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ABSTRACT

This paper summarizes ongoing theoretical work and the findings of a recent research project in nursing and midwifery education to understand the problems encountered with using scientific knowledge in actual health care practice and to address these problems with educational program redesign. Case studies and mini-studies are used to investigate the ways in which theoretical knowledge is taught and linked to professional practice in a variety of curriculum slots in education settings and the ways in which the use of theory is introduced in service settings. Some methodologies were found to be more successful than others. The main reasons for problems in practice include little mediation of theory in service settings, lack of clarity about the facilitation and location of use of certain learning objectives, insufficient provision for mediation in the curriculum plan, and inappropriate teaching. But even good teaching over a sequence of sessions cannot ensure appropriate use of theory in practice if crucial links in the mediation chain are missing. Problems were found to be the greatest in the biological sciences, where both understanding the context and appreciating its relevance cause considerable difficulty. This difficulty is believed to be a failure to sufficiently articulate the curriculum demands of teaching for theory use in addition to theory comprehension. It is highly recommended that every pre-registration program have an overall plan for coordinating the theory with the practice. (Contains 23 references.) (NAV)

Mediating Scientific Knowledge into Health Care Practice: Evidence from Pre-Registration Programmes in Nursing and Midwifery Education, and Recommendations for Future Curriculum Design.

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INTRODUCTION

The relationship between theory and practice has long been recognised as a central problem in professional education, especially during the phase of initial preparation for practice. Yet in spite of strong empirical evidence of its significance for the quality of professional education it remains weakly conceptualised. This paper brings together ongoing theoretical work (Eraut 1994) and the findings of a recent research project in nursing and midwifery education (Eraut et al 1995) to reach a deeper understanding of the problem and to suggest how we might more effectively address it in the design of educational programmes.

Our analysis of the usage of the frequently used phase **theory-practice gap** revealed no less than six meanings, all of which have some relevance for programme design:

(i) There are differences between the kind of practice advocated in education settings and that observed in service settings. This is more appropriately described as a gap between "idealised practice" and practice considered acceptable in most service settings; it can be accounted for by practitioners' unwillingness or unpreparedness to attempt "ideal" practice or by the impracticability of the "ideal" in service settings. Assertions of impracticability can themselves be interpreted as genuine or as defence mechanisms.

(ii) The variety of practice settings makes it necessary for teachers to describe practice in generic terms, giving sets of practical principles rather than detailed blueprints for specific situations. Applying general principles in practice is rarely straightforward because an interpretation is usually needed of what they imply for any particular situation; there may be conflicts with other principles; or practical constraints imposed by the setting or students' limited practical skills. This kind of theory-practice gap is central to students' daily practice. The relevance of the principles may not be disputed, but learning to implement them can be difficult, and students may receive insufficient practical support.

(iii) "Theory" may refer not to practical principles used to describe practice in a more generic way, but to that body of knowledge specifically referred to as **nursing theory** which is considerably more abstract. Student nurses' practical experience begins with being told what to do, and they acquire credibility through doing what they see others do. Working it out for themselves is an attractive pursuit for those with the time and inclination, but they will not be able to do it for real until they have acquired some experience and seniority; so theory is regarded as knowledge they cannot use, not necessarily irrelevant to practice, but irrelevant to current practice. Theory can be used to evaluate current practice, but that is best done in the safety of an essay rather than risk upsetting qualified staff in their placements.

(iv) 'Theory' can also refer primarily to knowledge derived from the scientific disciplines, especially to textbook representations of that knowledge. Sceptical practitioners tend to define as "theory" any knowledge they regard as irrelevant, and to regard knowledge they use as part of "common practice". Thus the theory-practice gap is a direct consequence of the defined irrelevance of theory. The remedy is to cut out most of the theory.

(v) A constructivist view of theory may describe the gap in terms of public theory and private theory, arguing is that we all use theories to organise our experience. Such theories may vary from near replicas of published theories, through personalised versions of these to theories derived only from personal experience. Private theories my be implicit in our thoughts and actions without being readily retrievable for critical evaluation. These ways of construing and thinking about the world have been called "schemes of experience" (Schutz, 1967), personal constructs (Kelly, 1955) and "schemas" by cognitive psychologists. Terms such as "lay theories" or "health beliefs" are commonly used by health care researchers. To claim there is a theory-practice gap, therefore, is implicitly to state that the theories being advocated are not **our own** theories, those embedded in our own practice.

(vi) Another form of "theory-theory" gap has been noted by Argyris and Schön (1974) who distinguish between people's espoused theories, those they claim to use, and their theories in use – those embedded in their practice of which they may not always be fully aware. It is not unusual for

theories taught in professional education to provide espoused theories which match professions' ideals and provide convincing justifications of their work but rarely get used in practice. This develops a kind of bilingualism in which aspiring professionals learn one kind of discourse for discussing and justifying their practice using ideal principles, while using a different discourse in practice itself (Melia 1987).

The brief for the research project was to evaluate **the contribution of the biological, behavioural and social sciences to pre-registration nursing and midwifery education programmes**. However, our proposal to the English National Board for Nursing, Midwifery, and Health Visiting, who prepared the brief and sponsored the research, argued that any evaluation of the contribution of scientific knowledge must consider not only **what knowledge** is or should be taught but also **how it is taught** and the extent to which students **learn to use it** in their professional practice. Although our brief was primarily concerned with the fourth of the meanings listed above, our evidence indicated that at the level of instructional design and student experience, this knowledge use interpretation of the theory-practice gap could not be separated from the other interpretations.

THEORETICAL BACKGROUND

The term **scientific knowledge** is used in this paper to refer to propositional knowledge in the natural and social sciences which can be found in textbooks and the research literature. Professional work, however, is not often described in terms of the scientific knowledge in use but rather in terms of those processes in which professional workers are engaged, with more reference to **know how** than **know that**. Such processes can be usefully analysed in terms of four types of sub-process, linked in a variety of sequences and combinations.

(i) sub-processes for acquiring situational understanding through collecting and interpreting information about clients and situations;

(ii) sub-processes for deciding how to respond to this current representation of the situation, both immediately and over a longer period;

(iii) sub-processes required for implementing one's own or other people's decisions : routine actions, special techniques, giving advice, referral, delegation, further inquiry etc.

(iv) meta-processes concerned with directing and controlling one's own behaviour and ongoing monitoring of clients and their environment.

These sub-processes can be recognised in the literature on professional practice, where they are most often described in the context of a deliberative process in which professionals assess a situation, think of alternative options and their implications, plan an appropriate course of action then modify their plan in the light of information from ongoing monitoring. This model of practice gives prominence to analytic reasoning and a strong professional knowledge-base. Claims for research-based practice and training in higher education are strongly supported because the greater the use of deliberative decision-making, the more explicit will be the knowledge being used and the greater the motivation to incorporate scientific knowledge into professional work.

The extreme form of their approach is the "ideal type" commonly referred to as **decision analysis**, which assumes that decisions should be based only on formalised decision-making models, logical and probabilistic reasoning, and research evidence. Human judgement, regarded as dangerously subjective and fallible, is limited to sifting the evidence and deciding which model to use. This sifting of evidence is normally done by researchers, whose recommendations for good practice are then disseminated to practitioners: so the role of the practitioner is confined to recognising when a particular case falls within the parameters covered by the model and knowing whether the model is still up-to-date. The main practical difficulty has been the availability of sufficient reliable research evidence: often decision models are only valid within relatively restricted domains. Theoretically, the main criticism has been that it assumes "a fixed set of known alternatives based on stable goals, purposes and values", conditions which are rarely found in practice (Orasanu and Connolly, 1993).

In complete contrast to the decision analysis approach and explicitly opposed to it is the model for developing and characterising expertise proposed by Dreyfus and Dreyfus (1986) and subsequently applied to nursing by Benner (1984). Whereas the decision analysis model is based on published research being used explicitly, the Dreyfus model emphasises the implicit use of tacit knowledge developed and refined by experience. Unlike authors who simply attack decision analysis models, the Dreyfuses offer a clear alternative in the form of a five stage progression from novice to expert (Figure 1), in which the use of a deliberative mode of cognition (not usually very analytic) peaks at the competence stage.

Level 1	**Novice** Rigid Adherence to taught rules or plans Little situational perception No discretionary judgement
Level 2	**Advanced Beginner** Guidelines for action based on attributes or aspects (aspects are global characteristics of situations recognisable only after some prior experience) Situational perception still limited All attributes and aspects are treated separately and given equal importance
Level 3	**Competence** Coping with crowdedness Now sees actions at least partially in terms of longer-term goals Conscious deliberate planning Standardized and routinized procedures
Level 4	**Proficient** See situations holistically rather than in terms of aspects See what is most important in a situation Perceives deviations from the normal pattern Decision-making less laboured Uses maxims for guidance, whose meaning varies according to the situation
Level 5	**Expert** No longer relies on rules, guidelines or maxims Intuitive grasp of situations based on deep tacit understanding Analytic approaches used only in novel situation or when problems occur Vision of what is possible

Figure 1: Summary of Dreyfus Model of Skills Acquisition

Progression beyond competence is then associated with the gradual replacement of deliberation by more intuitive forms of cognition.

> "The proficient nurse learns from experience what typical events to expect in a given situation and how plans need to be modified in response to those events ... the proficient nurse can now recognize when the expected normal picture does not materialize. This holistic understanding improves the proficien nurse's decision making; it becomes less laboured because the nurse now has a perspective on which of the many existing attributes and aspects present are the important ones. Whereas the competent person does not yet have

> enough experience to recognize a situation in terms of an overall picture or in terms of which aspects are most salient, most important, the proficient performer considers fewer options and hones in on an accurate region of the problem."(Benner 1984, pp 28-9)
>
> "The expert performer no longer relies on an analytic principle (rule, guideline, maxim) to connect her or his understanding of the situation to an appropriate action. The expert nurse ... now has an intuitive grasp of each situation and zeroes in on the accurate region of the problem." (Benner 1984, pp 31-2)

Both Benner and the Dreyfuses cite evidence to support the widespread use of rapid intuitive decision-making by experts, but do not establish their claim that deliberation has become virtually redundant. Benner recognises two situations where analytic approaches might be required: when an expert is confronted with a situation of which she has no previous experience or when the expert gets a wrong grasp of a situation then finds that events and behaviours are not occurring as expected. Dreyfus and Dreyfus suggest yet a third possibility, that "detached deliberation about the validity of decisions will improve decision-making". (p 164) Roughly translated, their advice is that if an intuitively derived decision proposal does not feel right or has an equally compelling alternative, think it through and check it out. Schon (1983) would describe this as deliberation triggered by reflection-in-action. This analysis, however, underestimates the self-evaluative dimension of professional work (neglected though it sometimes may be) and the degree to which experts still consult or work in teams. There is a dangerous tendency for an almost wholly intuitive model of professional expertise to perpetuate the myth of an almost infallible expert.

More problematic, perhaps, is the question of what happens to professionals who do not become experts. Benner noted that competence is typically acquired after two or three years on the job in a same or similar situation and proficiency after another three to five years, which means the newly qualified nurse or midwife will need to work in the deliberative mode for a significant period. Changes of work context may lengthen the time taken to reach competence and proficiency, perhaps even prevent it. Meanwhile, intuitive patterns of decision-making may be developed which are considerably less effective than those used by experts.

Orasanu and Connelly's (1993) summary of empirical evidence from research into naturalistic decision-making highlights the following findings:

"1. In contrast to procedures prescribed by normative models, experts on field decision situations tend not to generate and evaluate several courses of action concurrently to determine the best choice. Rather, based on their classification of the problem, they generate a single highly likely option and evaluate its appropriateness to the current conditions (Klein 1993, Lipshitz 1993) ....

2. The major factor that distinguishes experienced from less experienced decision makers is their situation assessment ability, not their reasoning processes per se (Chi et al, 1988, Klein, 1993). Experts in a field can look at a situation and quickly interpret it using their highly organized base of relevant knowledge. The identification of situation type carries with it retrieval of one or more action alternatives that constitute appropriate responses.

3. Because of situational and organizational constraints, decision makers usually use a "satisficing" (Simon, 1955) rather than an optimizing strategy (Hickson et al, 1986). That is, they select a good enough, though not necessarily the best choice ....

4. Reasoning is "schema-driven" rather than driven by a computational algorithm. Even for problems with many novel elements, decision makers use their knowledge to organize the problem, to interpret the situation, and to define what information is valuable for solution (Larkin et al, 1980, Noble, 1993). Some information may be selected or distorted to fit the existing schema, a potential source of error. But it also enables speedy assessment, search, selection, and interpretation of relevant information, a definite advantage when faced with information overload and time pressure. A critical feature of the schema-driven approach is that people create causal models of the situation.

5. Finally, reasoning and acting are interleaved, rather than segregated (Weick, 1983). Instead of analyzing all facets of a situation, making a decision, and then acting, it appears that in complex realistic situations people think a little, act a little, and then evaluate the outcomes and think and act some more (cf. Connolly & Wagner, 1988)" .... (pp 18-19)

These not only support the view that decision analysis is only occasionally feasible but also cast doubt on the appropriateness of normative approaches advocating the systematic exploration of alternatives. However, neither do they support the low priority accorded by the Dreyfus model to deliberation and reasoning. Rather they suggest that schemes for situational assessment and problem-solving developed by experience are often used intuitively to create a decision-making frame within which reasoning and the explicit search for evidence are pursued. Personal patterns of decision-making short-circuit cumbersome and often ill-fitting formal models. Though the Dreyfus model may help to explain how such personal patterns are developed, it neglects the role of reasoning and explicit selection and evaluation of evidence in improving the quality of decisions.

Eraut (1994) has argued that two key contextual variables affect the mode of cognition : the time available and the crowdedness of the situation, i.e. the number

of clients, activities, pieces of information, etc. competing for the practitioner's attention. Figure 2 depicts the effect of time on the four types of sub-process identified earlier, two of them, action and reflection (a meta-process) being combined. The relationship between time and mode of cognition is probably interactive : shortage of time forces people to adopt a more intuitive approach, while the intuitive routines developed by experience enable people to do things more quickly. Crowded contexts also force people to be more selective with their attention and to process their incoming information more rapidly. Under conditions of rapid interpretation and decision-making, reflectiveness is necessarily intuitive, in accordance with what Eraut (1995) has called the more useful interpretation of Schon's concept of reflection-in-action. But as the timescale expands, the role of meta-processes becomes more complex, expanding beyond self-awareness and monitoring to include the framing of problems, thinking about the deliberative process itself and how it is being handled, searching for relevant knowledge, introducing value considerations, etc.

Process	Speed		
Interpretation of Situation	Instant ---------- Recognition	Rapid ----------> Interpretation	Deliberative Analysis
Mode of Decision Making	Instant ---------- Response	Rapid ----------> Decisions	Deliberative Decisions
Reflectiveness of Action	Routinised -------- Unreflective Action	Action ----------> Monitored by Reflection	Action following a period of Deliberation

Figure 2: The Effect of Speed on the Nature of Professional Work

The quality of professional work depends on finding the right balance between modes of cognition. Dreyfus and Dreyfus' argument that progression from competent to proficient to expert involves reducing the amount of deliberation required has been confirmed by research on expertise in several occupations. But other factors are working in the same direction. In professions like teaching learning to cope at an early stage is paramount and the early development of routines essential. Hence deliberation is associated with beginner status and devalued by peer group norms. The need for psychological security in crowded, demanding situations leads to professionals reducing the proportion of the work that is treated as problematic. There is pressure to adjust the interpretation of situations to existing schemata until there is little uncertainty left to deliberate about. Lack of deliberation may signify entrenchment rather than expertise. Hence there are good reasons for examining when deliberation is most needed and for debating the circumstances under which lack of deliberation is likely to lead to sub-optimal practice. The following arguments suggest why deliberation must always remain a central feature of professional work.

1) A significant number of cases fall sufficiently outside a practitioners' normal experience to make rapid decision-making unreliable. These cases need to be recognised and appropriate responses worked out deliberatively, though without unduly delaying any required action.

2) Strategic thinking about the organisation of professional work, possible long-term problems for a client, how to get services for a client, etc, also require deliberation time.

3) Teamwork and consultation cannot be practised without time for deliberation; and may significantly contribute to problematic cases and strategic thinking.

4) Consultations with clients cannot be properly conducted without moving into a deliberative mode on at least some occasions, or the client viewpoint will be stifled and client understanding of advice limited.

5) Routinized behaviour and rapid decision-making, though necessary for coping with the pressure of professional work, can also lead to mistakes. Professionals succumb to many common weaknesses which psychologists have shown to be regular features of human judgement; and some may allow aspects of their expertise to become a little less relevant or even dated.

Professionals need to retain critical control over the intuitive parts of their expertise by regular reflection, self–evaluation and a disposition to learn from colleagues.

6) Dewey, Kolb and others have argued that in order to learn from experience consciously and critically, deliberative reflection is needed which compares and contrasts that experience with previous assumptions.

The amount of deliberation time required will depend on how it is used and varys from context to context. It is unlikely to be sufficient, however, unless professionals understand the contribution of deliberation to professional practice and actively seek to make time for it.

One major threat to quality of practice is that routines decay over time, either because circumstances change or because new improved practices are introduced or because practitioners begin to take shortcuts without being aware that their saving of effort is accompanied by diminished safety or reduced effectiveness. Yet routines are much more difficult to change than advocates or managers of change are prepared to admit. The replacement or modification of routines involves deskilling and disorientation, everything becomes problematic, and the experienced professional is returned to the state of a non-coping novice without the excuse of being a beginner. It takes time and great deal of psychological and practical support to rebuild new routines to replace those which were abandoned.

Student professionals are likely to encounter not just the expert practitioners whose artistry is celebrated by Benner and Schon but models of practice where once effective routines have become outmoded or debased and situational assessments ignore significant aspects of clients' needs. Moreover, when they do encounter good practice, the high proportion of underpinning tacit knowledge may make it difficult for practitioners to explain and students to understand.

THE USE OF SCIENTIFIC KNOWLEDGE IN HEALTH CARE PRACTICE

Returning to the research project, we can see that how scientific knowledge is used in health care practice will depend upon the mode of cognition. We may expect wholly explicit use of scientific knowledge when practitioners are using an analytic mode and partially explicit use of scientific knowledge in the deliberative mode. but only implicit knowledge use in an intuitive mode. During routinized action or intuitive decision-making, scientific knowledge may be either embedded in practice or not used at all. Four rather 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 scientific knowledge, 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 scientific knowledge, but could not withstand any challenge because there had been no critical evaluation of the practice since it was first adopted.

4) The practice can not only be justified but remains under the professional's critical control because it has been periodically re-evaluated.

Two problems are likely when the use of scientific 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 scientific discipline but is regarded as incorrect or alarmingly incomplete.

Becoming a professional is commonly regarded as making a moral commitment to serving one's clients' interests and developing one's knowledge base in order to continue to do so. Even when decisions and actions are rapid and intuitive, professionals need to maintain critical control of their actions. This involves

understanding the contribution of scientific knowledge to practice and being prepared for new knowledge which might improve service to clients.

Constructing a curriculum to prepare competent practitioners requires that we know both what scientific knowledge they need and how it will be used. This part of our research was focussed on 3 areas of professional practice (Midwifery, General Adult Surgical Wards, Mental Health Nursing) and six areas of scientific knowledge (Fluids and Electrolytes, Nutrition, Acute Pain, Shock, Stress and Self-Esteem). Our respondents were 8-10 experienced practitioners in each area of practice, recommended for the quality of their work and with experience of mentoring students. The methodology developed for eliciting and representing information about the use of scientific knowledge in the six focus topics involved:

(1) Long $1\frac{1}{2}$ to 2 hour interviews based mainly on respondents' interactions with current clients for whom knowledge in one or more focus topics was deemed to be significant. They were also asked to provide examples of areas where they had found that new staff or students needed help in applying their knowledge.

(2) representation of the information gained from these interviews in knowledge maps, specific to each topic and each area of practice

(3) repeat interviews with the respondents in which draft knowledge maps were discussed, additions and amendments accepted, and validation sought for the final version.

After trying several alternative forms of representation, a matrix format was adopted for the knowledge maps. Rows were used to depict the major themes or sub-areas of knowledge within the topic (such as one might find listed in a curriculum document) and columns to depict the practical processes and activities which professional midwives and nurses were expected to perform (these constitute an analysis of practice in that particular clinical area). Each entry in the matrix showed that a particular kind of knowledge was used by experienced practitioners when performing a particular process or activity. Surprisingly, the headings of the rows and column were not particularly controversial and found to be at an acceptable level of aggregation.

However, the research was concerned not only with **what knowledge** was used **when**, but also with **how** that knowledge was used. This was a new concept for

most respondents. Nevertheless their detailed accounts of work with clients, amplified by appropriate probing questions, provided sufficient evidence about modes of use to develop a coding system to fit the data (see Figure 3 below).

	Demands of the Process in Some Situations		
Mode of Use of Scientific Knowledge	Simple Application	Situational Adaptation	Problem Solving
Appreciating the Relevance	R1	R2	R3
Understanding and Interpreting the Knowledge	-	U2	U3

Figure 3: The Coding System for Mode of Knowledge Use

Essentially the code indicates whether the knowledge has to be **interpreted** to suit the situation (U) or just recognised as relevant (R); and whether the use of that knowledge is straightforward (**simple application**), requires a choice between known options depending on how the situation is assessed (**situational adaptation**) or requires **problem solving** to determine what to do next. Figures 4 and 5 (at back of paper) show two completed knowledge maps, in which entries in the matrix take the form of codes indicating the kind of knowledge use.

An example of R1 might be recognizing the need to wear sterile gloves when doing dressings, an immediate response which could be understood with only a rudimentary knowledge of microbiology. However, if there was any doubt about the sterility of the gloves, a little more knowledge would be needed. Recognizing such a situation and taking appropriate action would be a R2 episode, or even a R3 episode if no familiar course of action was readily available. The R Code remains because although the situation may require considerable interpretation, the basic biological knowledge does not require much thought. Examples of U2 and U3 episodes are given in Panels A and B below.

Panel A

The context for this box is the midwife's aim of making pregnancy, birth and the post-natal period a positive experience. Stress detracts from that aim and can have significant negative consequences for the health of the mother and baby, so the midwife needs to be aware of common sources of stress when making a risk assessment. The process of risk assessment, however, demands more than awareness of these sources of stress; the midwife must assess their effect on the woman's current behaviour and estimate their possible future significance. The discussion of issues and possible risks is part of the assessment process, and it would be difficult to assess the impact of sources of stress without understanding the client's views. Moreover, the ethics and practicalities of the situation require that no action be taken without the woman initiating it or consenting to it. The process often involves problem-solving (hence the U3 coding) because there may be several interrelated sources of stress and a considered judgement has to be made about the overall risk to the health of the woman and her baby which takes into account the unique circumstances of each case.

Panel B

Because the work is carried out by a doctor, Box 4B in General Surgery, **the use of biochemical knowledge when assessing biochemical results**, was coded **R1**. However Box 4T, **the use of biochemical knowledge when checking laboratory slips**, was coded **U3** because:

> "The nursing staff actually see biochemistry results that come back. We work out which ones should be put aside for the doctors. We work out which ones need to be looked at immediately as opposed to the next day."

The need to decide whether immediate action is needed gives it the U3 coding; while dealing with regularly occurring variations merits a U2 once a modicum of experience has been completed. While the example below mentions 'individual cases' it essentially refers to distinguishing between a well recognised set of variations:

> "I think everybody's blood pressure is different and you have to take each individual case. I think if somebody's blood pressure might be 90 systolic and they might have a brilliant urine output on that; and somebody else who normally has a systolic of 160 – their urine output may be low on that, so I think you need the whole picture really." [Box 8D, coded U2]

Panel B: Some Codings for Fluids and Electrolytes (see Figure 7)

Codes 1, 2 and 3 imply decisions which are very fast, quite rapid and slow, thus linking modes of knowledge use derived empirically with the theoretical framework presented in Figure 2 above. There is also close comparability with work on what is now being called Dynamic Environment Supervision (DES). Rasmussen's work (1993) on electronic trouble-shooting led to a three level model of decision-making in which he distinguished between very fast skill-based behaviour, rapid rule-based behaviour and slower knowledge-based behaviour. This has now been further transformed by Hoc, Amalberti and Boreham (1995) to give greater emphasis to the time dimension and the role of situational representation (Figure 6). Their characterization of the important middle level of processing is that explicit search of the environment (not automatic recognition) leads to a representation of the situation which sufficiently matches one of the representations stored in memory.

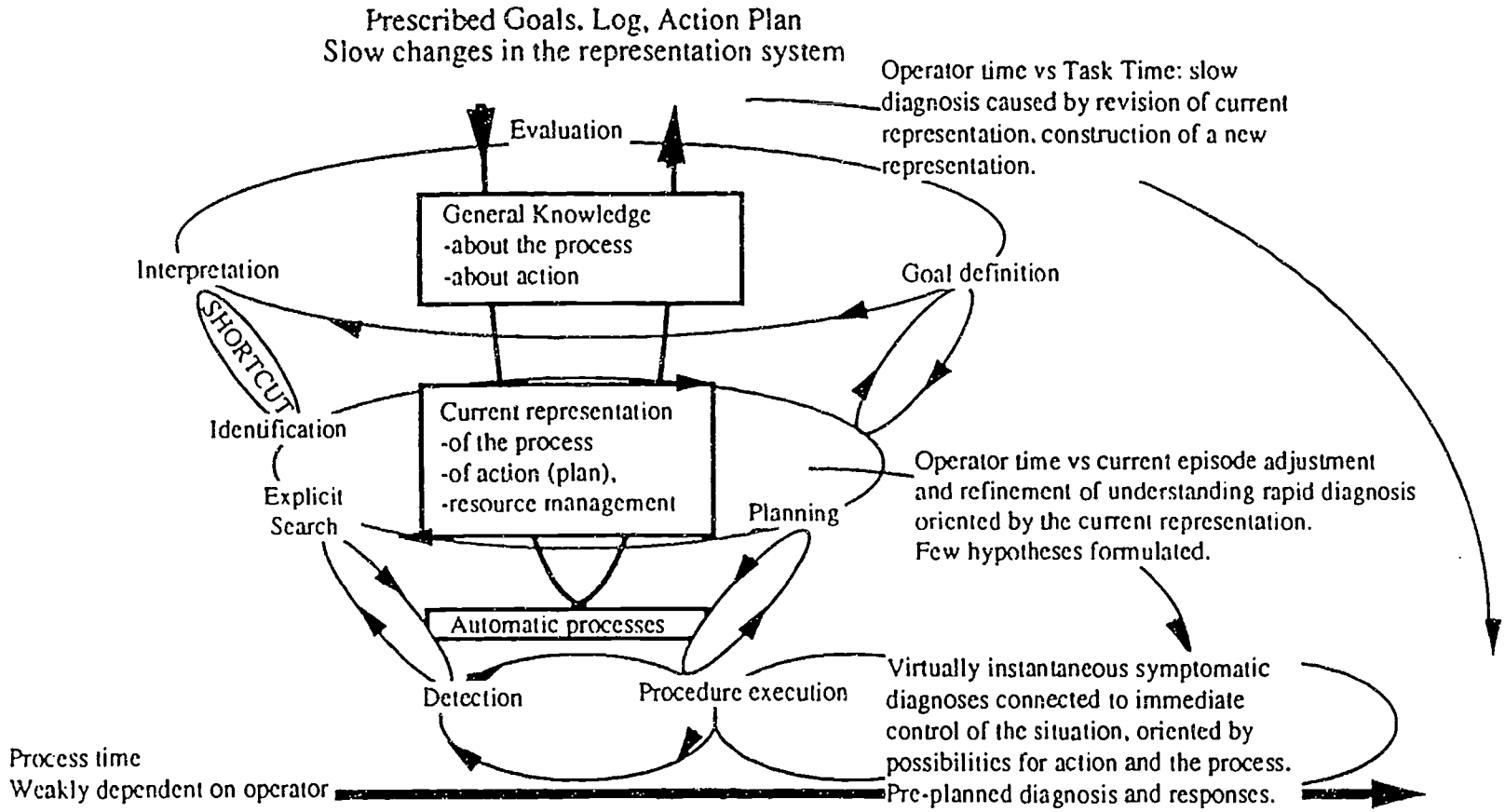

FIGURE 6: Extended model of Diagnosis and Decision-Making (after Hoc & Amalberti, in press)

Activity is organized and coordinated by a symbolic representation system of the current situation. Rasmussen's ladder has been incorporated (but reversed to symbolize the rising cost in resources when there is a need to revise the representation). The conception of a one-level diagnosis has been abandoned and replaced by several (possibly parallel) diagnosis loops characterized by different purposes and time perspectives as regards process evolution.

Then following the process Klein (1993) calls Recognition-Primed Decision-Making, a plan of action is rapidly called to mind and, if necessary, rapidly implemented.

Theoretical knowledge may underpin the assessment and u .derstanding of the situation, the implicit decision rule or the efficacy of the consequent action. It may even be recalled or used to label a situational representation, but it will not be significantly reinterpreted during the decision-making itself. During training, however, such knowledge needs to be made explicit because novices lacking the necessary experience will be operating in a problem-solving mode until they have developed a rapidly accessible repertoire of commonly used representations. Indeed the process of first engaging at the problem-solving level then progressing to situational adaptation is a central aspect of learning to use theory in practice. Paradoxically it also involves moving from explicit to implicit use of theory. This learning can only take place in practice settings or in close temporal proximity to practical experience.

What then is the status of the knowledge maps developed by the project such as in Figures 4 and 5. Their validity would be strengthened by using larger samples of respondents, but there is also some variation across clinical contexts to be considered. More important, perhaps, is that the maps should not be seen as descriptions of practice, they are aids to the description of practice. Examining each individual box in the matrix will show that some of them have Pandora-like qualities, as areas of uncertainty and controversy are revealed. Moreover practical decision-making will often involve using several boxes in combination. Suggestions for use have included clinical audit, a starting point for research into practice, and the design of post-registration education programmes. Finally one should note that detailed work on knowledge use within a single topic area needs to be complemented by a more holistic approach in which aspects of different topics are together for optimal decision-making. This could be achieved by case discussions in which practitioners were asked to judge which processes and knowledge areas should be prioritised in emergency, short-term and long-term decisions.

THE MEDIATION OF SCIENTIFIC KNOWLEDGE IN PRE-REGISTRATION PROGRAMMES

The second more substantial part of the research project used case study methods to study the mediation of scientific knowledge. This work proceeded concurrently with the development of the knowledge maps and involved three major case studies and four mini-studies. The main case studies were:

Case Study 1: An integrated midwifery programme with no shared learning and very close links with practice settings. It also has links with higher education but is located on a hospital site.

Case Study 2: A university-based midwifery programme with some shared learning with P2000 nursing students and links with three more distant practice areas.

Case Study 3: A large university-based Dip HE nursing programme with teaching on both university and hospital sites. CFP, Adult Branch and Mental Health Branch were studied.

Their main purpose was to investigate the ways in which theoretical knowledge was taught and linked to professional practice in a variety of curriculum slots in education settings, and ways in which the use of theory was introduced in service settings. Interviews with students and staff covered their experience of the programme as a whole, while a substantial programme of observation sought to cover a high proportion of those occasions where scientific knowledge from the six topics was mentioned or discussed. Course documents were examined in detail, and examinations and other assignments covering the six topics closely scrutinized. The methods used are summarised in Table 1 below. However, as the case studies involved observation and interviewing over several months, a great deal of information was gathered informally and most of the evidence collected was cross-checked with other sources.

Source of Evidence	Case Study 1	Case Study 2	Case Study 3
Observations of Teaching	36 hrs	20 hrs	71 hrs
Observation of Students' Clinical Practice	20 hrs	–	16 hrs
Students Interviewed	20	27	28
Teachers Interviewed	10	5	18
Mentors Interviewed	6	–	2
Scenario Exercise with Students	2	1	-
Course Documents	✔	✔	✔
Teaching Materials	✔	✔	✔
Student Essays	✔	–	–
Examination Papers	✔	–	✔

Table 1: Research Methods Used in the Case Studies

This was not so true of the four Mini Studies which were much shorter and exclusively focused on the mediation and use of biological knowledge.

Mini Study 1: An innovative Life Science Teaching Programme on a Dip HE nursing programme different from that in Case Study 3.

Mini Study 2: The use of biological knowledge by Dip HE nursing students working on an adult surgical ward.

Mini Study 3: The CFP life sciences programme on a third Dip HE nursing programme.

Mini Study 4: The use of biological knowledge about respiration by recently qualified and more experienced nurses working with breathless patients in hospital settings.

The evidence collected from these studies is summarised in Table 2 below.

Source of Evidence	Mini Study 1	Mini Study 2	Mini Study 3	Mini Study 4
Observation of Teaching	18 hrs	–	–	–
Observation of Students' Clinical Practice	–	18 hrs	–	–
Students Interviewed	–	6	28	–
Teachers Interviewed	6	–	7	–
Practitioners Interviewed	–	–	–	11
Curriculum Documents	✔		✔	
Student Questionnaires			30	

Table 2: Research Methods used in the Mini Studies

This section summarises the findings of the case studies and their implications for the design of pre-registration programmes, but first more information is needed about the context.

The research was conducted towards the end of a period of reform in both nursing and midwifery education. In nursing this change involved

- the amalgamation of relatively small schools of nursing based in district hospitals into larger institutes based in universities

- an overall reduction in the number of nursing students and nurse educators

- the upgrading of the basic nursing qualification to the level of a Diploma of Higher Education (one year short of a British degree)

- the introduction of a Common Foundation Programme (CFP) lasting half the course for all branches of nursing, with a focus on studying normal health rather than ill health.

In midwifery the change was even greater because

- small hospital-based schools of midwifery were merged into departments of midwifery within Institutes of Nursing and Midwifery, in which midwives were outnumbered by nurses

- direct entry into midwifery was expanded in preference to recruiting qualified nurses

- direct entry midwifery programmes also led to a Diploma in Higher Education

- there was pressure for shared teaching with other professions

Only Case Study 1 was similar in its organization (but not in the level of its award) to the pattern pertaining before the reforms. Case Study 1 was a strongly integrated course with annual cohorts of 10-12 students. The team of midwifery tutors exercised control over the use of higher education and service-based staff, only using those who could be relied upon to keep to their brief. We could not evaluate the total content of scientific knowledge in that programme, but our evidence strongly suggests that very little was superfluous; and a much higher proportion of the knowledge introduced was mediated into practical use than in any other programme studied. This may be easier to achieve in midwifery than nursing, because the knowledge-base is more focussed, but the curriculum flexibility and priority given to mediating that knowledge was also greater, and the proximity of education and service settings enabled interactions that were impossible in other settings. While proximity was greater before the reforms and

the academic emphasis weaker, similar levels of organizational flexibility and coordination between education and practice settings would have been possible only in small branches of nursing. Moreover, the very nature of mental health settings precluded the kind of drop-in visits that were possible in hospitals.

Another important contextual dimension is the process of **professional socialization**, which can be viewed sociologically and psychologically. Sociologists' prime concern has been the extent to which professional education and training reproduces the professional community (Atkinson1983). There is always tension between leading professionals, who aspire to raise their profession's status and standards of practice by increasing the use of scientific knowledge, and ordinary practitioners whose defensive responses stem from their wish to do the job they have always known. This was demonstrated by the sceptical attitudes of some practitioners towards new forms of pre-registration programme. For student nurses there was also conflict between the 'normal health' rationale of the CFP, and the reality that most student nurses are training to care for those who are ill.

An interesting feature of Case Study 3 was that students gained confidence in their psychological knowledge to the extent of feeling more capable of handling relationships with clients than some qualified staff, but did not acquire a similar level of confidence in biological knowledge. Mini Study 4 suggests that qualified nurses do not become confident in biological knowledge until they have taken an advanced specialist qualification. Many students rationalized their limited knowledge of biology by claiming that "good" practitioners did not appear to need it. This evidence does not augur well for students' continuing professional development; in settings where the socialization process is likely to reinforce these beliefs.

The psychological dimension of professional socialization is revealed by the changing nature of student priorities. Students' first psychological priority seems to be to gain acceptance as legitimate, and at least partially competent, professionals in service settings. This external validation of their personal career choice is of great psychological importance and can only be conferred by their acceptance as genuine colleagues by qualified practitioners. Such acceptance depends on them being useful rather than inquisitive. The sooner they can be trusted to carry out a range of tasks, the sooner they will be accepted. While leading professional nurses are stressing that nursing care goes far beyond the performance of tasks within the competence range of a health care assistant,

these so-called "low level" competences provide the student's passport to acceptance. The problem is less significant in midwifery though even there students would have preferred to have acquired at least some practical skills before going out on placement.

Students give need for validation of their career choice psychological priority over all other aspects of their education programmes. Scientific knowledge and even discussions about health policy will be subsidiary concerns until they feel accepted by authentic practitioners. While this kind of prioritization can be counteracted by instituting discipline-based examinations which are difficult to pass, this approach does not encourage learning scientific knowledge in order to use it in practice, and may intensify feelings of resentment and inadequacy in a manner that bodes ill for continuing professional development after qualification.

Mediation while teaching scientific knowledge

Although the project rationale put great emphasis on learning to use scientific knowledge, the interpretation of our evidence requires us to consider the less ambitious goal of establishing the relevance of scientific knowledge to professional practice. There was no indication that anything more ambitious was attempted during the CFP. In so far as learning to use scientific knowledge was on the agenda, it was confined to seminar discussions and workshops (see below). The ultimate criterion for achieving the more modest goal of establishing relevance would be evidence that during the latter part of their rostered service students would either recognise the relevance of scientific knowledge during practice or become aware, if asked to reflect but not otherwise prompted, of the scientific knowledge underpinning their decisions and actions. The project was in no position to conduct a blanket investigation of this kind, but it was able to study the kinds of mediations which took place and the later reactions of students to those mediations.

Interviews with students at the end of the CFP and half way through the university-based midwifery course (Case Study 2) made it clear that the socialization process created a perceptual screen which determined students' learning priorities. Content perceived as relevant at the time was welcomed while that perceived as irrelevant was ignored. During the CFP, when the greatest time was given to teaching scientific knowledge, students had relatively little experience of practice on which to base these judgements of relevance.

Unless there was some attempt at mediation and to actively engage students' interest, large areas of content were likely to be either screened out by inattention or quickly forgotten. Analogous processes have been noted in non-professional higher education students (Miller 1987) trying to cope with the information overload found in many university programmes, but this phenomenon takes longer to develop and is more assessment driven than application driven; the screening we observed started at the beginning of the programme.

The screening out process was strongest for intending Mental Health students; and also for student midwives sharing lectures with nursing students; neither group seemed to anticipate that their clients might sometimes be physically ill. Even the content allowed through the perceptual screen was likely to be soon forgotten if it was not encountered in practice settings within a few weeks. Many students reported forgetting knowledge that they did not quickly put into use, and staff described having to repeat content which had been previously taught because little learning had survived the other demands on students' attention. Several students expressed regret when they later began to realize that some of that forgotten knowledge had been relevant after all. Mediation at the awareness-raising level may be sufficient to prevent content from being screened out and to establish its presence in students' notes, but will not prevent it from being forgotten if it is not used. At best it becomes knowledge in store rather than knowledge readily retrievable for practical use. To make a more lasting impact on students mediations must either involve sufficient discussion to establish relevance in a more permanent fashion or rely on early subsequent follow-up in practice settings.

Fieldwork evidence also suggests, however, that in some circumstances broader definitions of relevance will be accepted by students. Psychology teachers were less dependent on students' direct experience of midwifery or nursing, because they were able to link psychological concepts to students' own life experiences; it often required little imagination to extend that relevance to current or future clients. Practical work in biology also enabled students to concentrate on fewer ideas at one time, a privilege rarely accorded in lectures. Direct experience of seeing real objects, such as a heart or a placenta, and manipulating models such as a doll and pelvis, made content more relevant and easier to understand.

Apart from mediation, the amount of material covered in a session was an important influence on student understanding. High density sessions precluded much mediation and forced students to screen out material, when they did not

necessarily know what was important to remember. This problem has been exacerbated by the incorporation of pre-registration programmes into higher education. Either disciplined-based higher education teachers with no professional background teach courses as if they were part of single-subject honours degrees, or nurse lecturers, uncertain about what constitutes diploma level, establish a similar academic level to that expected in other areas of higher education. Curriculum documents do not usually give sufficient guidance so there are wide variations in the level of treatment accorded to scientific knowledge even within the same programme; this confuses students and lowers their confidence. Another problem can arise when higher education modes of structuring content do not lend themselves easily either to regular mediation or to the appropriate sequencing of theory and practice.

Mediation in Clinical Settings

A great deal is expected of student learning in service settings, but there is little evidence that the expectations are met in the majority of contexts. In general the rationales and curriculum frameworks of new programmes are not well understood, and the brief for service-based learning is rarely clear. Even in midwifery, differences were reported between what lecturers think should be taught by mentors and what mentors think should have already been taught by lecturers. This kind of dispute did not occur in mental health, where the principal problem appeared to be the gap between the image of practice transmitted in the school and that experienced in clinical settings. In all three areas observed, the level of learning support provided by most mentors was significantly less than that envisaged by programme developers. Problems arose from insufficient contact between student and mentor, clinical management of students' and mentors' work, and the quality of mentoring itself.

The most incontrovertible evidence concerns the **time** spent by supervisors or mentors in direct observation of students, giving feedback, answering questions, discussing practice or coaching. In some placements contact time was very little; in mental health, students' main concern was the dearth of any opportunity to be observed with a client at all; in hospital settings, practitioners were often "available to answer questions" but in practice too busy to give students special attention. Even when qualified practitioners worked alongside students, this was no guarantee that feedback or advice would be given or any discussion take place.

The "pair of hands" syndrome appears to have been little affected by the introduction of supernumerary status. Students may observe more, but to what purpose and with what understanding? The observer role conflicts with students' psychological need for acceptance and the pedagogic principle of learning by doing. Without mentoring, however, learning by doing can easily become doing without learning, like the learning by copying behaviour developed by students who had done bank nursing in Mini Study 3.

Clinical management arrangements affected the nature of work students were expected to do, as well as opportunities for students to work with mentors or other qualified staff prepared to assume that role. Where problems arise, they can be attributed to the scheduling of placements or to clinical management arrangements within particular placements; in both cases the lack of any shared model of student progression is a primary cause. We have already referred to the need to sequence theory and practice, there is also a need to gradually increase students' skill repertoires and clinical understanding and further develop the quality of their practice. This depends both on having a model of progression and on formative assessment of students' progress; or it is difficult to match a student's work allocation to their learning needs. We were disconcerted to find little differentiation in hospital settings between students at different stages in their programmes, so that some could have their learning opportunities unreasonably constrained while others were stretched beyond their competence. Decisions about what responsibilities to give students were often determined more by circumstance than by judgement.

The quality of mentoring depends first on proper preparation for the mentor role. We observed considerable variation. Some mentors had a very clear sense of what they were trying to achieve; others, although apparently "good" practitioners, were reported as teaching "absolutely nothing" to their students. Poor role modelling was also reported in client assessment, interpersonal skills, care planning and mental health practice. Settings where deliberate attempts were made to create learning opportunities for students were unusual. Observers repeatedly noted even naturally occurring opportunities for teaching being ignored. Referring to scientific knowledge was not seen as part of a mentor's role, even when it was of critical importance for the quality of care.

Observational studies of student nurses in adult hospital settings revealed cases where lack of biological knowledge in particular affected the quality of care. In

some cases this applied to qualified staff as well as students. Hence the use of scientific knowledge is a service problem as well as an education problem.

Mentorship may improve over time, but current arrangements clearly do not provide quality assurance. There are good mentors but how many students work with them? The alternative or, preferably, complementary strategy for supporting learning in clinical settings is the use of link lecturers, where the problem appears to be not quality but quantity. Our observations found that in many contexts appearances by link lecturers were welcome but rare; other duties took priority.

Mediation during discussions and workshops

Our observations suggest that the greatest amount of mediation occurred in discussions and workshops where mediation of scientific knowledge was an important, explicit goal. However, only in Case Study 1 did there appear to be enough of this type of teaching to cover the range of scientific knowledge the programme purported to teach. Moreover, a significant portion of the available discussion time sometimes had to be used to explain scientific content which had previously been taught but not understood.

Another difficulty in nursing programmes noted was that mediation often stopped short of discussing implications for nursing care. Discussions enhanced students' understanding of a medical condition, but did not progress to discussing the appropriate nursing care; the final link with nursing practice was missing. It may have been assumed that this link would be made in service settings, but as we have seen that was not a safe assumption.

Conclusion

The case studies and mini studies reported above enabled us to observe how discipline-based theory was taught in a number of contexts and how that theory was mediated to promote and facilitate its use in practice. A wide range of teaching methods and approaches were observed in education settings, some achieving their purpose more successfully than others. However, even good teaching over a sequence of sessions, cannot ensure appropriate use of theory in practice if crucial links in the mediation chain are missing. The main reasons for the contributions of the biological, behavioural and social sciences not being realised in practice were:

- Little mediation of theory in service settings

- Lack of clarity about whether certain learning objectives were being facilitated in education settings, in service settings or both.

- Insufficient provision for mediation in the curriculum plan; important links might be omitted, too little time might be allocated, the group size and setting for teaching might be inappropriate for this purpose.

- Inappropriate teaching, which did not achieve the envisaged range of purposes: this could indicate either a staff allocation problem or a staff development problem.

Problems are greatest in the biological sciences, where both understanding the context and appreciating its relevance can cause considerable difficulty. It is unfortunate that low priority content is often included at the expense of a more thorough treatment of high priority content. This stems we believe from a failure to sufficiently articulate the curriculum demands of teaching for theory use in addition to theory comprehension. Another difficulty is that, in general, students come into contact with few staff who are skilled in mediating biological knowledge into practice.

We hope our work on knowledge use by experienced practitioners will give a clearer indication of the kind of learning goals needed; hitherto one of the problems facing programme designers has been a shared lack of clarity about precisely what was involved in using scientific knowledge in practice. Most programmes have some way to go to incorporate sufficient mediation to make the desired impact on the development of students' practice. We also need to recognise that helping students to become the kinds of practitioners we need requires more time than is available on a three year pre-registration programme. Our research suggests that less ambitious goals more directly pursued might be a wiser course of action; that would involve giving more attention to continuing professional development after registration.

IMPLICATIONS FOR CURRICULUM DESIGN

One important recommendation from our research project was that every pre-registration programme should have an overall plan for coordinating the different parts of the programme, moving between the development of specialist scientific knowledge and the holistic delivery of care, and linking book-based, propositional knowledge with process knowledge developed on placements. But how can overall plans be used to weave together different parts of the programme? How can sufficient time be allocated not only to note but also to work through the most vital areas of linkage between theory and practice? How can students be expected to combine theoretical knowledge and practical experience into their practice and into their continuing development of that practice? Although more mediation was necessary, we did not believe that just introducing more mediation into existing curricular patterns would effectively deal with these issues. A deeper and more thorough conceptual framework was needed to enable more radical curriculum designs to be conceived, developed and evaluated. Our observations suggested that, even when welcomed by students, mediations did not always have a clear purpose; and when the purpose of individual sessions was clear, the collective purpose of a sequence of sessions was less clear. **Most mediation chains appeared to have missing links.** Hence we decided to develop a model of the mediation process to incorporate all the kinds of mediation observed and suggest other possibilities; its prime purpose was to provide a curriculum overview of mediation and theory-practice relationships.

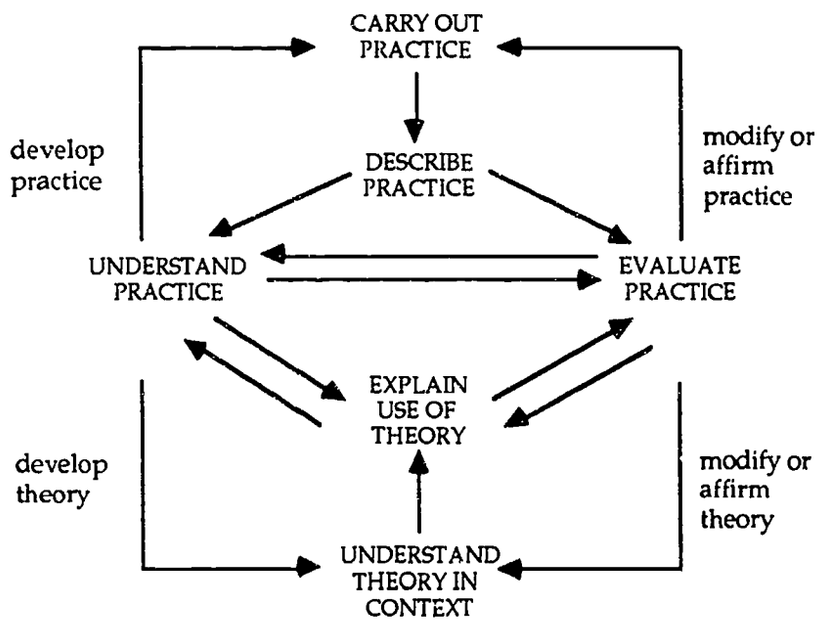

Figure 7: A model of processes linking theory and practice

The term 'theory' in Figure 7 refers to public theories of professional practice and those discipline-based theories and concepts we have described under the generic heading of scientific knowledge. The boundary between **personal** and **public theories** is difficult to delineate, but personal theories normally arise in the context of trying to **understand practice** by theorizing about one's observations and experience; so we regard them as primarily located in that part of the model. When somebody wishes to give public status to their personal theories they are obliged to explain and justify them and set them in the context of published theories – the process depicted by the arrow labelled **develop theory**. Similarly, moves to understand practice through theorizing may lead to attempts to **develop new practice**.

The main assumption underpinning the model is that the learners' primary aim is to carry out 'best' practice, where best implies optimal benefit to clients within the constraints of the service. It is also assumed that, if there is no deterioration in the context, personal practice can continue to improve after registration. Such improvements result from reflection on personal practice, and from incorporating new methods, ideas and understandings into that practice. The processes of understanding and evaluating practice and discussing the use of theory are distinguished primarily by their starting point (theory or practice) and purpose (understanding what is happening or assessing and valuing its effect). More controversial perhaps is our inclusion of **describe practice** as a separate element. There is much debate about the extent to which description is necessary for personal understanding or evaluation of practice, but it is difficult to argue that description can be avoided when these processes are pursued collectively. Students in particular need to describe practice both in discussions with mentors and in education settings, so describing practice is an important link in the mediation chain, without which people resort to exchanging opinions with limited mutual understanding.

Our model goes beyond the diagram in Figure 7 to list processes which may be involved under each of the six main headings. We found this level of detail to be necessary, because an evaluation of the effectiveness of various parts of the programmes we studied revealed that weaknesses lay not in the choice of teaching methods or styles but in a failure to adequately conceptualize the purposes of particular teaching events and their contribution to the whole programme. If people had the right purpose, there was a good chance that an appropriate choice of teaching method would follow. For convenience, the

processes which we see as contributory to the effective implementation of the model are discussed two sections at a time.

Panel C

Carry Out Practice

Interacting with clients; assessing, consulting, informing, responding, monitoring.
Performing the tasks required with appropriate adjustment to client and circumstance.
Responding to contingencies: dealing with the unexpected or things that go wrong.
Overall management of the process: setting priorities, allocating time, deciding when to do what, consulting others if necessary.
Handling the environment: both physical - with its health and safety implications - and interpersonal, made up of colleagues, clients' relations and friends etc.

Describe Practice

Describing what is involved in each of the above
Describing what various people think should happen
Describing what does happen in a range of contexts
Making the tacit explicit
Making practice available for criticism

Panel C: Processes involved in carrying out and describing practice

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People may wish to formulate their own versions of **carry out practice**; ours is adapted from Mansfield and Mathews (1985) Job Competence Model, widely used in the development of occupational standards. A more detailed breakdown can be found in the column headings of our knowledge maps. This part of the model may be given little attention because it is supposed to happen on placements where students are often expected to learn by osmosis rather than instruction: a revealing comment during a discussion of knowledge maps with a group of nurse teachers was 'we teach the rows (the theory) but we don't teach the columns (the practice).'

The scope of **describe practice** has also been defined in broad terms to include variations with context and person and possible idealised or fictional alternatives. Provided that clear distinctions are made between fiction and reality, this allows students to speculate on what practice might be like, an important stimulus to thinking about practice, responding to it emotionally as well as objectively, and expressing personal values in the process. It is also intended to get people to think through ideas for improving practice in detailed practical terms. Description also has an important role in helping to make the tacit more explicit and thus available for critical appraisal (Schon, 1987).

Panel D

Understand Theory in the Professional Context

Ensuring awareness and comprehension
Establishing its relevance
Linking it to other theory
Linking it to particular aspects of practice

Explain Use of Theory

Recognising its relevance to a range of situations
Interpreting its meaning and significance in particular contexts
Using theory in analysing particular cases and situations
Using theory in decision-making
Using theory in evaluating practice

Panel D: Processes involved in understanding theory in context and explaining its use

Panel D gives a more detailed breakdown of the theory end of the model. There is some possible overlap between the two main headings where linkage is concerned; **understanding theory in the professional context** necessarily involves establishing its relevance and linking it to particular aspects of practice; but this level of linkage is more at the level of knowing where it is used, while **explain the use of theory** also involves knowing how it is used. The former may be achieved by lower levels of mediation, what we earlier described as "putting out markers"; the latter requires thorough discussion and relevant experience of practice to be fully effective.

Our research provided strong evidence that even in programmes where placements began relatively early (towards the end of Year 1) frontloading scientific knowledge was a wasteful strategy. Teaching theory before students had experience of professional contexts to which it was relevant led to most of it being screened out. Students psychological priority was to gain some acceptance in authentic clinical settings. Hence we suggested using the first part of a pre-registration programme to develop minimum standards of practical competence, familiarity with clinical settings and some general holistic understanding of clients' experiences and needs. This can be used as a platform from which to address client assessment and the delivery of care at a more advanced level, requiring higher levels of thinking and the use of more scientific knowledge. More specialised treatment of scientific knowledge could start at the beginning of the second year, by which time a holistic approach to care has been established and students have sufficient experience to facilitate understanding of how that

knowledge links to practice and, more specifically, to clients' needs. Thus there is no room in our model for teaching theory out of context.

The two-way arrows in Figure 7 indicate close interaction between **explain use of theory** and the two central headings **understand practice** and **evaluate practice**. This central triangle reflects our research finding that knowledge use involves more than interpreting theory, it also involves assessing and understanding the practical situation. This dual focus is reflected in the coded boxes on the knowledge maps, an area where much more research is needed. Another argument for the heading **understand practice** is that understanding is the natural goal of reflection and a prerequisite for any sensible attempt to change one's practice. While evaluation will sometimes suggest what changes might be desirable, understanding is required in order to bring them about. As suggested in Panel E, understanding involves knowing why practice is like it is.

Panel E

Understand Practice

Institutional factors
Midwives and Nurses traditions
Developing situational understanding
Explaining why things get done in a particular way
Establishing the knowledge base underpinning practice
Developing personal theories of practice

Evaluate Practice

Assessing effect on clients
Impact on other stakeholders
Possible consequences and outcomes
Recognizing value issues
Awareness of alternatives
Awareness of constraints
Midwife's role/Nurse's role
Developing quality awareness and discernment
Using research evidence

Panel E: Processes involved in understanding and evaluating practice

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Practice does not emerge fully developed out of a research laboratory; it is already largely determined by the nature of health and illness, health care organization and the ways in which health professionals are accustomed to working. Practice relies not only on the knowledge and competence of individuals but also on organizations that work. It may be quite difficult sometimes to differentiate practice that genuinely represents the best available, feasible alternative and that

based on well-established routines and coping mechanisms that have ceased to be optimal for clients. Reflective practitioners need to develop a critical understanding of service settings, their historical evolution and current culture in order to appreciate the problems and possibilities of change and the tensions that can arise when changes in practice are proposed. They also need to understand the extent to which observed or alternative forms of practice are supported by research and scientific knowledge.

Many would argue that this kind of understanding is an important prerequisite for evaluation, or at least for any sensible decision-making that might follow evaluation. The general concept of ongoing improvement of practice depends on good evaluation, which in turn depends on understanding current practice and possible alternatives, including the use of relevant scientific knowledge. Evaluation without explicit reference to both values and theory is dangerous; because it means hidden or implicit values and theories are being used which have not been properly identified and subjected to critical analysis.

At one level the purpose of the model is to provide a **conceptual framework** for **analysing curriculum designs**. One can ask about the contributions of the various curriculum slots to the processes listed in Panels C, D and E and even the likelihood of these goals being achieved within a particular curriculum framework. Or one can ask where the various processes described in the model are meant to occur, what priority they are given, and hence whether the design incorporates sufficient and appropriately located mediation. However, a more radical purpose is also embedded in our thinking. The model gives equality of treatment to theory and practice, thus challenging the traditional assumptions of higher education. But it also raises hard, and often still unanswered questions about practice itself, and that challenges the traditional assumptions of the professions.

	ASSESSMENT AND MONITORING				RECOGNITION						RESPONSES		
STRESS MIDWIFERY	Presentation physical psychological A	Self awareness B	Foci of stress antecedents situational C	Normal coping mechanisms D	Normal / abnormal E	Acute / chronic F	Functional / dysfunctional G	Risk assessment H	Seek further information I	Identify need for action J	Seek help from others K	Modify environment L	Promotion of adaptation M
1. Manifest responses to stress													
physiological	U3	R2	R3	R3	U3	U3	U3	U3	U3	U3	U3	U3	U3
psychological	R2	R2	R2	R2	R2	R2	U3	U3	R2	R2	R2	R2	R2
2. Common sources of stress	R2	R2	R2	R2	R2	R2	U3	U3		U3	U3	R2	U3
3. Sources related to illness / hospital	R2	R2	R2	U3	R2		R2	U3		U3	R2	U2	U3
4. Theories and models of stress	R2	R2	R2	R2			R2	R2	R2	R2	R1		
5. Factors affecting an individuals response to stress intrinsic / extrinsic	U3	R2	R2	R2	R2	R1	R1	U2	R2	R2		R2	R2

Figure 4: Stress in midwifery

ACCESSING KNOWLEDGE

R = Appreciating the relevance

U = Understanding and interpreting

USING KNOWLEDGE

1 = Simple application

2 = Situational adaptation

3 = Problem solving

FLUID, ELECTROLYTES AND RENAL FUNCTION - GENERAL (Page 1 of 2)

Assessment and Interpretation

Areas of Knowledge	Constraints. NBM & Surg. A	Biochem. Results B	Cardiac dysrhytm. C	CVS changes: BP,P,CVP D	Current orders E	Urine O/P & other fluid O/P's F	Gen.Activity Levels: mental/physical G	Nausea & Vomiting H	Status peripheral tissues I	Risk factors J
1 Electrolytes and ionization		U2	U3		R2			U2		
2 Interstitial circulation				R2		U2			U2	
3 Water Compartments	R2			R2				U2	U2	
4 Biochemical knowledge		R1								
5 Hydration status	R1	U3		U3		R2		U2	R2	R1
6 Acid/base balance	R2	U3								
7 Fluid and electrolyte need	R1				R2	U2		U2		U3
8 Renal function		R2		U2		U2				
9 Oedema mechanisms				U2		U2	U2		U3	
10 Risk situats. for electrolyte imbalance	R2				R2					R2
11 Features of potassium imbalance		U3	U3				R2			
12 Features of sodium imbalance		U3		U3						
13 Features of acid/base imbalance		U3						U2		R2
14 Features of acute renal failure		U3	R1			R1	R2	R1		
15 Features of fluid overload			R2	U3		R2	R2			U2
16 Outflow obstruction		U3				R2				R3
17 Features of azotaemia		R1						R1		
18 Features of chronic renal failure	U3	U2				R2	R2	R1		
19 Anaemia in renal failure		R2					R2			
20 Nutrition in chronic renal failure		U3								U2
21 Consequences of hypoproteinaemia									U3	U2
22 Catheter management										U2

R Appreciating the Relevance
U Understanding and Interpreting

1 Simple Application
2 Situational Adaptation
3 Problem Solving

Figure 5: Fluids, Electrolytes and Renal Systems (page 1)

FLUIDS, ELECTROLYTES AND RENAL FUNCTION. - GENERAL (Page 2 of 2)

	Assessment and Interpretation				Response							Monitoring	
Areas of Knowledge	History K	Pruritis L	Resp.changes M		Advice/Explain N	IV Fluids O	Catheter P	Referral Q	Anti-emetics R	Rehydrate S		Check lab slips T	Cardio'resp state U
1 Electrolytes and ionisation						U2							
2 Interstitial circulation													
3 Water compartments													
4 Biochemical knowledge			U3							U2		U3	
5 Hydration status						U3							U3
6 Acid/base balance													
7 Fluid and electrolyte need	R2					R2							
8 Renal Function													
9 Oedema mechanisms			U3					R2					
10 Risk situations for electolyte imbalance						R2						R2	
11 Features of potassium imbalance	R2				R1			R2				R2	U2
12 Features of sodium imbalance	R2				R1			R2				R2	U2
13 Features of acid/base imbalance	R2		U3		R1			R2				R2	U3
14 Features of acute renal failure	R2		R2		R2					U3		R2	U2
15 Features of fluid overload			U3										U3
16 Outflow obstruction							R1					R2	
17 Features of azotaemia												R2	U2
18 Features of chronic renal failure		R2			U2				R2			R2	U2
19 Anaemia in renal failure					R2							R2	U2
20 Nutrition in chronic renal failure					U2			R2					
21 Consequences of hypoproteinaemia													
22 Catheter management					R2		U2			R2			

R Appreciating the Relevance
U Understanding and Interpreting

1 Simple Application
2 Situational Adaptation
3 Problem Solving

Figure 1 Fluids Electrolytes and Renal Systems (page 2)

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