knowledge* and then seek to extend it
- As *mediating artefacts* to trigger and sustain discussion and the sharing of meanings and understandings
- As *advance organisers* for texts and lectures.

Finally, there is a new generation of instructional designers, such as van Merriënboer (1997), who address professional and vocational work, but still tend to focus on what is taught or used in higher education settings.

Eraut et al (1995) developed a similar matrix to represent connections between the academic and practice-based dimensions of professional knowledge. In order to represent the use of scientific knowledge by nurses and midwives, they mapped the titles of the *topics* taught for broad areas of knowledge like nutrition, pain or self-esteem against the *activities* used in daily practice.

Whenever knowledge of the topic was used in practice, the mode of use (R for appreciating the *Relevance of the knowledge* or U for *Understanding and interpreting the knowledge*) were entered in the relevant box of the matrix. Otherwise it was left blank. Thus it was easy to see where any sub-topic was relevant, and whether its use was simply (1) *remembering* to use it, (2) *recognition-primed decision-making*, based on prior experience once the situation had been recognised (Klein 1989), or (3) *problem solving*, possibly requiring some external advice. Users were warned that those with less prior experience would require more time for deliberation or seeking advice. What these matrices offered was:

- An indication for learners (and their teachers and mentors) of where scientific knowledge was important
- Some hints as to how it might best be learned
- A mediating artefact for focusing on shared knowledge within one box at a time, while still recognising that it would need to be combined with the knowledge signalled by entries in other boxes, i.e. directly addressing the part-whole problem.

**Table 1: Surgical Nurse Mentors' Interpretation of Causes of Acute Pain<sup>1</sup>**

Areas of knowledge	Signs of infect	Haematoma	Retention of ur	Constipation	Wound assessment
Transmission Perception of pain		U2	U3	U3	U3
Causes of pain	U2	U2	U3	U3	U3
Effects of pain			U2	U2	
Bacteriology	U3		R2		R2
Wound healing	U3	U2			U3
Pre and Post operative care	U3	U3	U3	U3	U3

In order to more fully represent the knowledge involved in a single case, one would need all the matrices relevant to that case, and some indication of how the relevant knowledge was recognised, selected and used in

<sup>1</sup> Areas of knowledge of Acute Pain not used in this section were Nerve pathways, Pharmacology, Anaesthesia, Barriers to expression of pain and Alternative methods

a wide range of cases. Examples of this can be seen in the case studies of surgical nursing investigated by Fessey (2002).

All vocational and professional practitioners are knowledge workers, who are expected to recognise or find out what knowledge is most relevant for their current learning goals, track down that relevant knowledge and make appropriate notes for speedy retrieval at a later date. Information from several sources may be required and, if concept maps of the topic and/or notes on its evidence base are constructed as these investigations proceed, they will greatly enhance the usefulness of their inquiry. Managing one's knowledge adds value to the time spent acquiring and refining it, but this approach is rarely found in practice. Hence it is important to develop a repertoire of these approaches to knowledge representation.

## Competence and Capability

*Competence*, has come to be used within both socio-cultural and personal perspectives. Eraut (1998) has argued that, historically, the socio-cultural definition of competence is based on "meeting other people's expectations"; and that removing that definition would have a bad effect on citizens already sceptical about the ever-changing jargon. According to the context, one's competence may be construed as being properly qualified, able to perform on your own, capable, or adequate but not expert. The scope of such competence usually remains implicit in the context. Although I have chosen to define competence as "*being able to perform the tasks and roles required to the expected standard*", this expectation, being socially defined, may be taken for granted, decided by a chosen group or determined by the micro-politics of the context. Hence the definition of competence is likely to vary across contexts and over time. Competence can also be a moving target; because the expected standard often varies with the experience, responsibility and reputation of those concerned.

On page 2 I defined the term '*capability*' as "*everything that a person or group or organisation can think or do.*" One key difference is that, while competence is necessarily within the capability of the agency (I use this term to cover individuals, groups and organisations), the reverse is not true. Agencies normally have additional capability, which provides a useful resource for making changes in the current job. Such changes may not be fully covered by additional capability, so further learning may be needed. Thus additional capability may be helpful both in enhancing competence through learning; and in helping to transform a job through innovation. On the negative side, additional capability may atrophy through lack of further use or lead to individuals moving elsewhere

Ideally, a practitioner's competence is enhanced and expanded by further practice and new challenges. But this will depend on the affordances offered by their practice context and the disposition of individuals or groups to take advantage of them. At any one time, their competence is limited to the domain, within which their practice meets the expectations of significant others in their workplace or among their clients. Key aspects of this domain include:

- The contexts in which the performer will have to operate, including likely locations and their salient features
- The conditions under which the performer will have to work, e.g., degree of supervision, pressure of time, crowdedness, conflicting priorities, availability of resources
- The situations which the performer may encounter, covering such factors as client types and demands, tasks to be tackled, interpersonal events, emergencies, etc.

This complexity is incompatible with the common but simplistic assumption that competencies can be treated as binary variables, i.e. that workers are either competent or incompetent in each aspect of their performance. Moreover, there are several reasons why competence may not always be translated into performance:

- Personal disposition, which may be affected by both contextual norms and personal confidence in that particular context
- Lack of capacity due to too heavy a workload or lack of time (a common feature of many examinations)
- The context and conditions in which the performance is situated (these may be too crowded, lack important facilities or fail to provide appropriate support).

Over time these factors can cause a person to settle for lower standards of performance. Thus learners in both education and workplace settings need to understand how these factors affect the quality of their work and to work in small groups or with mentors to explore whether quality might be improved within reasonable cost constraints.

My research into government based competency-based qualifications in UK workplaces (Eraut et al 1996<sup>2</sup>, Eraut et al 2001<sup>3</sup>) also indicates real difficulties in articulating and representing the nature of competence. These include:

- Finding the most appropriate level of detail: very broad representations of competence are too vague for any practical use; and very specific representations tend to become too numerous to handle, as lists of competencies approach the size of telephone directories
- There are similar problems with assessment to those found with even the most detailed learning objectives. Assessors rarely agree unless there is a past history of developing a consensus by discussing individual cases. Moreover, the half-life of such a consensus is usually very short, because personnel change and so do the expectations of significant others who influence the implicit social agreement on what counts as competence
- Capturing the essence of an area of expertise is both difficult and controversial
- Both listing important attributes of competence and describing their integration into performance is a part-whole problem, for which nearly all previous representations (including many of those in higher education) have focused only on the parts
- Covering all aspects of the job is rare, because many aspects remain tacit or get explained away by terms like “experience” or “personality” which tell us very little about how people learn to do them.
- Recognising the changing and conditional nature of what counts as competence: this changes over time and between contexts, and an approach that works well with one group may not work so well with another group.

Another difficulty concerns mid-career vocational qualifications, where there is often a large gap between university provision and employer provision. Some large employers seek to bridge this gap, but the supply is limited and many such schemes are vulnerable when long term priorities lose their support. My analysis of the UK government’s contribution to this problem is that too much time is spent on verifying existing piecemeal competences and too little on more holistic challenging assignments that benefit the long term expertise of both the candidates and their employers (see Appendix A for details).

## Learning Trajectories

Trainees in most professions are allocated to a series of placements, through which they are expected, with suitable support, to acquire the specified level of competence. However, the learning affordances of each placement vary considerably according to the local context, and these differences will affect what each trainee learns and the profile of their competence at the point of qualification. This has two consequences: the variable

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<sup>2</sup> This was mainly used by unemployed school-leavers and unskilled workers who lost their jobs

<sup>3</sup> This was mainly used by mid-career employees backed by their employers

profile of qualified professionals is unlikely to be well described in their qualification, and their new employers may not be sufficiently informed to make good use of their strengths and improve their relevant weaknesses. These problems could be addressed by the use of learning trajectories both before and after qualification in order to prepare newly qualified professionals for tracking their performance and embarking on a career of lifelong learning.

**Table 2 A Typology of Learning Trajectories**

<p><b>Task Performance</b>  Speed and fluency  Complexity of tasks and problems  Range of skills required  Communication with a wide range of people  Collaborative work</p> <p><b>Awareness and Understanding</b>  Other people: colleagues, customers, managers, etc.  Contexts and situations  One's own organization  Problems and risks  Priorities and strategic issues  Value issues</p> <p><b>Personal Development</b>  Self evaluation  Self management  Handling emotions  Building and sustaining relationships  Disposition to attend to other perspectives  Disposition to consult and work with others  Disposition to learn and improve one's practice  Accessing relevant knowledge and expertise  Ability to learn from experience</p> <p><b>Teamwork</b>  Collaborative work  Facilitating social relations  Joint planning and problem solving  Ability to engage in and promote mutual learning</p>	<p><b>Role Performance</b>  Prioritisation  Range of responsibility  Supporting other people's learning  Leadership  Accountability  Supervisory role  Delegation  Handling ethical issues  Coping with unexpected problems  Crisis management  Keeping up-to-date</p> <p><b>Academic Knowledge and Skills</b>  Use of evidence and argument  Accessing formal knowledge  Research-based practice  Theoretical thinking  Knowing what you might need to know  Using knowledge resources  Learning how to use relevant theory  (in a range of practical situations)</p> <p><b>Decision Making and Problem Solving</b>  When to seek expert help  Dealing with complexity  Group decision making  Problem analysis  Formulating and evaluating options  Managing the process within an appropriate timescale  Decision making under pressure</p> <p><b>Judgement</b>  Quality of performance, output and outcomes  Priorities  Value issues  Levels of risk</p>
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During two successive research projects on mid-career and early career professional learning in the business, engineering and healthcare sectors, we developed a typology (Table 2) for classifying what was being learned. However, instead of calling our categories 'competences' we called them *learning trajectories* and adopted a lifelong learning perspective (Eraut et al 2005). Not only did the concept of learning trajectories fit our project's data much more closely than a set of competences (Steadman et al 2005), but it also took into account discontinuities of learning so that at any one time:

- Explicit progress is being made on several of the trajectories that constitute lifelong learning



- Implicit progress can be inferred and later acknowledged on some other trajectories
- Progress on other trajectories is stalling or even regressing through lack of use or because new practices have not yet been adopted.

A second advantage of using learning trajectories is that they can reduce the need to base qualification decisions on limited samples of performance under conditions of high anxiety. Mapping progress over time also measures the ability to learn from experience, probably a better predictor of future performance than a final assessment.

A third advantage is the opportunity to include the context of performance in the learning record. What is learned is affected by the context and conditions for learning, and acquired competence does not usually transfer across contexts without significant further learning. Hence it is important to include information about the context and conditions in the performance record in order to indicate the domain of a professional's current competence. The implication of this need for amplification of the record is that entries on these learning trajectories are best considered as windows on episodes of practice, in which the aspect of learning portrayed by each trajectory plays a significant part. Each entry both presents a single holistic performance and covers all the trajectories that contributed to that performance. The performer is responsible for creating the window, but will often get their entry witnessed by other people who can verify it.

Where possible, this entry should include the following information about the performance:

- The setting in which it took place, and features of that setting that affected or might have affected the performance
- The conditions under which the performance took place, e.g., degree of supervision, pressure of time, crowdedness, conflicting priorities, availability of resources
- The antecedents to the performance and the situation that gave rise to the performance
- The other categories of expertise involved
- Any differences from previously recorded episodes
- Indicators of expertise in the domain of the trajectory having been maintained, widened or enhanced

The holistic nature of any complex performance should never be neglected, because it is unusual for a performance to use knowledge from only one trajectory, and the seamless integration of personal knowledge from several trajectories may itself be an important learning challenge.

The implication of using entries based on complete episodes of practice is that:

- The data displayed in each entry represents a whole performance, involving not only the relevant trajectories but also the ways in which they interact
- Each trajectory contains a sequence of entries which show how its particular track has progressed over time
- It enables future learning to address both further development along trajectories and whether the right trajectories were chosen and combined in the most appropriate way.

Within this overall framework it is still possible, indeed desirable, for different types of representation to be used for different trajectories and at different career stages.

### **Complex Performance and the role of Mediating Artefacts**

Another important feature of Table 2 is that most of the trajectories represent complex aspects of work, which cannot be achieved by using only codified knowledge and may often be subject to some disagreement. But this

is not the main problem. Our interview-based study of mid-career learning in the business, engineering and healthcare sectors found that respondents were unaccustomed to talking about learning, and when they did so, they were more likely to talk about formal learning than informal learning. We became acutely aware of the difficulty of getting respondents not only to describe their job, when many aspects of it were likely to be taken for granted, but also to progress from that description to discuss the nature of the expertise which enabled them to do that job. They were aware that they had learned implicitly to do many things which formed part of their job, but they could not easily describe their personal knowledge and know-how.

Our next study was a longitudinal study of learning during the first three postgraduate years of prospective chartered accountants, qualified engineers and nurses which included observation of our participants at work. This made it much easier to talk about what they were doing in an informal language of description, moving from what we saw to what we might have seen on other occasions; then asking about how they had progressed between our meetings. We discovered that even in accountancy, where there were several weeks of formal training each year, the large majority of learning events (at least 80%) were informal and integrated into their work. Thus most learning was not a separate activity but a by-product of their ongoing work; and most of these events involved working with other people. This gave rise to a second typology of the learning modes of early career learners to match the learning trajectories (Eraut 2007).

**Table 3 A Typology of Early Career Learning**

<b>Work Processes with learning as a by-product</b>	<b>Learning Activities located within work or learning processes</b>	<b>Learning Processes at or near the workplace</b>
Participation in group processes Working alongside others Consultation Tackling challenging tasks and roles Problem solving Trying things out Consolidating, extending and refining skills Working with clients	Asking questions Getting information Locating resource people Listening and observing Reflecting Learning from mistakes Giving and receiving feedback Use of mediating artefacts	Being supervised Being coached Being mentored Shadowing Visiting other sites Conferences Short courses Working for a qualification Independent study

The significance of *Working alongside others* is that it allows early career workers to observe and listen to other people at work and to participate in their activities; and hence learn new practices and new perspectives, become aware of different kinds of knowledge and expertise, and gain some sense of other people's tacit knowledge. This mode of learning, which includes a lot of observation as well as discussion, is extremely important for learning tacit knowledge or the knowledge that underpins routines and intuitive decisions and is difficult to explain. When people see what is being said and done, explanations can be much shorter because the fine detail of incidents is still in their minds. Other research studies of learning at work also provide evidence for the importance of the five non-codified types of personal knowledge listed on page 2.

However, while it is possible for pairs of experienced colleagues to understand and learn from each other's practice by a combination of discussions and working together, without even attempting to make their tacit knowledge more explicit, the same assumption cannot plausibly be extended to a group of practitioners with few opportunities for mutual observation. So we have to consider ways of communicating at least some tacit knowledge if important aspects of practice are to be shared. Approaches to sharing tacit knowledge that we have used or encountered in the literature include:

- Demonstrating skills with a voice-over commentary may not be an authentic account of normal thinking in action, but can still communicate much useful tacit knowledge
- Discussing common episodes at which the participants were co-present
- Recordings of episodes, with the possible addition of a voice-over commentary (Holmstrom & Rosenqvist, 2004)
- Describing incidents or telling stories, followed by discussion (Fairbairn, 2002)
- Discussing cases and/or problems, real or fictional

Our mid-career study gave us some evidence about what and how some learning took place, so we were able to reflect on factors other than personal characteristics that affected the extent to which respondents seemed able to tell us about their work, even within the limitations of our particular project. These factors affecting the ability to tell were linked to people's prior experiences of talking about what they knew. Thus talking more explicitly about their knowledge at work was more likely to occur when there was:

- A climate of regular mutual consultation encouraging those consulted to describe what they know
- A training or mentoring relationship in which explanations were expected, sometimes of cultural or behavioural norms as well as more technical matters
- Informal relationships leading to work-related discussions of information out of hours, when more 'provisional' and 'riskier' comments might be made which conveyed some meaning but were not understood as pretending to be comprehensive or accurate
- A crisis, review or radical change in practice, which caused people to exchange opinions and experiences, sometimes even to making values more explicit. (Eraut et al 1998)

Another factor was the role of continuing education in the form of courses or serious reading. For many respondents this added an important dimension to their ability to think and talk about their work situation when it provided (1) a vocabulary for talking about aspects of their experiences which had been previously difficult to discuss and (2) concepts and theories which helped them to make sense of their experience and understand issues and alternative perspectives more clearly. This was particularly true of mid-career courses which build on participants' experiences, the most frequently cited examples being in management. For example, studying organisational behaviour helped our respondents to comprehend aspects of their own context of which they were partially aware but had not previously understood; and studying the management of change helped them to understand why so many new initiatives had failed to be fully implemented and ground to a halt. Many people were helped to move their thinking from a purely organisational level to a strategic level; and/or to see their organisation's relationship with its environment from a different perspective. The net effect was an enhanced capacity and encouragement for people to think and talk about their own work and its organisational context (Eraut et al 1998). Such educational experiences were not simply making tacit knowledge explicit, but using some of their tacit knowledge as one component of a more developed, as well as more explicit understanding of their working situation.

The conclusion we drew from these situations was that improving communication and sharing expertise with others led to further understanding and in-house innovations, usually with modest but significantly positive outcomes. The underlying principle for success seems to be an expansion of the affordances for learning within a group or organization that leads to better outcomes for those involved. A complementary approach could be to create a *mediating artefact* that might catalyse new thinking beyond the sharing of existing expertise. Let me give some examples.

Table 1 was a 2 dimensional matrix linking nurses formal learning about acute pain with their own experiences of the causes of acute pain. It was created through a series of interviews with nurse mentors and included five other sections on Acute Pain: Assessing the Patient, Assessing the Pain, Alternative Methods, Drugs, and Assessment of the Response. When one group commented that these diagrams looked too tidy, I suggested

that perhaps they were like Pandora's Box, whose opening led to a further set of hidden problems waiting to be tackled. We had no evidence that these entries had the same meanings for those who suggested them; but it did give us the possibility of exploring those boxes in depth without feeling that we had to discuss all the other boxes on Causes of Pain at the same time, i.e. it did not claim that these problems were not connected with others. These kinds of discussions never occurred, but they clearly presented a pathway towards sharing their experiences, exploring differences between patients seen as similar, and consulting others if necessary.

The same issue can be found in the training of junior doctors, who are exposed to all the patients in their ward, but are never asked to make notes of all patients with a similar condition in order to be able to *participate in a discussion about their similarities and differences* and eventually become able to take more responsibility for those patients in the future.

Another example was a piece of educational development work on the structure, style and classroom use of text books. Together with German colleagues, we developed a framework for teachers and other educators to analyse textbooks, which included both an analysis of the book itself and an analysis of ways in which it could be used and the role it could contribute for different pupils (Eraut et al 1975). This involved not just understanding the affordances of the book, but also its suitability for different students, the contribution it might make to a particular class, and views about its choice of content, readability, and explicit or implicit values. Those using the book found out a great deal more about it, found new ways of using it and became more aware of where supplementary material might be needed. In this case, the newly developed material provided an opportunity (1) for each teacher present to develop new knowledge of ways of using the book with their current classes; and (2) a cluster of material from several teachers with different approaches and different groups of children to teach. All these products were sufficiently detailed to provide at least some new ideas to other teachers not at the workshop.

In all three of these examples a **mediating artefact** was developed with appropriate practitioners that could be both revised and used by other practitioners to address key issues in their own work contexts. Both examples could also be expanded to include the views of their clients, patients, students or other stakeholders about how their needs might best be met.

Our study of early career professionals was also full of different kinds of *mediating artefacts* (Eraut 2007). For nurses, the daily handover sheets were critical for continuity of care. They summarised key information on the progress of each patient and were backed up by patient records covering temperature, fluid intake and output, drugs administration, biochemical data and various types of image. These referred both to the immediate past and to plans for the immediate future, and salient features considered important were prioritised for the incoming shift at every handover. Understanding the thinking behind these handover rituals was essential learning for newly qualified nurses. Then, they had to learn the MEWS protocol for deciding when a patient needed urgent attention and patient pathway protocols for patients with particular conditions. More experienced nurses could use their own discretion on some aspects of MEWS, but for less experienced nurses it was essential for ensuring patient safety.

Engineers were frequently using artefacts, both for planning and for distant communication with colleagues. For example, a mechanical engineer was observed discussing virtual design 'drawings' on the screen over the telephone with colleagues, contractors and clients on an almost daily basis; and she also sent digital photographs and measurements to initiate a discussion about a sagging bar. A water planning engineer and her colleagues all used her progress reports on meterage to decide whether to clean out a mains pipe, re-line it with plastic piping, or replace it - all with different associated cost and time implications.

However, the most substantial use of *mediating artefacts* was in accountancy. Not only were the accounts themselves mediating artefacts that provide a central focus for all audit activities, but comparisons with previously audited accounts were a great help to new arrivals. Their senior colleagues also used software

packages of considerable range and scope to help deal with complex accounts, which they gradually mastered over a series of audits. The really expensive ones were used as a guide for the auditors through their tasks, as a framework for assigning sub tasks, as a repository of accumulated judgements, as an archive of explanatory material, and as a record for the following year. The distinctiveness of these higher level artefacts was their incorporation of a considerable amount of professional knowledge, which could be used under supervision before all that knowledge had been acquired.

The most interesting aspect of these particular artefacts is that they provide a framework for trainees throughout their “apprenticeship”. They contribute to the accounts from the first month onwards, and can always look at the accounts to get a bearing on progress and, if momentarily short of work, to see what they can do next. They are usually near to someone only a few months ahead of them, so they are not afraid to ask questions and they witness discussions about the strategy of the audit whenever unexpected problems occur. They also spend a lot of time on client premises and gradually learn the many ways through which business processes can be represented, or possibly misrepresented, by appropriate sets of accounts.

The first three examples on nursing, medicine and school textbooks showed how useful innovation can be developed through creating opportunities for practitioner groups to focus on key issues. The second group presented examples of mediating artefacts already in use for early career professionals; and we might predict that these kinds of artefact will now expand quite rapidly. A third type of artefact now beginning to expand is the use of still or motion pictures for initiating the sharing of new experiences that might help to enhance the quality of complex work. For this I return to nursing and then discuss a current problem in medical training. One possibly unusual aspect of this work is my preference for still pictures rather than video pictures.

The first example comes from a doctoral student seeking to discover the expertise used by surgical nurses dealing with post-operative wound-work. Fessey (2002) worked by creating a small knowledge map, similar to that presented in Table 1 but encompassing all the knowledge used on one particular occasion. Her plan was to discuss her first draft version with the expert soon after the event she was researching, but there were several occasions when this was not possible until the following day, by which time the expert’s memory of that particular incident had faded. She thought that the nurse’s memory might be improved by showing her still pictures of the episode being discussed, and felt that videos would be cumbersome, more obtrusive and less likely to promote discussion. The patient’s consent would have to be requested, and still pictures could be deleted by the patient as soon as they saw them. She found that the patients both appreciated having command of the delete button, which gave them real consent, and were very interested in the pictures. My immediate reaction was that this would also be an excellent way to start discussions with patients about their wounds and the implications for their future life at home, instead of waiting for the last hour before leaving the hospital with very limited awareness of how their operation had changed their anatomy and how they would be able to cope.

The second example is a plan for the future. My work for the Royal Colleges of Surgeons on the learning of registrars<sup>4</sup> found that a combination of the European Working Time Directive (EWTD) and the move to sub-specialties meant that registrars and their trainers were not often on the same shift (Eraut, 2008). This made it necessary for registrars to have two or three trainers; but these trainers never met to discuss the progress of their trainees, and the experiences of operations not observed by a trainer were effectively ignored. Since progress in surgery depends on trainers having a high level of trust in their trainees, based on seeing them operate under their own eyes, operations taking place with other trainers make little or no contribution to the trust of trainers who were not there to see it. Not only do trainees have less overall time than before, but the need to be trusted by all their trainers individually hugely reduces their rate of progress.

I am now trying to persuade trainers and trainees to take still pictures at key points when they are not operating; so that trainer and trainee can discuss the pictures soon after the operation. My suggestion is that each of them

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<sup>4</sup> the final stage before becoming an independent consultant

should tell the other what they were thinking about at the time when each picture was taken, and record the conversation. The trainee will learn more about the trainer's concern for safety and aspects of the operation where their knowledge was a bit limited. The trainer will get a much clearer sense of what the trainee was thinking while they were operating and a chance to give them appropriate advice on the spot. The trainee would then be responsible for sending copies of these audiotapes to all their trainers, who would then have a much clearer picture of that trainee's capability at that particular time. In both these examples still pictures create much more powerful mediating artefacts because they give more power to the learners and create more relevant ideas than videos.

### Implications for Academic and Vocational Outcomes

This paper has focused on what learners learn in both educational and workplace settings. In both settings they learn how to create artefacts that are valued by those who allocate and assess their work.

Some of the knowledge displayed in these artefacts is considered to be satisfactory, i.e. competent, some is judged to be excellent and some to be inadequate. These decisions may be described as criterion-based, but they will always be shaped by normative features that determine what counts as competent in that particular time and place. The quality of work, however, will not be determined only by the individual learners but also by the quality of those who support their learning and the match between what is expected of them, what the context provides and what they themselves find most relevant.

The problem with most competency-based learning is not primarily with the competencies themselves, but with the way that they are used and understood. My discussion of Learning Trajectories shows that:

- Many of the items in Table 2, especially working in groups and personal feelings and qualities, are given little formal attention in either education or workplace settings
- The need for good holistic performances which combine several skills together is critical for developing good work
- Examining learner pathways over time gives much better evidence than single assessment events

My conclusion is that discussions about learning trajectories and learning goals should become generally available across the population, regardless of age and formal qualifications.

We are continually reminded about the need for more skilled and more flexible workers, but our qualifications and learning support systems are only rarely focussed on innovation and change at a micro level. Engestrom (1987) and Engestrom et al (2003) have shown how bringing people together with a series of mediating artefacts can create new approaches to important problems at a local level, and some of my examples have addressed even simpler ways of designing artefacts that people can use to develop their collective knowledge base or to include people who might otherwise not be consulted. Most of these examples involved groups rather than individuals and this is crucial to the use of mediating artefacts. **When artefacts are seen as mediating tools rather than reified knowledge, we come to recognise that much of our knowledge lies in the discussions we have around mediating artefacts rather than in the artefacts themselves.**

Higher education learners who are participating in work-based practice are effectively using at least two sorts of mediating artefacts. Firstly, they are, like any other professional, creating their own artefacts, or adding to existing artefacts while they are engaged in their work. Much of a learner's development is embodied in these artefacts and conversations about their use and what they represent should logically be an important part of the learner's own self-evaluation and representation of learning. They might also usefully be included in conversations about performance and development but given that interviews with tutors normally last about an hour and they are focused solely on the mediating artefacts provided by the institution (at least at the University

of Surrey) probably little direct use of such artefacts is made. The extent to which this happens is not known and should form the basis for further research.

Secondly, learners are using the mediating artefacts created by the institution explicitly to make judgements about learning and performance. Examples of mediating artefacts used in the placement environment include:

- Learning logs, diaries
- Blogs and wikis (including Wikipedia)
- E-portfolios
- Reflective reports
- Power Point presentations
- Digital stories
- Posters
- Journal publications – formed around the work undertaken during work placement
- Questionnaires
- Micro stories (Reisch, 2011) and Sense Maker stories (Willis and Jackson, 2011)

An example of the artefacts (criteria for assessment during a placement tutor visit in the School of Management at the University of Surrey, is shown in Table 4a and 4b the criteria for structuring a Work Placement Report at the end of a one year work placement. Student responses to these frameworks effectively create a mediating artefact that is generally judged without conversation (ie assessment is a conversation free cognitive process on the part of the assessor). However, there are examples where students also give presentations (typically using power point or posters) linked to their placement experiences. These forms of mediating artefact open up the possibility of conversation.

## Conclusions

Given the importance of mediating artefacts as the vehicle through which the learning and development that emerges through work is represented, more attention should be given to these entities during the preparation of learners for work placement and when evaluating the performance of learners in work placement settings. Universities also need to take stock of the roles performed by the mediating artefacts that they create that are intended to be used by work placement learners to reflect on and represent their learning and development. Given the importance of conversation in revealing an individual's knowledge and understanding, *'When artefacts are seen as mediating tools rather than reified knowledge, we come to recognise that much of our knowledge lies in the discussions we have around mediating artefacts rather than in the artefacts themselves,'* it would seem necessary to involve learners in conversation about the way in which they have used the mediating artefact to represent their knowledge.

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## Appendix A

My evaluation of High Level National Vocational Qualifications (Eraut et al 2001) revealed three major problems which have yet to be addressed: the effect of using qualifications for accrediting existing competence, the dangers of a fragmented approach to performance, and the limited development of expertise in assessment and learning support. We found that our sample of over 600 candidates spent, on average, only 28% of their time on developing new competence. *Candidates who spent more time on development emerged with significantly higher ratings on two critical outcomes: taking the qualification helped their work and led to changes in their working practices.* Moreover, spending more time on developing new competence did not increase the time it took candidates to qualify. A major reason for this last finding is that candidates seeking development embarked on fairly ambitious projects which, though time consuming, were both of value to their organisation and positive learning experiences; and these projects provided evidence of competence across large areas of the qualification, leaving only small pieces of units to be “picked up” towards the end. In contrast, candidates considered already competent spent a great deal of time searching for evidence of past accomplishments with relatively little learning gain. These candidates could equally well have chosen a more developmental pathway but were unaware that this could have been no less burdensome. This is but one illustration of the unintended effects of designing a qualification with no attention to learning.

The neglect of learning is even more apparent when one looks at the tendency for the pursuit of NVQs to be a fragmented learning process caused by a fragmented assessment process. Occupational Standards are the end-product of a functional analysis of competence, and NVQs are in effect a selection of units from those standards. Under present financial arrangements, the government pays for the development of the Standards and the Awarding Bodies (in this case Management, Accounting, Care, Occupational Health & Safety, Training & Development, Waste Management) organise the assessment; but no finance is available to develop a learning programme which is motivating, meaningful and effective, incorporates formative evaluation and progression, and concludes with holistic final assessments that are more valid measures of performance in the workplace than a portfolio of bits and pieces of evidence. People drift into the fragmented approach through lack of expertise, without recognising how frustrating and non-developmental it can be for candidates or its lack of workplace validity.

We should not conclude that the last 40 years of discussing competences and/or judging criterion-related performances have been wasted. Our problem is to find how such potentially useful work might best be used. Two possibilities, which might be usefully combined, are to replace work-based qualifications by longer term *Learning Trajectories* (long term changes in the pattern of assessment) and to treat competencies and capabilities as *Mediating Artefacts* that enable focused discussions about workers’ ongoing performance record and future learning (long term changes in workplace learning).

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