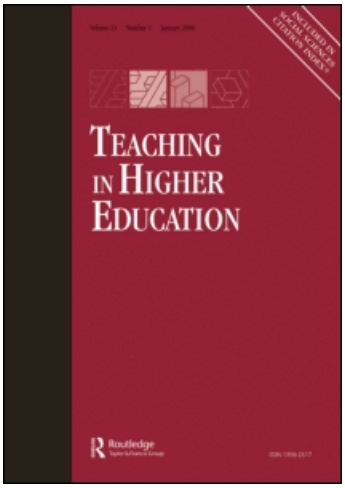

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Visualising expertise: towards an authentic pedagogy for higher education

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The development of expertise is seen as a crucial element in higher education, but the nature of expertise has been clouded by assumptions of the centrality of intuition and tacit knowledge. In this paper the authors contend that much knowledge that has been described as tacit can be surfaced for examination through the application of concept mapping techniques. This approach allows experts to articulate their practice in a way that is transparent, making it available for scrutiny by students. Expertise is described here as connecting the chains of practice that denote competence with the underlying networks of understanding that are required to support academic development. This occurs across the academic disciplines with various degrees of subtlety. It is described in the context of clinical teaching as it is in this context that the separation of chains of practice from underlying networks of understanding is most pronounced.

Keywords: concept mapping; clinical teaching; expert knowledge

Introduction

When appointing new academic staff to a university department, the possession of appropriate expertise is the unspoken assumption lying behind the examination of the candidate's qualifications, CV and interview performance. However, the literature is unclear about the nature of expertise and the attributes that may be justifiably taken as indicators of its existence. Our contention in this paper is that much of the literature on expertise has been based on a number of untested, and possibly unfounded, assumptions that are implicit in much of the literature on expertise. Particularly that:

1. Expertise is a structured phenomenon that may exhibit stability within a timeframe that is sufficient to permit it to be measured, recorded, and compared with exemplars.
2. The structural nature of expert knowledge is universal and will exhibit the same physical attributes irrespective of context.
3. Expertise may be assessed within a community of practice by those presumed to possess a 'goal structure' that may be perceived as the end point of development.

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Our responses to these three assumptions are presented here through the application of a heuristic to aid the visualisation of higher education proposed by Kinchin and Hay (2007), elaborated by Kinchin, Lygo-Baker, and Hay (2008) and supported by observations of teaching in various higher education settings. This has been developed through the use of concept mapping tools that act as *windows into the mind* (Shavelson, Ruiz-Primo, and Wiley 2005), and enable the visualisation of learning at university. This visualisation has enabled us to distinguish between the chains of practice that are manifest in teachers' actions from the underlying networks of understanding. From this the differences between 'expert knowledge', 'competence' and 'expertise' are made available for scrutiny. The relationships between these components can be used to address current inadequacies in university teaching by adopting discipline-specific lexicons and practical examples that may be adopted by academics (e.g., Cabot and Kinchin 2007; Kinchin, Cabot, and Hay 2006), on the way towards the development of a higher education pedagogy that is 'authentic' in that it encourages a scholarly learning cycle, linking approaches to teaching and research (Kinchin, Lygo-Baker, and Hay 2008).

Progression to expert status

There are many models of skills progression. That of Dreyfus and Dreyfus (1986) is well known and has served as a template for subsequent models. Dreyfus and Dreyfus posit that as a practitioner develops a skill, he/she passes through five levels of proficiency. These are novice, advanced beginner, competent, proficient and expert. These changing levels reflect changes in three aspects of skilled performance. The first is a movement from relying on abstract principles to using past concrete experiences as paradigms. The second is a changing view in the practitioners' perception of the situation, which is seen less as a compilation of equally relevant parts and more as a complete whole in which only certain parts are relevant. The third is the passage from 'detached' observer to 'involved performer.' The performer is now engaged in the situation (Manley and Garbett 2000).

The significant attributes of the Dreyfus model are presented in Figure 1. This model, as befits its philosophical underpinning, has an emphasis on learning from experience, but as Eraut (1994) points out, Dreyfus and Dreyfus do not really explain how this actually occurs. There are only occasional references to theoretical learning or the development of fluency on standard tasks. Identifying where a practitioner is on this model is therefore difficult. Eraut argues that the strength of the Dreyfus model lies in the case it makes for tacit knowledge and intuition as critical features of professional expertise. There are significant similarities between Eraut's own model of practitioner progression (presented in Figure 2) and the Dreyfus and Dreyfus concept of professional expertise – and the earlier work of Ryle (1963), who suggested that when people perform an activity they cannot always articulate the theory underlying their actions. The expert no longer relies on rules or guidelines; the rules are in fact forgotten. There is instead an intuitive grasp of situations based on a deep tacit understanding. From Dreyfus and Dreyfus (1986), we hear of the proficient practitioner:

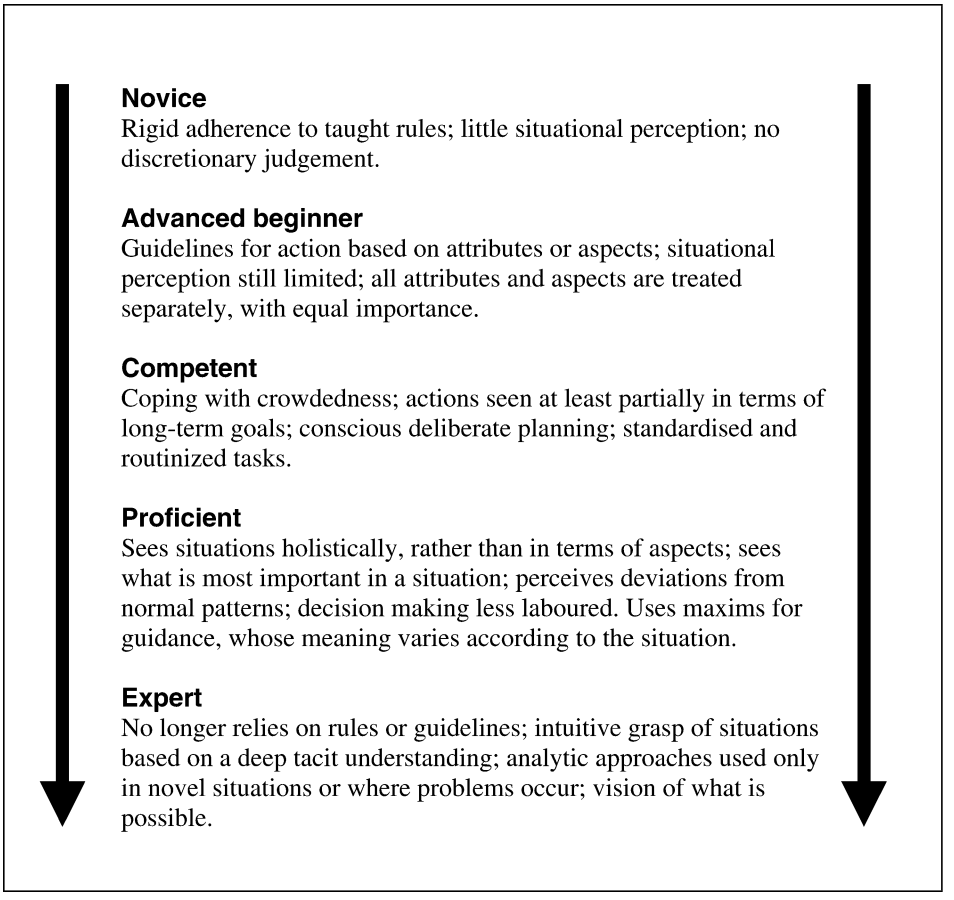

Figure 1. The Dreyfus and Dreyfus model of expertise (indicating the significant attributes of each level) (summary from Eraut 1994, 124).

> Because of the performer's perspective, certain features will stand out as salient and others will recede into the background and be ignored. As events modify the salient features, plans, expectations and even the relative salience of features will gradually change. No detached choice or deliberation occurs. It just happens, apparently because the proficient performer has experienced similar situations in the past and memories of them trigger plans similar to those that worked in the past. (28)

We must note that for the proficient practitioner there is still an analytical approach to decision making. Critically the progression to expert requires that decision-making and indeed an understanding of the particular situation is intuitive. Dreyfus and Dreyfus suggest that this perhaps takes longer to reach than any of the intermediate stages, if indeed it is ever reached at all.

The expert practitioner has reached a completely different level to his/her less expert colleagues. The performance of the expert is largely automatic, and non-reflective:

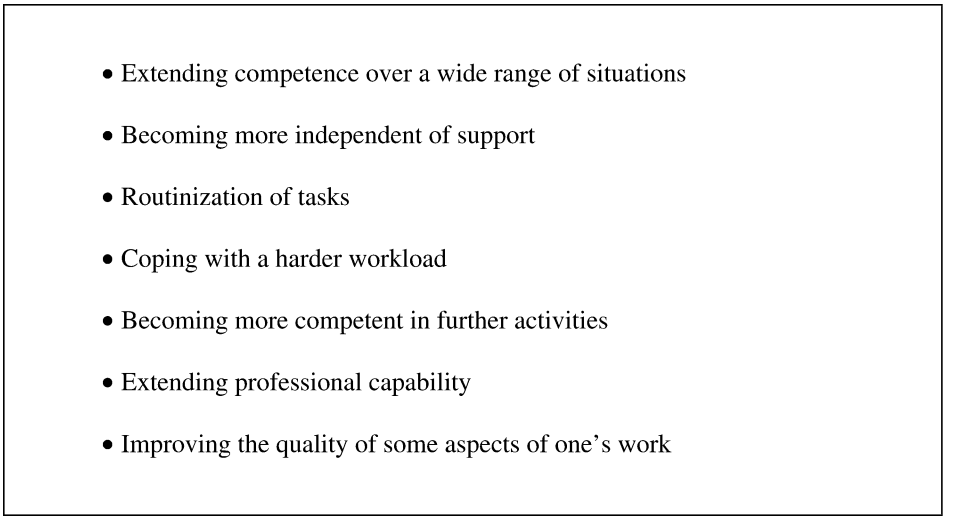

Figure 2. Eraut's model for progression during the period before and after qualification (Eraut 1994, 218).

> An expert's skill has become so much a part of him that he need be no more aware of it than he is of his own body…When things are proceeding normally, experts don't solve problems, and don't make decisions; they do what normally works. (30)

The expert will only move out of this mode on the occasions that the task in hand is particularly difficult or critical, or because they have critically reflected on their own intuition and are reconsidering the initial action.

Manley and Garbett (2000) suggest that in selecting expert practitioners, two assumptions seem to be made: expertise can be recognised in others by colleagues and significant practical experience is required as a prerequisite for expertise. Both these assumptions can be challenged. These authors reveal that in an analysis of studies in which expert practitioners were selected, a range of criteria were used to identify expertise. These included identification by peers and/or senior colleagues, experience, educational attainment, personal qualities and status. They noted that there appeared to be little consistency between studies in the criteria that were employed and there were only a few examples of attempts, Conway (1996) is one, to account for the rationale behind the identification and/or selection of participants. Probably the most striking finding was that the identification of experts was not seen as being intrinsically problematic, although the obvious effort taken to select appropriate participants suggested that selection was an important issue. Were they selecting for expertise or experience? Bradley, Paul, and Seeman (2006) are quite clear that experience alone is not an acceptable indicator of expertise and argue that

other factors must also be present to define expertise. Within this framework the cognitive ability to correctly structure experience is necessary to define expertise.

Interestingly, Benner (1984) avoids defining the expert clinical practitioner; she does however provide a comprehensive account of the term in the context of a nurse demonstrating her/his expertise in clinical practice. She describes the expert nurse in terms of the Dreyfus model. The expert nurse has an intuitive grasp of situations and immediately focuses on a problem without the wasteful consideration of a large range of unfruitful diagnoses and solutions. In contrast, a competent or proficient nurse faced with a novel situation must rely on conscious deliberate analytical problem solving.

A heuristic for visualising the locus of expertise

The visualisation that has been used here (summarised in Figure 3) has been derived from the qualitative examination of several thousand concept maps produced by students and their teachers over the past nine years (Kinchin and Hay 2007). These maps have been classified according to their morphology (Kinchin, Hay, and Adams 2000). This resonates with the description of knowledge structure as providing 'the essence of knowledge' (Anderson 1984), and shown to be a characteristic of concept maps that is as influential on the learning process as the content that is portrayed within them (e.g., Hay, Wells, and Kinchin 2007).

Figure 3 may be read vertically or horizontally. The vertical dimension explains the characteristics and roles of each of the knowledge structures. Many students embark upon their undergraduate studies with firmly established chains of understanding that have developed during their secondary schooling (Martin 1994). These are often incomplete or inappropriate for their new context. Such chains are resistant to development and so students are faced with the dilemma of either trying to abandon their existing beliefs or rote learning the new material as an adjunct to their existing prior knowledge.

The chain of appropriate understanding is indicative of strategically successful learners (students and lecturers). Such goal-orientation enables these learners to select the essential information from that which is available while selectively ignoring the rest. This may be seen by some as an efficient way of studying while others could interpret this as a blinkered view of higher education. There is certainly a tension created within the university environment by attitudes towards this kind of strategic approach that may reflect disciplinary differences. For example, in the clinical environment the development of chains of clinical reasoning is seen as one of the key aims (e.g., de Cossart and Fish 2005).

The demonstration of highly developed and integrated nets of understanding may be seen as the hallmark of the expert (Bradley, Paul, and Seeman 2006), for whom the demonstration of expertise is achieved by the accommodation of competing chains of understanding and the selection of appropriate chains to suit particular contexts.

A horizontal reading of Figure 3 suggests a progression in the development of knowledge structures from chains to nets. Such a directional development has been observed (Kinchin Hay, and Adams 2000) though the mechanisms of change are complex and have been introduced elsewhere (Hay 2007). The implication that the development of net structures among students may be the goal of higher education is

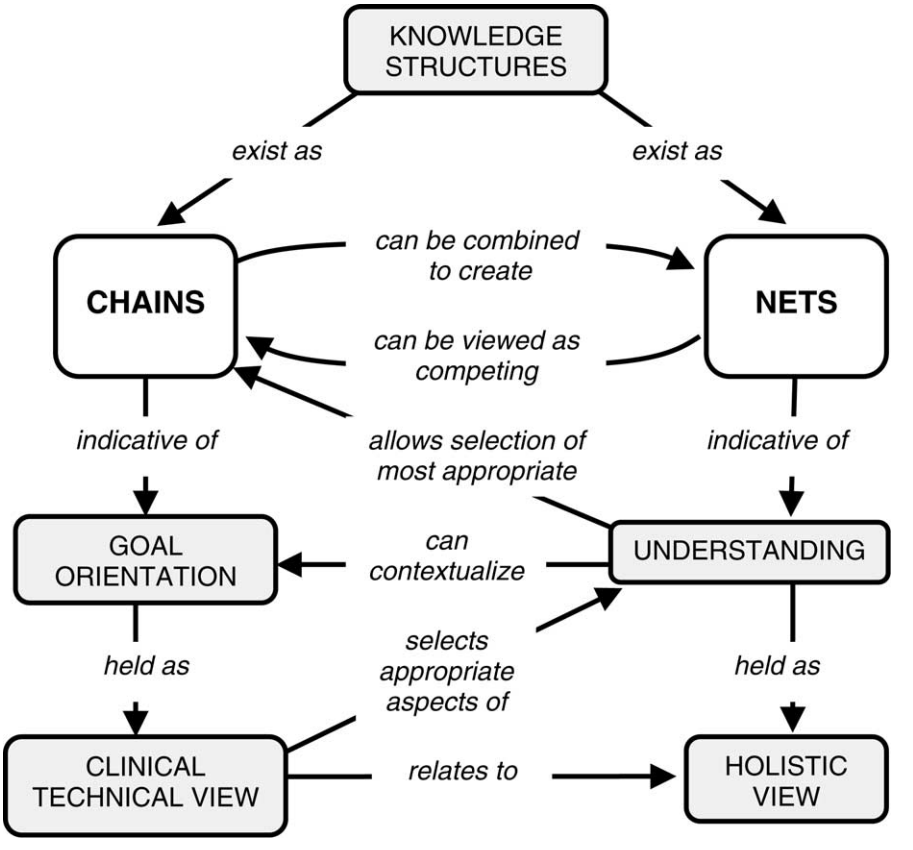

Figure 3. The relationship between chains of practice and networks of understanding. The active engagement in the links between these chains and nets are indicative of expertise (modified from Kinchin, Lygo-Baker, and Hay (2008)).

one that may be contested, particularly where chains of practice seemingly have more immediate utility than networks of understanding.

Navigating between knowledge structures

Rather than attributing expertise to a certain level of sophistication and integration within a knowledge structure (e.g., Bradley, Paul, and Seeman 2006), expertise may be characterised by an individual's ability to navigate between underlying *networks of understanding* and *chains of practice* that are appropriate to the context; analogous to the 'professional artistry' described by Manley et al. (2005). Application of Kinchin and Hay's heuristic (Figure 3) provides a transparent mechanism for this artistry that goes beyond opaque assumptions involving intuition or tacit knowledge as explanatory factors. Novak and Symington (1982) made the key point when they stated:

> The problem of moving from linear [text] structure to a hierarchical [psychological] structure and back again is in some ways the fundamental educational problem.

That experienced clinical practitioners cannot always articulate rational explanations for their clinical practice (e.g., Benner 1984, 32) resonates with Polanyi's view of tacit knowledge as a description of 'knowing more than we can tell' (Polanyi 1967, 4). Critics of Polanyi have considered the label 'tacit knowledge' as a way of avoiding addressing a whole class of mental events (e.g., Fodor 1968), and so rendering the development of expertise as a mystical event that defies adequate description that would help those who are trying to promote it. Although Dreyfus and Dreyfus (1986, 152) doubt the efficacy of tacit theories for the development of educational practice, they do consider the equally opaque phenomenon of intuition to be 'at the very core of expert decision-making' (Dreyfus and Dreyfus 1986, 10). However, as with tacit knowledge, the black box of intuition does little to support the student or the teacher in the development of clinical expertise. If colleagues are unable to verbalise their actions, it may simply be that they lack the appropriate tools to uncover what it is that they are doing, and/or the vocabulary to articulate it. Hoffman and Lintern (2006, 216) argue that there is no indication that tacit knowledge 'lies beyond the reach of science in some unscientific netherworld of intuitions and unobservables', and that tools such as concept mapping can support colleagues in identifying and describing their practice with unprecedented clarity. That knowledge may be tacit is not in doubt. Where we depart from accepted views is that not all such knowledge need remain tacit and undescribed. This paper contributes to the understanding of clinical expertise by adding transparency to the processes (often presumed to be tacit) that link invisible expert knowledge to visible chains of practice. Such transparency, mediated by concept mapping, may help students and teachers appreciate the other's perspective and avoid the problem described by Perkins:

> learners' tacit presumptions can miss the target by miles, and teachers' more seasoned tacit presumptions can operate like conceptual submarines that learners never manage to detect or track. (Perkins 2006, 40)

To avoid such a mismatch, the links between developing practice and expert knowledge need to be made explicit. Figure 3 shows the relationships between chains of practice and the network of underlying understanding upon which they depend. The links between the two elements are rarely articulated by professionals who have not conceptualised understanding in terms of knowledge structures in this way and who, therefore, lack an appropriate vocabulary for its description. In this way, the difference between *expertise* and *expert knowledge* becomes easy to explain:

a. Expert knowledge describes an integrated/holistic framework of understanding.
b. Expertise describes the application of expert knowledge through the selection of appropriate chains of practice (i.e., repeated movements between chains and networks that may occur so quickly as to appear tacit).

This provides a mechanism to explain the loss of expertise (know-how) experienced by teachers who are no longer practising, but who clearly hold expert knowledge structures (Dreyfus and Dreyfus 1986, 17).

Variation between clinical and non-clinical knowledge structures

While we have observed our view of expertise (as related chains of practice and networks of understanding) working across the spectrum of academic disciplines, we describe it in detail here in the context of clinical teaching as the separation of chains of practice and underlying networks of understanding is so pronounced in this setting and therefore easier for the observer to identify. Although expert knowledge structures are assumed to be holistic (e.g., Bradley, Paul, and Seeman 2006), clinical reasoning skills have been shown to be linear in structure (de Cossart and Fish 2005). Possession of highly competent skills within a given chain of practice is not sufficient within a clinical teaching environment that aims to educate the next generation of professionals who are able to make informed choices when innovative clinical practice threatens established procedures. Such isolated chains of practice are what Stronach et al. (2002) have called 'broken stories'. These chains of practice or broken stories will not have the capacity to evolve with understanding unless they are related to an underlying network of understanding.

The clinical teacher needs to be able to capture the elements of his/her students' broken stories and to contextualise each of them within an underlying network of understanding. This places a considerable burden on the clinical teacher when, in addition to the individualised learning needs of the students, there also needs to be consideration of the needs of the patient. While the student is encouraged to make links from his/her chain of practice to a developing network of understanding, the patient is typically given a discrete chain from which links that may complicate or confuse are obscured, or at least intentionally neglected (Katz 1988) – see Figure 4.

Assessing expertise

Manley and Garbett (2000) note that a key insight into identifying and judging expertise is that experts require facilitation to demonstrate their expertise and help them highlight the knowledge embedded in their practice:

> It is not the 'know-that' that is difficult for experts to articulate, but the 'know-how,' practical knowledge used spontaneously which is tacit and intuitive. (355)

These authors consider that the notion of critical companionship is central to the recognition of expertise. The role of the critical companion is essentially to enable the expert make his/her tacit knowledge explicit and move out his/her intuitive knowledge/practice. However if much of what we accept as expert knowledge is unknown, tacit or intuitive (Bradley, Paul, and Seeman 2006), is it possible to make this knowledge explicit? Perhaps expert knowledge is not tacit and or unknown. In which case the critical companion is helping the expert not to make his/her tacit knowledge explicit but to articulate knowledge in a clear and meaningful way.

Expertise may be determined on a 'closeness-of-fit' model of assessment. Where an expert is designated, using arbitrary criteria (e.g., Manley and Garbett 2000), to assess junior peers, the implication is that the expert holds the 'right answer'. However, as experts often fail to agree, the 'right answer' is a moving target for the student to identify (Cabot and Kinchin 2007; Hay and Kinchin 2007). When there is considered to be sufficient overlap between the established expert view and the emerging expert view, then the designation, expert, may be safely applied to the

Figure 4. The clinician's complex network of understanding may contain all sorts of uncertainties that are not passed on to the patient – who is left with a simplified and 'certain' chain of practice.

junior partner. This model assumes that the established expert is able to stand back and reflect upon his/her own practice and appreciate its dynamic nature. Some may be able to do this, but support from an observer with complementary expertise may be helpful.

Appreciation of the skills by which the expert is able to move from chain of practice to underlying network can only really be appreciated by an observer who holds at least one of those structures within his/her own knowledge structure and is able to appreciate the nature of the manipulations required to successfully navigate the transition from one knowledge structure to another. This would have implications for the roles played by students and by colleagues in educational development centres. The student (rather than exclusively the 'fellow expert') is in a good position as assessor, giving a real focus for student evaluations of teaching that go beyond questions such as: 'was the course well organised?', 'were the lecturers' slides clear?'. Student evaluations of teaching would need to focus on the lecturers' success in demonstrating the link between linear and hierarchical structures (Novak and Symington 1982). While colleagues within educational development units are placed in a position to support the development of strategies to move between structures, disciplinary colleagues may help in the development of the underlying network. This gives clear and complementary roles for the development of higher education pedagogy, and a clear purpose for those working in educational development (Gosling 1996, 2001).

Conclusions

We have demonstrated how the qualitative interpretation of knowledge structures through concept mapping reveals how complementary structuring as *chains of practice* and *networks of understanding* provides a way of explaining some of the anomalies that are described within the literature on expertise. It is the interactions between these complementary structures and the ease of transformation (from one to the other) that may be the hallmark of expertise rather than the existence of one or other structure in isolation.

We consider that the assumption of the central role of intuition (as described by Benner (1984) and Dreyfus and Dreyfus (1986)) in the consideration of expertise has provided a barrier to the description of the actions experts exhibit. The labels 'intuitive' and 'tacit' have consequently served to cloud the description of what actually takes place, and we support Hoffman and Lintern (2006) in their view that professionals have simply lacked the tools and vocabulary to uncover and explain their practice. The heuristic (summarised in Figure 3) has been tested in various disciplines, and appears to function equally in each.

The tensions we have observed in clinical settings can be explained by our visualisation. The chains of clinical practice that are acquired by students are often taken as indicators of competence. However, when the utility of such chains are challenged, the clinician needs to refer back to a wider understanding of the field in order to select a revised chain of practice. This resonates with the comment made by Schmidt, Norman, and Boshuizen (1990, 619):

> The notion that expertise is associated with a qualitative transition from a conceptually rich and rational knowledge base to one comprised of largely experiential and non-analytical instances is a radical departure from conventional views of clinical competence.

It seems that a decade and a half later, this is still a radical departure from orthodoxy. Such tensions come to the fore when chains of practice are seen as an end point by assessment regimes that promote rote learning. Such goal-orientation (characteristic of linear learning sequences, Hay and Kinchin 2007) is compatible with the intentional neglect of uncertainty that has been described within medical education (e.g., Katz 1988).

The visualisation of expertise is a necessary step in the development of a pedagogy in which expertise is the currency of exchange between teachers and students (Kinchin, Lygo-Baker, and Hay 2008). However, just as expertise comes from 'effort and sacrifice' (Alexander 2005), so too will the development of a scholarly pedagogy built on expertise demand effort from all involved. Alexander (2005) has set out a number of pedagogical principles that serve as a good starting point for the development of teaching that has expertise as its goal. Recognition of the complementary nature of linear and networked knowledge structures may help in the development of an authentic pedagogy of higher education that focuses on the transformation of knowledge structures rather than the acquisition of a single structure. The appreciation of multiple representations of knowledge and their contextual significance needs to be central to any assessment regime if it is to reward university students (and their teachers) for their efforts.

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