Transfer of knowledge between education and the workplace

Michael Eraut

University of Sussex
Falmer Brighton

Transfer of knowledge between education and the workplace

Michael Eraut
Institute of Education
University of Sussex

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 formal higher education, the most prominent of these resources are the codified academic knowledge embedded in texts and databases and the cultural practices of teaching, studentship, scholarship and research. Codified knowledge which is not academic can be found in nearly all workplaces, including those of educational organisations, in the form of textual material containing organisation-specific information, records, correspondence, manuals, plans, etc.

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 any textual form; and the evidence gathered so far 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 social activities; and much 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. It is a prominent feature of educational institutions in spite of the overt dominance of codified academic knowledge; and it occurs in both formal and informal settings.

As a counterpart to cultural knowledge, I define *personal knowledge* as what individual persons bring to situations that enables them to think, interact and perform. Codified versions of personal knowledge are associated with the concept of authorship; and provide the basis for assignments and assessments within educational programmes from which more than the replication of publicly available knowledge is expected. But my definition is intended to include non-codified personal knowledge and a far broader concept of knowledge than academic performance. For example, it includes not only personalised versions of public codified knowledge but also everyday

55

knowledge of people and situations, know-how in the form of skills and practices, memories of episodes and events, self-knowledge, attitudes and emotions. Moreover, it focuses on the use value of knowledge rather than its exchange value in a world increasingly populated by qualifications. This implies a holistic rather than fragmented approach to knowledge; because, unless one stops to deliberate, the knowledge one uses is already available in an integrated form and ready for action.

During the last two decades, several distinctive theories of "situated learning" have been developed. Their most prominent common feature is the assumption that what is learned in any given situation is significantly determined not only by the codified knowledge presented in that situation but also by the manner of its representation and by other features of the situation such as the social relations between the participants. A second common feature that follows from this recognition of the situated nature of learning is a more flexible view of knowledge itself, which becomes more a property of social interaction than a property of an authorised text. Gruber et al. (1996) provide an excellent review of the implications for transfer of five varieties of situated learning theory, which I will not attempt to summarise.

However, while strongly supporting these two common features, I strongly dissent from those theorists, such as Lave and Wenger (1991), who attempt to eradicate the individual perspective on knowledge and learning. Their research, based mainly on fieldwork in stable communities, focuses selectively on common rather than differentiated features of people's knowledge; and fails to recognise the need for an individual situated (as well as a socially situated) concept of knowledge in the complex, rapidly changing, post-modern world. Individuals belong to several social groups in which they both acquire and contribute knowledge, and their experiences of multiple group membership cannot be ring-fenced. Many of these groups have changing memberships and relatively short lifetimes. Thus members of a group acquire only part of the knowledge present in that group, and interpret it within a personal context and history that has been shaped by their experiences in other groups, both prior and contemporary. There will also be aspects of a person's knowledge that have been constructed through lifelong learning and have become unique to them, i.e. outside the circle of shared cultural knowledge, because of the unique set of situations in which they have participated. For example, a single idea will acquire a distinct web of meaning for each individual user according to the sequence of situations in which they used it. The greater the range of usage, the more distinctive its personal meaning is likely to be (Eraut, 2000).

Theories and the manner of their acquisition

Theory is an inherent part of how we interpret and understand the world around us. The way in which we conceptualise our environment depends on our personal theories. Our assumptions about what causes what or what will happen if we do X also can be characterised as personal theories. Such theories are pervasive and unavoidable but what is their status as knowledge? Several possibilities come to mind, all of which might be considered to be true in certain circumstances; and their relationship with formal theory found in books is highly differentiated. There is no need to elaborate on the role of theory within the domains of codified knowledge we refer to as academic disciplines, except to point out that academics can be considered as a particular group of users who operate within a range of contexts from being key interpreters of a theory within the heartlands of a discipline to importers of that theory into cognate disciplines or more applied fields of study. Each makes its own assumptions about the role of theories in their discourse, which can be readily inferred by critical reading of the journals favoured by different groups and factions. Although elements of this discourse may carry connotations that are picked up by only a small group of 'insiders', these serve only a micropolitical function. The theory and range of interpretations and criticisms are explicitly described and publicly available to those with sufficient prior knowledge to understand them.

In contrast, at the other end of the range are *implicit theories* which are seldom explicitly stated by the knower but used by psychologists (and other social scientists) to explain observed regularities in his or her behaviour. Those observed behave as if they are using the implicit theory imputed to them. If knowers are informed about their own implicit theories, they often recognise them but also sometimes deny them. Recognition is extremely important, because it helps to bring actions based on theory under the critical control of the actor. Being unaware of the theories informing one's actions is tantamount to not being responsible for the effects of those actions. Such implicit theories can be developed by the unconscious aggregation of experiences of similar situations or by participation in a community of practice for whom certain implicit theories form part of their taken-for-granted world. The denial response, often only temporary, is usually because the implicit theory conflicts with the knowers' self-image or with the theories they use to justify their actions. Argyris and Schön (1974) made a very useful distinction between *espoused theories*, often ideologically correct and acquired during professional education, and *theories in use* which determine what people actually do; and go on to discuss how mid-career professionals and managers can be helped to reconcile them.

Between these two extremes are a wide range of situations in which some explicit use is made of theory in professional/vocational contexts. Theories in use may be explicitly derived from personal experience informally acquired from colleagues, or learned from private study or formal education and training. Unless the use of theory is repetitious, it will have to be reinterpreted/transferred to fit each new situation; and this will require a little or a great deal of further learning, depending on how different the new situation proves to be from those previously encountered. Thus a person's theoretical capability will depend not only on the range of theories which they 'know and understand' or even on the range of theories they have used; but also on the range of contexts in which they have used them, and their accumulated expertise in, and disposition towards, further use of those theoretical resources.

Reframing the concept of transfer

Before 1980 research on transfer focussed on two main variables: the nature of what is being transferred and the differences between the contexts from which and to which the transfer was, or was not, observed to occur. To these I wish to add the disposition of the transferee and the time and effort devoted to facilitating the transfer process; because research into knowledge use outside laboratory settings clearly indicates that these variables are important influences. Transfer should not be conceptualised as an event but as a learning process whose progress is affected by a large number of variables. Thus my definition of transfer is " the learning process involved when a person learns to use previously acquired knowledge / skills / competence / expertise in a new situation". This may be short and easy if the new situation is similar to some of those previously encountered; but long and very challenging if the new situation is complex and unfamiliar.

In the complex situations encountered by most professional workers, the transfer process typically involves five inter-related stages:

1 The extraction of potentially relevant knowledge from the context(s) of its acquisition and previous use;
2 Understanding the new situation, a process that often depends on informal social learning;
3 Recognising what knowledge and skills are relevant;
4 Transforming them to fit the new situation;
5 Integrating them with other knowledge and skills in order to think/act/ communicate in the new situation.

The whole process is much more complicated than just desituating and resituating a single piece of knowledge.

Higher education defines its interest in terms of transferring its knowledge, whose significance is taken for granted; and will, at most, attend to stages (1) and (3). The workplace may give some attention to stage (3) and generally takes stage (2) for granted. It expects knowledge from higher education to be "ready to use" and questions its relevance if it is not. Thus both cultures not only ignore the very considerable challenges of stages (4) and (5) but deny their very existence! Since transfer is a social process as well as an individual process, this lack of preparedness is best described as disastrous.

Types of knowledge acquired in education contexts

Teachers in secondary and post-compulsory education are organised according to the subjects they teach, each of which forms a distinctive sub-culture and provides a major part of their professional identity (Becher, 1989; Goodson, 1983). Most learning pathways that precede full-time employment comprise mainly subjects, which have potential vocational relevance, but are taught primarily under the auspices of general education. When subjects are claiming territory on the timetable, arguments based on vocational relevance are used with vigour, if not rigour. But, once their territory has been established, historical traditions, the prevailing assumptions of the subject culture and the expertise of the current teaching staff dominate the selection and treatment of academic content. The prime objective becomes progression within the discipline and increasing participation in its culture to first degree level and beyond, even though only a small minority of students follow that particular path. In many subjects applied aspects are given just a "walk on part" and an occasional mention.

Professional and vocational education programmes typically include three kinds of content: these derive from (1) disciplines which feature prominently in general education and form major components of honours degrees, e.g. Mathematics, Sciences, Social Sciences, Languages, (2) the applied field which sponsors the programme e.g. Business, Engineering, Education, Health Professions and (3) occupational practice itself. According to their background and orientation, individual teachers have a primary allegiance to one of these three types of content, but are sometimes also required to teach a second. In every case the treatment of the content and its relationship to practice are significantly influenced by the academic and vocational experience of those who teach it.

Most teaching within an applied field in is also strongly influenced by an often quite recently constructed body of knowledge about that field, which thus becomes either a quasi-discipline like Education or Nursing or a constellation of quasi-disciplines like Business Studies or Engineering. Over time, teachers in the applied field are drawn from

59

its own graduates and a cultural succession becomes possible whereby new teachers are recruited with little or no work experience in the relevant occupation. These may remain a minority, but the codified academic knowledge of the field, as represented in publications, begins to dominate knowledge derived from personal experience of occupational practice, both culturally and experientially, as the impact of early occupational experience recedes. Some of this theory of the applied field is concerned with the application of theories and concepts from scientific disciplines; some is based on empirical research and conceptual frameworks peculiar to the applied field; some is based on the elaboration of practitioner maxims and practical principles; some is based on what can best be described as a preferred view or ideology of the occupation, a theoretical justification of its purposes and practices in terms of moral principles, views of society and occupational beliefs about the effectiveness of various practices.

This last aspect of "applied field" theory is strongest in occupations based on personal interaction with clients, where there is a strong tendency to construct theories of practice which are ideologically attractive but almost impossible to implement. The main problem is that the professionals concerned are urged to adopt practices that involve much greater levels of time and effort than service users and/or the public purse can possibly finance. Hence, there is a significant gap between the theories of practice taught by former practitioners, based on how they would have liked to have practised, and the activities performed by current practitioners. This contrasts with the common workplace stance, in which current practice is uncritically accepted as an inevitable reality, and any impetus towards improving the service provided by an occupation is lost. Neither provides an adequate basis for a professional career. There are so many variants of problem-based learning curricula and staffing strategies that it is impossible to discern the extent to which PBL even attempts to bridge this cultural gap between education and workplace settings.

The third type of course found in Education settings involves teaching occupational practice through skill workshops or simulations; or, if there is concurrent work experience, seminars linked to discussions that interpret that experience and introduce relevant theory in order to facilitate learning in the workplace. This last is commonly described as the "reflective practitioner" model. To be successful these skills sessions or reflective seminars require small student groups, good facilities and hyperactive staff who sustain close working links with practitioners. Recruiting and retaining such staff is often difficult; and in Higher Education the demands of such bicultural work tend to conflict with activities more likely to lead to promotion.

To conclude this section, I shall briefly summarise the kinds of knowledge which Vocational and Professional Education Programmes claim to provide:

60

1 *Theoretical Knowledge* constructed in the context of either a subject discipline or an applied field. This introduces concepts and theories to help students to explain, understand, and critique occupational practices and arguments used to justify them; and to appreciate new thinking about the role of the occupation and proposed new forms of practice.

2 *Methodological Knowledge* about how evidence is collected, analysed and interpreted in academic contexts and in occupational contexts; and the procedural principles and theoretical justifications for skills and techniques used in the occupational field.

3 *Practical skills and techniques* acquired through skills workshops, laboratory work, studio work, project work etc.

4 *Generic Skills* claimed to be acquired during Further and/or Higher Education, either through direct teaching, or more often, as a side effect of academic work. These include:
   • basic skills in number, language and information technology
   • modes of interpersonal communications
   • skills associated with learning and thinking in an academic context
   • self-management skills

5 General knowledge about the occupation, its structure, modes of working, cultural values and career opportunities.

Although most of these types of knowledge are described as transferable, there is little evidence about the extent to which 2, 4 and 5 are acquired by students and about the chances of 1 and 3 being subsequently transferred (or not) into the workplace. There is even some doubt as to whether the phenomena described as "transferable skills" have sufficient affinity with workplace activities for the term "transfer" to be a valid description of any suggested connection.

Types of knowledge acquired in the workplace

My research into mid-career learning in a wide range of settings (Eraut et al. 1998, 2000) led to a rough typology of knowledge found in the workplace, which contrasts with that found in Education settings. This is summarised below in a slightly modified form:

1 *Codified Knowledge* acquired during initial professional training and further episodes of formal learning; or in the workplace itself. The former includes codified academic knowledge of concepts, theories and methodology. The latter includes job-specific technical knowledge and knowledge of systems and procedures.

2 *Skills* needed for competence in a wide range of activities and for performing several work-related roles, including leadership and working collaboratively within a team. These can be grouped under four headings – technical,

61

interpersonal, thinking and learning – and are acquired through practice with feedback. Progression is associated with increasing fluency, responsibility and complexity.

3 *Knowledge Resources* include a range of materials and on-line resources; but learning from other people is even more important in most work settings. These include immediate work colleagues and other members of one's organisation; networks of clients/customers, suppliers and competitors; professional networks; and other personal contacts developed over time.

4 *Understanding* provides the basis for most action, although it is inevitably incomplete. It encompasses the understanding of other people- colleagues, clients, managers, etc.; the understanding of situations and contexts, including one's own organisation and its environment; self-understanding and strategic understanding of a range of changes and developments. This includes both explicit and implicit theoretical perspectives and theories of action.

5 *Decision-making and Judgement* vary with the conditions in which they are exercised. Decisions may be rapid, with little time for analysis or consultation, or deliberative and consultative. When situations are complex or information is sparse, judgement becomes a critical aspect of decision-making: judgement of people; judgement of the quality of products, practices and processes; judgement of the relative significance of, and interaction between, different factors; judgement of priorities, options and strategies.

Unlike many typologies, this one gives considerable emphasis to working contexts and conditions. Not only is situational understanding context specific, but it requires knowledge acquired through experience; and the capability to decide and act requires both experience of working in the context, and adaptation to a range of local conditions. One cannot understand the knowledge needed for doing a job without a detailed description of what I like to call its *performance domain*. This comprises three types of variable:

1 The contexts and cultures in which the performer will have to operate, including likely locations and their salient features;

2 The conditions under which the performer will have to work, e.g., degree of collaboration and supervision, pressure of time, crowdedness, conflicting priorities, availability of resources;

3 The situations which the performer may encounter, covering such factors as client types and demands, tasks to be tackled, interpersonal events, emergencies, etc.

Like other typologies, however, mine has one very serious weakness. It cannot represent the knowledge that results when several different kinds of knowledge are combined to achieve a complex task or performance. The difficulties entailed in trying to solve this

62

problem of knowledge representation can be best understood by adopting other approaches to the study of knowledge in use, which allow for the possibility of interference between tasks and draw attention to problems of prioritisation and deciding which task to do when.

Studying performance periods

The period chosen for analysis will vary according to the focus and the occupation; for example one could consider a lesson, a clinic, a shift or a day. A major aspect of professional experience is that many tasks do not get completed during a performance period, so there is the constant problem of 'picking up the threads' at the beginning or receiving new information that will cause a change of plan; then a need to record progress at the end and/or to hand over clients to a colleague. This is reflected in the separate boxes for Initiation to indicate the initial briefing and reading of the situation when the period starts, and for Ending to indicate what has been achieved, or left undone, by the time the period ends.
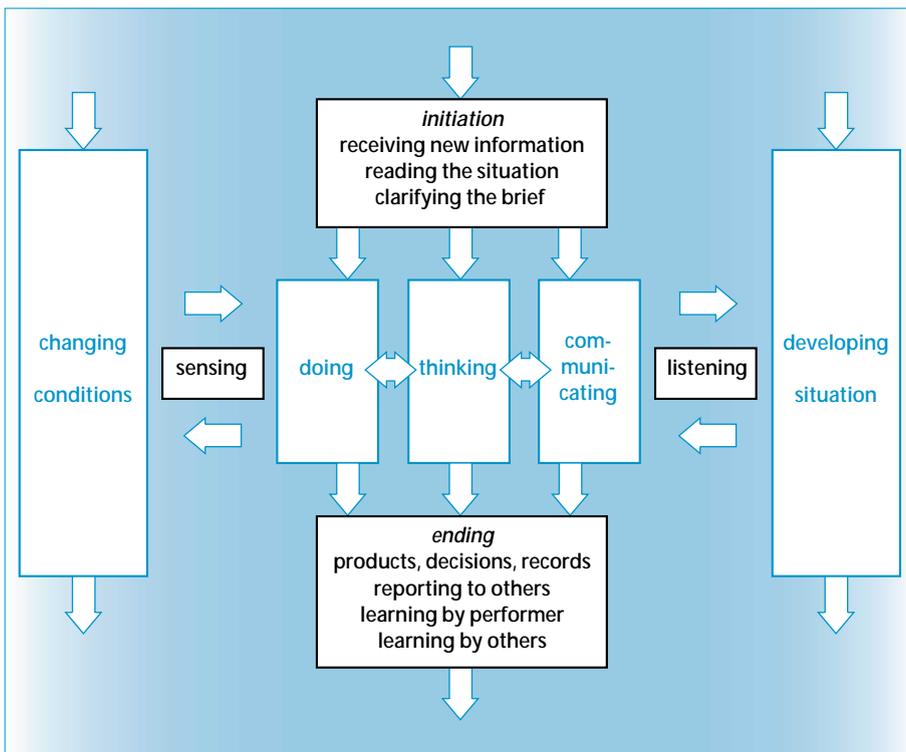

Figure 1   Activities during a performance period

One advantage of using a performance period is that situations often develop over time. So, instead of a static model in which all decisions and plans are made at the beginning of a period, one has a dynamic model in which a constantly changing environment provides a changing input that leads to the constant modification of plans. The input side is shown by placing the activities within a context characterised by changing conditions and a developing situation, with the opportunity for inputs prompted by sensing and listening. A great deal of competent behaviour depends not just on being able to do certain things (output) but also on the correct reading of the ongoing situation (input) so that the appropriate action can be taken. Nor is it only the external environment that changes of its own accord. The performer is an actor who affects that environment, not always in totally predictable ways. So another role of input is to provide feedback on the effect of one's own performance. This applies whether one is making something and sensing it change, or talking to people while listening to their reply and observing their reaction.

The interpretation of this input is just one aspect of the cognitive element, indicated by a central column marked Thinking. Other aspects of thinking include planning and monitoring one's activities and solving problems. People are constantly thinking and making decisions as they go along, even though they could probably tell you very little about it afterwards. Hence Thinking is shown in constant interaction with Doing and Communicating. These activities overlap to some extent, the main distinction being between acting on inanimate objects and interacting with other human beings.

Factors affecting modes of cognition in workplace performance

The performance period approach introduces issues pertaining to the pace and pressure of the workplace; and, through emphasising the importance of cognition, raises the question of when and how workers find the time to think. This led to a model linking four types of professional activity to different amounts of thinking time, and hence, to examining the *modes of cognition* employed in professional work (Figure 2). The four types of activity were:

1 Assessing clients and situations (sometimes briefly, sometimes involving a long process of investigation) and continuing to monitor their condition;

2 Deciding what, if any, action to take, both immediately and over a longer period (either on one's own or as a leader or member of a team);

3 Pursuing an agreed course of action, modifying, consulting and reassessing as and when necessary;

4 Managing oneself, one's job and one's continuing learning in a context of constrained time and resources, conflicting priorities and complex inter- and intra- professional relationships.

These activities can take many different forms according to the speed and context and the types of technical and personal expertise being deployed. Although analytically

distinct, they may be combined into an integrated performance that does not follow a simple sequence of assessment, decision and then action. For example a health professional will often have to decide whether to take action and then reassess whether to continue with a further assessment of their client or whether to simply wait and see. There may be several assessments, decisions and actions within a single period of consultation and treatment. Indeed recording both the nature of these activities and the ways in which they are sequenced and combined is another very useful approach to describing professional practice.

In order to understand the nature of workplace performance, one has to examine the thinking entailed in carrying out these activities, which depends on both (1) the conditions and constraints on the performer, and (2) what the performer has learned to do, with or without stopping to think. Sometimes the situation itself demands a rapid response; sometimes rapid fluent action is the hallmark of the performer's proficiency; sometimes the number of activities proceeding simultaneously limits the attention that can be given to any of them i.e. the workload is so heavy that there is little time to think. Thus the model assumes that *time* is the variable that most affects *mode of cognition* and divides the time-continuum into three sections, headed Instant, Rapid and Deliberative. These terms attempt to describe how the time-scale is perceived by the performer, and are interpreted differently according to the orientations of performers and the nature of their work. For example, in one context *rapid* might refer to any period less than a minute, while in another context it might include periods of up to ten minutes or even half an hour. The critical feature is that the performer has little time to think in an analytic mode.

Type of process	Mode of cognition		
	Instant/Reflex	*Rapid/Intuitive*	*Deliberative/Analytic*
Reading of the situation	pattern recognition	rapid interpretation	review involving discussions and/or analysis
Decision-making	instant response	intuitive	deliberative with some analysis or discussion
Overt activity	routinised action	routines punctuated by rapid decisions	planned actions with periodic progress reviews
Meta-cognitive	situational awareness	implicit monitoring short, reactive reflections	conscious monitoring of thought and activity self-management evaluation

Figure 2   Interactions between time, mode of cognition and type of process

The *instant/reflex* column describes routinised behaviour that, at most, is semi-conscious. The *rapid/intuitive* column indicates greater awareness of what one is doing, and is often characterised by rapid decision-making within a period of continuous, semi-routinised action. Typically it involves recognition of situations by comparison with similar situations previously encountered; then responding to them with already learned procedures. The time available affects the degree of mismatch that is tolerated, because rejection of action based on precedent leads to deliberative, problem-solving and hence to a more time-consuming approach. The *deliberative / analytic* column is characterised by explicit thinking about one's actions in the past, present or future, possibly accompanied by consultation with others. It involves the conscious use of prior knowledge, sometimes in accustomed ways, sometimes in novel ways or in a more critical manner.

The interesting question arises as to whether performers are aware of the knowledge embedded in their practice when it is not explicitly used at the time. Four very different circumstances may pertain:

1 The practice was modelled on that of other professionals without understanding the reason for it or being aware of any underpinning knowledge.
2 The practice was developed with awareness of its rationale and underpinning theory, but that awareness dissipated over time and with it the ability to explain or justify it.
3 The practice can still be justified by citing underpinning theory, but cannot withstand any challenge because there has been no critical evaluation of the practice since it was first adopted.
4 The practice cannot only be justified but remains under the professional's critical control because it has been periodically re-evaluated.

The need for knowledge transfer during initial training and the period of workplace learning that follows it will largely be determined by whether the desired option is (1) or (4) above.

Two problems are likely when the use of underpinning knowledge is not under critical control. First, conflicts may arise in problematic cases between competing responses based on different practical principles – these cannot be resolved unless the underlying reasons for these principles are understood. Second, there is a danger that "scientific" knowledge will be replaced by unscientific knowledge – that which falls within the domain of a discipline but is regarded by leading professionals as either incorrect or alarmingly incomplete. The normal assumption is that being a competent professional implies keeping one's practice under critical control; and therefore keeping up to date with relevant areas of theory and research. Reviews of practice may arise from individual reflection and consultation or, more officially, from the work of an appointed group. They examine the rationale for the practice, the evidence for its effectiveness,

alternative approaches and recent research; and may lead to a decision to retain the practice unchanged, modify it, or adopt an alternative. But, in spite of the growing emphasis on audit and on evidence based practice, such reviews are far from frequent and are restricted by the limited, and often exaggerated, scope of research based evidence.

Heuristic devices for investigating and learning scientific knowledge

Over the last few years, and with support from colleagues, I have been developing a heuristic framework to address the problem of investigating the use of scientific knowledge, to enable people to focus their attention on areas of particular concern to them and to help them appreciate the complexity of the issues involved. This heuristic can be represented as a two stage process:

1 establishing which areas of knowledge are relevant to a particular case or situation;
2 focusing more precisely on what knowledge is needed for a particular investigation, decision or action; and ascertaining how that knowledge is interpreted in a manner appropriate to each particular situation and context.

Establishing which areas of knowledge are relevant is not as simple as it seems. When teachers in education settings spend time discussing how their theoretical contributions relate to practice, a large collection of potentially relevant theory is quickly assembled. But who uses which parts of it, why and when? Our earlier section on modes of cognition noted that time to consider theory is at a premium in the workplace; and suggested that most theory was more likely to be embedded in practice than explicitly used in daily decision making. There is a marked contrast between the very large number of knowledge areas deemed relevant by those who teach them and the very limited number of knowledge areas that can be taken into account at any one time by a busy practitioner with a high caseload. The practitioner has to assess the priority to be accorded to each particular area of knowledge in each particular situation; but in practice patterns of attention will soon be developed and only some knowledge areas will even be considered.

Recognising what theory you need in any particular situation is mainly learned through participation in practice and getting feedback on your actions; and most components of a practitioner's theoretical repertoire remain dormant until triggered by a very specific aspect of the situation. In healthcare contexts the nature of the client(s) is the main factor determining what knowledge and skills are relevant; but time-scale is also important. Figure 3 presents a useful framework for discussing and deciding not just which areas of theory are relevant to a particular case but also their respective priority. It can be supported by an appropriate checklist of areas of theory.

Status of knowledge	Emergency	Short-term action	Medium to long-term future	Review of practice
Embedded in – assessment – decisions – behaviour				
Explicit influence on – assessment – decisions – behaviour				

Figure 3   Framework for deciding priority areas of knowledge

The two rows allow a distinction to be made between (1) knowledge embedded in practice through routines or protocols but which remains essential for the justification of that practice and (2) knowledge which needs to be explicitly considered at the time. Such knowledge may influence how the client is assessed, what decisions are made and/or how the practitioner interacts with the client.

The column headings reflect the assumption that priorities will vary according to the time scale. For example, the knowledge used to treat a patient in hospital with a stable condition will not necessarily be given priority in an emergency; and yet other kinds of knowledge may become important when longer term issues are being considered. The fourth column, headed Review of Practice, has been added for two reasons. First to ensure that embedded knowledge is reviewed at some time; and second to enable contextual factors constraining practice to be identified and addressed in a way which would not normally be possible when an individual client is the focus of attention. Such reviews of practice might occur in the context of audit, continuing professional development, a formal evaluation or funded research.

The framework presented in Figure 3 can be used both to find out what practitioners currently do, in which case embedded knowledge may be difficult to elicit without using special methods of inquiry (Eraut, 1999; Fessey, 2000); and to discuss what they ought to do. Repeated use on a case by case basis would reveal common patterns of practice, differentiation between clients and concerns about the efficacy of practice, including the cumulative effect of neglecting longer term issues. Using this framework to broaden the scope of cases used in problem based learning could also play an important role in orienting students towards the significance of a wider range of theory without inducing cognitive overload.

The second stage of the process focuses more specifically on what scientific knowledge is used when and how; and uses knowledge maps developed during research into the use of scientific knowledge by nurses and midwives (Eraut et al., 1995, 1996). Our approach was to interview experienced practitioners, engaged in mentoring students, about recent cases involving the use of particular areas of scientific knowledge and to use a matrix to summarise the information we gathered.

Figure 4 on page 70 is the first half of a map depicting aspects of knowledge about Acute Pain used by Surgical Nurses, and when they are used. The rows cover relevant topics of codified knowledge within the area of Acute Pain, while the column headings describe the range of activities that constitute the practice of Surgical Nurses. The missing half contains a further fourteen columns under the headings of Alternative Methods, Drugs and Assess Response. The use of knowledge from a particular topic (row) during a particular activity (column) is indicated by making an entry in the appropriate box. Our research found significant differences in the headings of the matrix between specialisms, and some variation according to the type of clinical setting. Relatively few differences were noted between respondents from similar settings, but samples were not large enough for that to be a definitive finding.

The entries in the boxes indicate different kinds of knowledge use, codified for brevity. The R coding indicates that Recognition is all that is required, very little further interpretation is needed, and the transfer problem is mainly that of spotting when it is relevant; whereas the U coding indicates that significant Understanding of the knowledge is required, and probably some transformation. The knowledge has to be reinterpreted in order to be resituated. The numerical headings relate to the mode of cognition and correspond to the Instant, Rapid and Deliberative modes of response portrayed in Figure 2.

1 *Simple application*, for which recognising that some specific piece of knowledge was relevant was virtually all that was needed in order to take appropriate action;

2 *Situational adaptation*, where the appropriate response from an established repertoire was selected according to how the situation was understood, usually by matching one's model of the situation with situations previously encountered (described by Klein (1989) as Recognition Primed Decision Making); and

3 *Problem solving*, where the appropriate course of action had to be worked out from first principles.

Areas of Knowledge	Assess patient			Assess pain			Interpret cause					
	Perso-nality	Knowledge	History	Vital signs	Ability to cope	Intensity	Unrelated to surgery	Signs of infection	Haema-toma	Retention of urine	Consti-pation	Wound assessment
1 nerve pathways				U3			R2					
2 transmission/ perception of pain		U2										
3 causes of pain	U2	U2		U3	U2	U2	U2	U2	U2	U3	U3	U3
4 effects of pain	U2	U2		U3	U2	U2	U2	U2	U2	U2	U3	U2
5 bacteriology				U2	U2	U2				U2		
6 pharmacology				U2			R2			R2		R2
7 anaesthesia				U2			R2			U2		
8 wound healing				U3				U3	U2			U3
9 barriers to expres-sion of pain	U2	U2	U2		U2	U2		U3	U2			U3
10 pre and post operative care			U2	U3	U2	U2		U3	U3	U3	U3	U3
11 alternative methods	U3	U3	U3		U2 U3	U2 U3						

Figure 4 Knowledge of acute pain used by surgical nurses

Accessing knowledge
R Appreciating the relevance
U Understanding and interpreting

Using knowledge
1 Simple application
2 Situational adaptation
3 Problem solving

Only with this third category was scientific knowledge explicitly used during the relevant episode of practice. In categories (1) and (2) any scientific knowledge used was embedded in already familiar understandings and actions. Since category (2) depends on the knowledge user having sufficient prior experience of similar situations, those lacking such experience have either to consult more experienced colleagues or engage in a slower, problem-solving approach that makes more explicit use of scientific knowledge. Resorting to consultation is quicker, but usually leads to new practices being acquired without any theoretical justification.

Parboteeah (2001) found that the use of knowledge maps is best taught to student nurses in practice settings, and in "real time" as and when relevant events occur. But, after an initiation period of 'on the spot' tutoring, students become able to use knowledge maps on their own with consultative access to 'experts' and even to create new maps as part of a group project. Newly qualified practitioners will need a similar induction, before they can begin to use knowledge maps as a guide to the kinds of knowledge that need to be fed into their decision-making processes, for the identification of their learning needs and for the debriefing of experts who find it hard to explain their apparently intuitive decisions. We have found them to be especially useful in initiating discussions about knowledge use and the more hidden aspects of practice during Continuing Professional Development.

The final stage in transfer involves combining the various relevant aspects of knowledge and skill into an *integrated, holistic, performance*. It will probably interact with those aspects of the previous stage that are relatively new; and will cease to be distinguishable as a separate stage when sufficient practice has created a rapid response. In practice reviews, prior attention should be given to the selection of the most relevant aspects of knowledge (see Figure 3), before using knowledge maps as aids to probe more deeply.

Conclusions

First degrees are no longer considered as qualifications for a lifetime, but nor are they regarded as preparation for only one or two years of work. The knowledge resources that graduates take with them into the workplace have to last longer than that; so they must relate to a reasonable range of jobs, roles and workplaces. However, most of these knowledge resources will not become useful until they have been further transferred and resituated in one or more working contexts. Hence knowledge perceived as irrelevant in the workplace may not necessarily be irrelevant; those who possess it may not yet know how to use it in a new context. With these considerations in mind, the selection of content and modes of learning for programmes intended to provide knowledge resources for a particular occupation should be conducted with great care and the reasons for the selection should be public and subject to review.

Learning in Education settings cannot be substituted for learning in workplace settings. Practice components of professional programmes have to be authentic. However, learning to practice and learning to use knowledge acquired in Education settings do not happen automatically. The conclusions we can draw from the above discussion are that:

1 learning to use theory in practical situations is a major learning challenge in its own right – it is *not* a natural consequence of learning theory on its own and practice independently of any critical theoretical questioning of its appropriate-ness and effectiveness.
2 Such learning requires both time and support. Learning programmes rarely allocate any time to this form of learning, but just assume (wrongly) that it will occur spontaneously.
3 Not only has little thought been given to the kind of support needed for this kind of learning, but there is rarely any clarity about who is responsible for providing it.

The solution to these problems is first to develop more integrated programmes, in which theory and practice components are continually linked and not separated by time, space and culture; and second to commit significant time and resources to the critical process of knowledge transfer both during and after graduation. This is most likely to succeed if staff are employed in practice settings with a practice development role that incorporates responsibility for both students and new staff, and the facilitation of continuing professional development.

References

Argyris, C. & Schon, D.A. (1974). *Theory in practice: Increasing professional effectiveness.* San Francisco: Jossey Bass.

Becher, T. (1989). *Academic tribes and territories.* Buckingham: Open University Press.

Eraut, M. (1999). *Theoretical and methodological perspectives on researching workplace learning.* Paper presented at the Annual Meeting of the American Educational Research Association. Montreal, April 1999.

Eraut, M. (2000). Non-formal learning and tacit knowledge in professional work. *British Journal of Educational Psychology, 70,* 113-136.

Eraut, M., Alderton, J., Boylan, A., & Wraight, A. (1995). *Learning to use scientific knowledge in education and practice settings.* London: English National Board for Nursing, Midwifery and Health Visiting.

Eraut, M., Alderton, J., Boylan, A., & Wraight, A. (1996). *Mediating scientific knowledge into health care practice: Evidence from pre-registration programmes in nursing and midwifery education.* Paper presented at the Annual Meeting of the American Educational Research Association. New York City, April 1996.

Eraut, M., Alderton, J., Cole, G., & Senker, P. (1998). *Development of knowledge and skills in employment.* Research Report 5, University of Sussex Institute of Education.

Eraut, M., Alderton, J., Cole, G., & Senker, P. (2000). Development of knowledge and skills at work. In: F. Coffield (Ed.), *Differing visions of a learning society, Vol.1,* (pp 231-262). Bristol: The Policy Press.

Fessey, C. (2000). Capturing expertise in the development of practice: Methodology and approaches. *Learning in Health and Social Care, 1(1),* 47-58.

Goodson, I. (1983). *School Subjects and Curriculum Change.* Beckenham: Croom Helm.

Gruber, H., Law, L-C., Mandl, H., & Renkl, A. (1996). Situated learning and transfer. In: P. Reimann & H. Spada (Eds.), *Learning in humans and machines: Towards an interdisciplinary learning science.* Oxford: Pergamon.

Klein, G.A. (1989). Recognition-primed decisions. In: W.B. Rouse (Ed.), *Advances in man-machine systems research* (pp 47-92). Greenwich CT, JAI Press.

Lave, J. & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation.* Cambridge: Cambridge University Press.

Parboteeah, S. (2001). *The Effect of Using Knowledge Maps as a Mediating Artefact in Pre-registration Nurse Education.* PhD Thesis, University of Sussex. Brighton.