Transfer and social practice.

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Abstract

This paper examines knowledge transfer from cognitive and sociocultural perspectives. It is held that transfer is not from the general to the specific or vice versa, neither is it wholly from the disembedded to the embedded. Rather, transfer is the process of disembedding knowledge from one situation and transforming it to have utility in another, which includes finding analogies which ease transfer. Consequently, expectations of and understanding about transfer across different types of social practice (e.g. the classroom and workplace) may be based on incomplete assumptions. It is proposed that vocational knowledge has its genesis in different levels of social development, each with its own characteristics and potential for transfer. In current vocational curriculum frameworks, goals for vocational education often relate to the disembedded sociocultural level of knowledge, yet there is an expectation of that knowledge being transferable across communities of practice, such as workplaces with their own sets of embedded norms and values. Yet, not only are these communities distinct, but that transfer is from one type of community of practice to another (e.g. a workplace to a .particular classroom). This makes the prospect of transfer across different kinds of settings 'far' (transfer to circumstances which are novel), something which does not readily happen. This may help explain the paucity of transfer between two different communities of practice - the 'classroom' and the workplace. The paper concludes by discussing approaches to instruction for maximising transfer across settings and circumstances, which emphasise the need to embed and disembed knowledge as well as seeking to construct analogous opportunities for transfer.

Introduction

A sociocultural view of knowledge transfer is proposed in this paper building upon cognitive theory to propose that transfer has social and cultural dimensions. Knowledge is held as being initially richly associated with the social circumstances in which it is constructed. Consequently, the social genesis of knowledge plays a role in transfer as these associations underpin the prospect for transfer. Therefore, transfer is not premised on knowledge being an epistemological truth of an absolute objective character (Alexander, Schiller & Hare 1991) but rather on how that knowledge is constructed, valued and utilised in the circumstances of its deployment. For instance, the transfer of mathematical knowledge across different circumstances has been demonstrated to be quite limited (e.g. Stigler, Barclay & Aiello 1982, Carraher, Carraher & Schliemann 1985, Ceci & Liker 1986, Scribner 1984, Lave et al. 1984). What is understood about, and an ability with, mathematics in one circumstance (e.g. school room, construction site, race track) does not necessarily predict the ability to transfer that knowledge to another. In fact, quite the opposite is sometimes the case. When faced with mathematical problems based in everyday activities in work environments, school students have been shown to abandon the mathematical knowledge they had acquired through school activities (Pea 1987, Scribner 1984). Such findings are significant because mathematical ability might be thought of as being a skill which could be applied quite universally. Given the goals of educational programs are to provide students access to knowledge which is applicable to circumstances other than those where the knowledge is constructed, an understanding of the potential of knowledge to transfer is central to considerations for instruction. Whether individuals

learn in educational institutions or workplaces there should be an expectation that the knowledge they construct will be transferable to other circumstances. This paper discusses how the social genesis of knowledge influences the prospect for transfer, thus rendering problematic views about the wholesale transfer of knowledge from one circumstance to another.

Drawing on cognitive perspectives, knowledge construction and transfer are discussed initially in this paper. These views are then augmented by sociocultural theory which emphasises how the social practice that individuals engage in influences the structuring of their knowledge and, hence, its transfer through engaging in particular kinds of activities. It is then proposed that these activities are embedded in, and structured by, the activity systems of particular instances of social practice, referred to as communities of practice (Lave & Wenger 1991). To illustrate the embedded nature of knowledge and its impact on transfer, this community level of knowledge development is compared to the sociocultural level. Moreover, the problem of transfer between, say, the vocational college or school room and the workplace is held to be a product of knowledge being constructed in different ways in these different kinds of social practices (Rogoff 1995). This may explain the failure of wholesale transfer of knowledge between different types of communities of practice such as from the educational institution to the workplace. Furthermore, the belief that disembedded representations of vocational knowledge such as industry competencies or generic competencies are inherently transferable, has failed to account for their initial construction necessarily being associated with particular social practice. The degree of difference between the knowledge constructing activities in particular settings is likely to be a determinant as to whether transfer is 'near' transfer which is easy because the target situation is similar or analogous to its source, or 'far' transfer to circumstances which are novel (Royer 1979). Therefore, the prospect of transfer appears associated with how individuals' knowledge is shaped by the circumstances of its construction (Billett 1995) and the relationships between this socially constructed knowledge and the circumstances to which the knowledge is to be transferred. The paper concludes with some discussion about how transfer can best be addressed through instruction based on the need to both embed and disembed, and also to seek analogous situations. That is, to make transfer 'near' wherever possible.

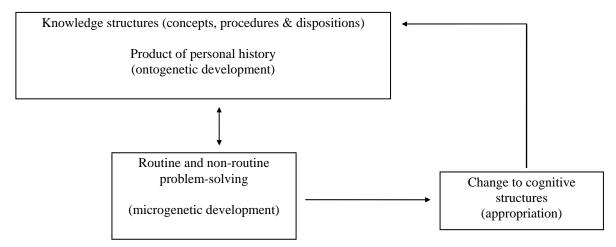
Cognitive and sociocultural views of knowledge construction.

An account of the construction of individuals' representations of knowledge in memory is provided by cognitive psychology which holds <u>representations</u> as being cognitive structures in the forms of conceptual and procedural knowledge. These forms of knowledge are constructed, organised in memory and utilised in addressing both routine and non-routine cognitive activities, such as problem-solving and transfer. The cognitive literature thereby views thinking as a skill (Sternberg 1989), the effectiveness of which is determined internally by the extent and organisation of individuals' cognitive structures.

Problem-solving is central to this cognitive perspective, being viewed as the process which both secures goals and transforms (extends) knowledge, thereby being associated with learning and cognitive development (Anderson 1993). Moreover, the effective deployment of cognitive structures in nonroutine situations (e.g. "complex" problem-solving and 'far' transfer) within a domain of knowledge is associated with high levels of performance or expertise (Anderson 1982; Ericsson & Simon 1984; Glaser 1989; Gott 1989; Wagner & Sternberg 1986), a facility dependent upon how individuals represent the problem and construct 'problem spaces' to secure solutions (Chi, Feltovich & Glaser 1981; Glaser 1984). The construction of the problem space (the organisation of the boundaries of the problem, its possible solution choices and pathways) (Newell & Simon 1972) is also underpinned by the adequacy of individuals' cognitive structures within a domain of knowledge. Domains of knowledge, within the cognitive perspective, are bodies of knowledge held as long-standing truths usually associated with an academic discipline or subject matter (Prawat & Floden 1994). The domain of knowledge premise is that individuals construct knowledge in ways which are similar to these domains of knowledge. This assumption seems to illuminate the transfer problem because there are different sources of these representations. It seems that domains of knowledge are not absolute nor do they represent epistemological truths. Instead, individuals construct their own domains of knowledge which are socially-derived, premised on their experiences, rather than working towards constructing a body of domain knowledge which represents epistemological truths. In short, cognitive theory does not offer a view about the influences of these social sources and how they render transfer more or less likely.

Whereas the cognitive constructivist perspective is primarily concerned with the internal processes of the mind, the sociocultural constructivist perspective furnishes an account of the social genesis and construction of knowledge (Wertsch 1993; Scribner 1985). This latter view of cognitive development, emphasises the appropriation of knowledge through interpersonal social interactions (Vygotsky 1987) as well as through guidance from more distant social and cultural sources (Scribner 1985). As is discussed below, the community of practice (e.g., the school room or workplace) is held to be the situation where problem-solving occurs and the patterning of individuals knowledge is realised through appropriation. Appropriation is the interpretative process of constructing knowledge from social and cultural sources, albeit mediated by individuals' already idiosyncratically structured knowledge (Rogoff 1995). Figure 1 synthesises work in this field and depicts this process of knowledge construction through problemsolving. Appropriation contributes to individuals' ongoing ontogenetic development or construction of knowledge throughout their life histories. However, appropriation is interpretative. Therefore, the particular stimuli or problem-solving interlude will not be interpreted and constructed in a uniform way. Its construction is premised on individuals' existing cognitive structures which have been structured through their life history (ontogeny). It is held that only through ongoing joint activities over time in social interaction, that individuals' interpretations are likely to become more comparable (Newman, Griffin & Cole 1989).

Figure 1: Construction of knowledge through problem-solving (Source Billett 1995)



Thus appropriation emphasises mutuality between persons acting and the social and cultural circumstances in which they act (Lawrence & Valsiner 1993, Rogoff 1995). Hence, the construction of individuals' knowledge is socially determined, which necessarily proposes that the transfer of knowledge is mediated by interpretative and social factors. The interpretative view is supported by Pea (1987) who states that "elements perceived by the thinker as being common between the current and previous situation are not given in the nature of things, but are real in terms of thinkers' culturally influenced categorisations" (p.639). Take dialects, for example. Dialects are a social product that have become a routinised part of individuals' everyday acting and have involved social sources being transformed into determining how the muscles in the mouth are used to enunciate words (Bourdieu 1991). Hence, the adoption of another accent requires the transformation of existing procedures. Moreover, the meaning of words is also a social product, rather than being objective or singular. Rather, they have social sources holding particular meaning in different circumstances and settings (Cazden 1993).

Sociocultural theory affords an explanation for these phenomena, holding that engagement in socially-determined goal-directed activity promotes the psychological function of the learner (Martin & Scribner 1991; Scribner & Beach 1993). It seems that the knowledge needed to be learnt, particularly complex knowledge, such as that which monitors and determines action has social and historical origins (Billett 1995, Bourdieu 1991; Scribner 1985; Vygotsky 1978; Wertsch 1993).

In a complementary way, cognitive theory explains the phenomena outlined above as compilation of procedures and chunking of concepts. As procedural knowledge becomes well-practised, compilation, which comprises the collapsing of specific procedures into a single production occurs (Anderson 1982). Compilation involves automating responses to particular situations and activities; hence, what is compiled has social origins. Equally, as concepts become routinely associated, they become chunked.

This development, like compilation, is sourced directly from the socially-determined circumstances of the acquisition of knowledge, as the compilation of procedures and chunking of concepts are appropriated through engagement in socially-sourced activities and goals (Billett 1995). Consequently, as specific procedures are responses to engagement in goal-directed activity (problem-solving) in particular social circumstances and socially-generated goals, compilation of procedures may be regarded as the automation of responses sourced in particular circumstances. The significance of the chunking and compilation of knowledge is that it furnishes associations between particular social sources and cognition (Billett 1996). Moreover, chunked concepts and compiled procedures are those usually deployed 'unconsciously' but which may require conscious monitoring and careful (non-chunked or decompilation) deployment if they are to be transferred to another situation. Yet, as Garner (1990), Pea (1987) and Posner (1982) caution, such tasks are effortful and unlikely to be undertaken, unless individuals perceive value in expending the effort. Furthermore, Goodnow (1990) observes that individuals not only learn to solve problems, they also learn what problems are worth solving. If support, guidance or reward are not forthcoming for engaging in the effortful task of knowledge transfer, it is less likely to occur than where those attributes are available. Therefore, social circumstances, including values and social norms, also influence the amount of effort expended in the search associated with problem-solving and transfer. So, from a sociocultural perspective, more than being purely an individual response, transfer has its basis in social and cultural practice.

Transfer and knowledge

A view of knowledge being sourced and patterned by social circumstances raises questions about the degree to which it is reasonable to expect transfer of knowledge across situations which individuals might characterise as being unlike (Perkins & Salomon 1989). Cognitive theory has been criticised for not questioning assumptions behind its conceptualisations of transfer, despite overwhelming evidence of the paucity of transfer from one situation to another (Lave 1988). For example, as discussed above, the transferability of general mathematical algorithms and heuristics, which might carry expectations of general applicability, has been questioned. Studies of professional abacus counters (Stigler, Barclay & Aiello 1982), street vendors (Carraher, Carraher & Schliemann 1985), horse racing handicappers (Ceci & Liker 1986), dairy workers (Scribner 1984) and shoppers (Lave et al. 1984) indicate that, when asked to undertake school-type mathematical calculations, subjects performed weakly. Yet these subjects performed mathematical calculations with high levels of success in other 'domain-specific' activities. Consequently, they are not mathematically incompetent; a situation which questions assumptions about domains of mathematical activity and circumstances in which transfer is more or less likely. Transfer, therefore, cannot be conceptualised as simply the transfer of knowledge from one situation to another (de Sessa 1982). Rather, from a sociocultural perspective, the prospect for transfer is likely to be based on the ways in which this knowledge is interpreted by individuals as being similar to another form of activity. This interpretation appears to be mediated by social and cultural factors (Billett 1995).

Within cognitive science, transferring knowledge is usually viewed as being the process of recognising similarities between a past situation and a new (problem) situation, and then using cognitive structures to fashion an understanding of the new situation. Royer (1979) proposes that knowledge representations are used in transfer, and that transfer depends on the richness of knowledge structures. Richness is associated with the number of connections or interconnections made through representation and indexing to the circumstances of its application (Royer 1979). (Indexing is the association between knowledge and the indexical factors which are used to organise and re-present individuals' knowledge for its subsequent deployment (Ericcson & Simon 1982)). Royer (1979) classifies transfer as being either 'near' or 'far', permitting transfer to either similar or novel situations. So for instance, open-cut coal miners might be able to transfer their mining knowledge to other open-cut mines (near) but not to an underground mine (far). A tailor may be able to understand the role of seaming in the manufacture of lingerie (near), but not be able to work with the materials and processes used in the manufacture of those types of garments (far). The university lecturer may similarly be able to teach with ease in another university (near) but might be challenged by the aspects of the instructional requirements of a vocational college or primary school (far). A key premise of Royer's theory is that comprehension is necessary for transfer and dependent upon circumstances under which material is experienced. Prawat (1989, p. 25) views transfer as "the ability to draw on or access intellectual resources in situations where those resources may be relevant". This was elaborated upon earlier by Hoffding (1892 cited in Pea 1987) who suggests that failure of transfer occurs most frequently because the learner is unable to recognise the new situation as similar to the one encountered previously. Access to rich indexing reduces the need for a conscious search strategy (Ericsson & Simon 1984). So, enriching the conditions of acquisition may assist maximising indexing and recall, thereby embedding thinking and acting in particular circumstances. Yet, this rich indexing (embedding) might also act as an inhibitor on transfer when indexical factors (e.g. physical environments, tools or circumstances) are different between source and target settings. This problem appears evident in the above-mentioned studies of maths use.

From the above, transfer and problem-solving are viewed as being similar activities, with 'far' and 'near' transfer being consonant respectively with routine and non-routine problem solving. Voss (1987) holds that learning is subordinated to transfer, as knowledge acquisition involves reconciling prior knowledge with new information by interpreting new information against what is already known. For example, with 'far' transfer, higher order procedures are required to interpret the situation, to recognise, represent or relate to the indexation (Stevenson 1991), thereby abstracting understanding from one situation to apply to another. So, transfer is either from one set of embedded knowledge representations to another, between two exemplifications which are similar (*near*) or through a process of disembedding and transforming the knowledge to the requirements of another situation. When considering 'far' transfer, individuals' capacities to discern familiar, albeit abstracted, elements within the target task depend upon

their capacity to conceptualise the problem, and to use domain-specific procedures and higher order procedures to probe, monitor and determine progress. However, it is argued that these associations are not given. Rather, they are socially sourced and individually constructed. Therefore, together, the cognitive and sociocultural constructivist perspectives are helpful in examining the nature of transfer (Billett 1996). In particular, sociocultural theory is able to build upon and augment the understandings of transfer provided in the cognitive literature.

For example, the paucity of transfer of the knowledge that students construct in educational institutions to applications outside of those settings (e.g. workplaces) has been widely reported (e.g. di Sessa 1982, Lave 1988, Pea 1987, Raizen 1989; 1991, Resnick 1987, Scribner 1984). Concerns about the lack of transfer have been used to suggest that workplaces, rather than educational institutions, should be used to foster the development of knowledge for workplace performance, to overcome the transfer problem (e.g. Raizen 1991). But to what degree is the problem one of failure of knowledge transfer from the educational institutions or a more fundamental question about how individuals construct knowledge? A proposition worthy of careful consideration is that learning is a product of ongoing participation in everyday activities in the 'lived in' world (Lave 1993) and that knowledge is initially embedded in the circumstances of its construction. As such, there is no reason why, on its own, learning in educational settings should be expected to be any more transferable than knowledge constructed in other settings (e.g. workplace, home); similarly, transferability cannot be expected to be a direct consequence of learning in those settings. Rather, to improve transferability across settings, specific guided instruction is likely to be required to initially embed then disembed knowledge in order to enhance the prospect of its adaptability to other circumstances. Central to the role of instruction is to make transfer 'near' rather then 'far'. The more 'far' the transfer, the less likely it is to occur and the less satisfactory the utility of the knowledge.

It is proposed therefore that the likelihood of transfer depends on the effectiveness of cognitive representations which have social and situated geneses. Transfer is therefore not premised on the application of disembedded knowledge regardless of circumstance; instead, it depends partially on situational factors which assist performance. Transfer to another similar form of mathematical practice, for instance, or use of another counting aid, may render the transfer 'near'. Individuals need to abstract concepts from one set of circumstances and determine the nature of their applicability in another, as Lave (1993) argues. Transfer is also person-dependent, as individuals' cognitive structures are always to some degree idiosyncratic (Billett 1995), determining whether transfer is 'near' or 'far'. In order to understand further how social factors pattern knowledge and transfer, a more explicit understanding of the social genesis of knowledge is necessary. In the next section, a view about the social genesis of knowledge is presented and the consequences for transfer discussed.

Transfer and the social genesis of knowledge

Drawing on Vygotsky and his adherents, sources of the social genesis of knowledge have been synthesised in order to understand further the nature of social practice and how it influences learning and transfer (Billett 1995). These sources comprise, firstly, the evolving socio-historic source of knowledge (phylogenetic) (Vygotsky 1978, Wertsch 1985). For Vygotsky (1981), humans' higher mental functions are a product of the evolving history of the species. This source furnishes procedures and goals which are likely to be common across different kinds of sociocultural practice such as general goals for performance (e.g. find out what is required and then enact the most appropriate solution) and general means of securing those goals. Secondly, sociocultural practice (Scribner 1985) furnishes goals, techniques and norms for vocational practice (e.g. coal mining, tailoring, nursing, hairdressing) which guide and establish expectations for practice. For example, with hairdressing, this source provides knowledge associated with goals for, and expectations of, hairdressers, the techniques and practices of hairdressing (Billett 1995). These forms of knowledge provide instantiations of how socio-historic knowledge has been transformed in particular ways to accommodate the evolving sociocultural practice of hairdressing. Thirdly, communities of practice (Lave & Wenger 1991) are instantiations of the deployment of sociocultural knowledge in particular circumstances. The application of sociocultural knowledge varies across different kinds of vocational practice (e.g., different hospitals, hairdressing salons and coal mines) and its application is unlikely to be uniform, as discussed further below. The particular classroom in which an individual engages with instruction is a community of practice as is the particular hairdressing salon. The next source is individuals' life histories or ontogenies (Vygotsky 1978). The ongoing construction of knowledge by individuals draws on, extends and organises the knowledge constructed throughout their personal histories. Individuals' life histories are socially determined and furnish the knowledge with which individuals interpret stimuli and develop further their knowledge. Finally, there is also microgenetic development, the moment-by-moment knowledge construction occurring through problem solving, which involves deploying existing knowledge in response to stimuli provided in the environment (Rogoff 1990). These sources are depicted in Figure 2. In that figure, representations of knowledge are depicted as the patterned consequences of the social genesis and mediation of knowledge which has its origins in history, culture and the community in which the learning occurs. However, the figure also indicates that this learning is also mediated by the knowledge that individuals have already constructed, through their own socially-determined personal histories, which are unique.

Key among the social circumstances for accessing and acquiring knowledge and, hence, cognitive development, are the socially and culturally derived norms of a <u>community of practice</u> (Lave 1990; Lave & Wenger 1991) where individuals engage in goal-directed activity and which are the target circumstances for transfer. The norms of the community, the <u>culture of practice</u> (Brown, Collins & Duguid 1989), are central to the conduct of, and participation in, vocational activities and also determine

what constitutes expertise in these communities. In contrast to the sociocultural source which can be seen as the disembedded canonical knowledge of the vocation, the particular circumstance transforms and determines how this knowledge is deployed in those circumstances. For example, key components of nurses' work are likely to be undertaken differently in a major metropolitan hospital, country hospital or a clinic in a remote aboriginal community or minesite.

Figure 2: Social genesis of vocational practice

Socio-historic knowledge (phylogenetic) Wertsch, 1985 Scribner 1985 (e.g. client service or counting)

Guiding concepts and procedures (calculations and a number system)

Socio-cultural practice (Scribner, 1985)

Historically derived knowledge transformed by cultural needs (e.g. hairdressing, doctoring, lighthouse keeping) norms, practice and expectations (particular uses and methods of counting)

Community of practice (Lave & Wenger, 1991)

Particular socio-cultural practice shaped by a complex of circumstantial social factors (activity system) norms and values which embody the community - culture of practice (Brown, et al. 1989) (e.g. hairdressing salon, doctors' surgery, a particular lighthouse)

Microgenetic level (Rogoff, 1990; Scribner, 1985)

Individual's construction of socially derived knowledge through routine and non-routine problem-solving -which transforms and co-constructs knowledge (appropriation).

Ontogenetic development (Scribner, 1985)

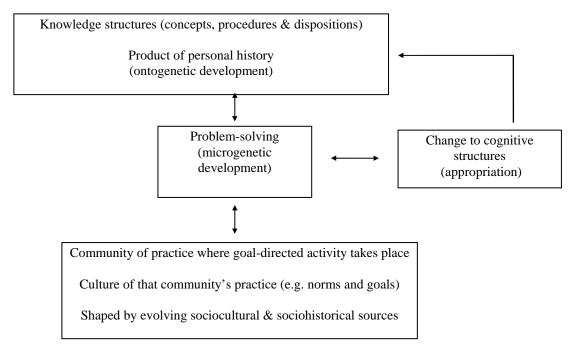
Individuals' personal histories including participating in overlapping communities

This representation suggests that expertise cannot be accounted for by the application of universal cognitive activities (e.g. from the socio-historical and sociocultural levels) which are the levels at which, respectively, key competences and core national curriculum are fashioned. Rather, situational factors are key determinants in knowledge construction and transformational activities such as transfer. Hence, transfer from one community (e.g. vocational college) to another (e.g. workplace) depends on the norms and types of problems and goals that occur in those communities. This suggests that communities of practice represent versions of sociocultural and sociohistorical-derived knowledge, transformed by the exigencies of particular circumstances.

Differences among communities of practice can be understood by referring to the complex of factors influencing each community's activities and, hence, its culture of practice. These social factors which are likely to be unique (Billett 1995). Figure 3 builds upon Figure 1 by depicting the way problem-

solving in a particular community of practice influences the construction of knowledge and the prospect for transfer. So, knowledge at the sociocultural level within a domain of activity (mathematics, hairdressing etc.) is transformed by the community of practice, and manifested as the culture of practice.

Figure 3: Influence of the circumstances in the construction of knowledge (source Billett 1995)



Transfer across communities of practice

From what has been proposed above, transfer is influenced not only by general socio-historical fcators but also by particular social practice. That is, there are cognitive consequences of engaging in particular goal-directed activity. Consider the activities in which students engage in colleges, universities and schools. To what degree do these activities reflect those which are being undertaken in the circumstances where the knowledge is to be applied? Students may well learn many things which are unique to the goals (intended or unintended) of educational institutions, but may not develop many of the forms of knowledge needed for performance in the target circumstances (e.g. workplaces), which are simply unavailable to them in educational institutions. For example, consider the activities that nurses engage in during their university-based training, compared with those in hospital-based training. Regardless of the value placed on either of these settings, there is a likely prospect of constructing knowledge differently in each setting. How will nurses in an educational institution learn about the relations among other professionals and staff in hospitals, and how to organise their time on a shift in circumstances where they will not encounter these activities? Additionally, to what degree can even the "mock" hospital wards, now being created in universities to 'contextualise' nurse education, provide the authentic experiences needed to develop knowledge which is 'near' to that used in hospital wards. Put simply, while purporting to focus on the same sociocultural practice (nursing), the two settings comprise different kinds of communities of practice. It seems more likely that transfer will occur across two similar circumstances (e.g. between two hospital wards or between two university-based activities) because it is 'nearer' than across two different types of settings which would require 'far' transfer. This is not to blame educational institutions or their programs for failing to secure transferable knowledge, but rather suggests the need for greater recognition that knowledge has social and cultural dimensions, which influence the prospect for transfer, and which needs to be considered in deliberations about curriculum.

However, despite the above, it would be inadequate to view knowledge as being totally situated; welded to particular circumstances. Rather, particular social practice provides a basis for knowledge to be constructed, thereby embedding it initially in situational factors which make the associations among and organisation of that knowledge rich. Yet, individuals' knowledge also needs to be disembedded from the social practice associated with its construction in order to maximise the prospect for transfer. To achieve this goal, it would be also incorrect to assume that certain situations (e.g. educational institutions) are best for the development of knowledge which is transferable. Most likely, it is the sort of activities (problem-solving opportunities) engaged in by the learners, and the guidance provided, which will determine the prospect for transfer. Part of the transfer impasse appears to arise from the assumption that educational institutions are providing knowledge to students at the sociocultural level, and that this knowledge is inherently transferable across a range of communities of practice (workplaces) which conduct that sociocultural practice (vocations). However, in reality, even educational institutions are operating at the community level, as this is the level of social practice is embedded in everyday activity of educational institutions. Hence, transfer is not from the general to the specific or disembedded to the embedded, but from one embedded circumstance (community of practice) to another, albeit through a process or embedding and disembedding. It is the transfer across communities of practice which needs to be considered, not "inherently transferable" generic knowledge. Consequently, it can be argued that curriculum provisions and intents which claim to be generic or industry-wide are positioned at the disembedded sociocultural level. They have to be deployed (embedded) in particular circumstances to have any meaning and be disembedded to be transferable to other circumstances.

This discussion also indicates the need for a re-conceptualisation of 'knowledge domains'. As stated earlier, within cognitive theory the term domain can be used to describe a specific field of study, such as biology, economics, or medicine where it is conceptualised as an academic discipline (Alexander, Schallert & Hare 1991) or as being long-standing absolute truths (Prawat & Floden 1994). In vocational education, attempts are often made to capture this knowledge through an occupational analysis which is offered as the basis for curriculum, in the form of the content of national core or as competency standards. With the help of levels of the social genesis of knowledge depicted in Figure 2, the formal disciplinary view of knowledge (long-standing truths) can be thought of as being the historically-derived sociocultural knowledge identified by Scribner (1985b). However, the evolving social practice will be different in the circumstances where this knowledge is deployed, as it is influenced by communities'

social factors. Accordingly, two reasons can be offered why individuals' interpretative constructions are not reducible to some uniform base of knowledge - the 'absolute' truth (Prawat & Floden 1994). Firstly, practice is different across social circumstances, resulting in different situations (communities of practice) influencing the construction of knowledge in ways that are probably unique, given the complex of factors which comprise communities' activity systems. For example, expertise within vocational activities is likely to be highly diverse, even when described under a common occupational title. An electrician's knowledge of air-conditioning, for instance, is likely to be more highly prized and developed in a humid region than in a more temperate one. Consequently, experience with, and encouragement to learn about, air-conditioning may be given priority in one situation and de-emphasised in another. This questions the contemporary approach in the development of curriculum for vocational education which details prescriptive outcomes at the industry (sociocultural) level. Yet, these outcomes are expected to be meaningful across workplaces. Secondly, individuals' interpretations of what they experience are likely, initially, to be quite idiosyncratic (Newman, Griffin & Cole 1989) as they are derived from unique personal histories. Even expectations about apparently objective occupational practice are unlikely to be experienced, or knowledge about them constructed, in ways that are the same among individuals. Moreover, vocational practice is often based on deciding among a series of options which occur during practice, and take into account the kind of variables which are not easily able to be stated within the confines of a formal discipline (Alexander & Judy 1988).

It is proposed therefore that a domain of knowledge is identifiable by the knowledge required by the circumstances of its application (community of practice) and by how it is constructed by individuals, rather than by a set of disembedded principles (sociocultural practice). This is not to deny the importance of those long-standing principles which comprise the sociocultural knowledge of the vocation. Indeed, these are transformed and embedded in different ways across communities of practice. However, to improve prospects for transfer, there may be a need to move away from tasks which are either substitute (e.g. simulations) or are disembedded from the circumstances of their intended application, to those which are more embedded in the circumstances of their deployment. Curriculum development practice might benefit from relying on situational factors as well as the sociocultural knowledge of the vocation which tends to be privileged in current vocational education curriculum. Therefore, the view of domains advanced within the cognitive literature needs to be augmented by social and cultural factors, and an understanding that these are not epistemological truths, but are influenced by individuals' existing cognitive structures. Consequently, a domain can be understood at a number of levels. At the community level, it is the individually constructed rule-system (procedures) and related conceptual knowledge (propositions), mediated by social and cultural circumstances of its deployment (community of practice). There are also domains of knowledge which exist at the sociocultural level, albeit disembedded from actual practice, which yield the canonical vocational knowledge (the long-standing truths of coal mining, teaching and clothing manufacture) which are likely to be common across communities of practice where that knowledge is deployed. There is also the more abstracted domain associated with sociohistorical development of knowledge - evolving historically-derived knowledge which is associated with general goals of vocational practice (e.g. satisfying clients, mining, communication).

Considerations for instruction

Regardless of what settings individuals learn in, whether the workplace or the 'classroom', there is a need to improve the prospect for transfer. Underpinning considerations for instructional practice are the need to both embed, in order to develop robust knowledge, and disembed, to make that knowledge transferable and make transfer 'near' wherever possible. Drawing upon cognitive and sociocultural theory and associated research, the following means are advanced to achieve this goal. These are: (i) developing the forms of knowledge most likely to facilitate the transfer of knowledge; (ii) providing guidance in the securing of this knowledge; (iii) enriching the conditions of knowledge construction through authentic experiences to include opening up possibilities for its application in other circumstances; (iv) pressing learners to abstract principles from a particular circumstance and apply them elsewhere (disembedding); and (v) sequencing activities to provide access to the circumstances where the knowledge is to be applied.

(i) Developing knowledge which aids transfer

Cognitive theory holds that the development of higher orders of procedural knowledge and deep conceptual knowledge underpins the kind of thinking which permits 'far' transfer. Transfer is unlikely unless these knowledge structures are available. For instance, the chunking of concepts permits transfer (Sweller 1989) as it reduces the load on memory, thereby permitting the conscious effort required for transfer to be efficient. Although not sufficient for transfer on its own, a strong base of this domain-specific conceptual knowledge seems important because 'far' transfer requires the abstraction from the existing knowledge structures and a search for similar conditions in the target circumstance (Royer 1979). Hence, the development of these forms of knowledge at both sociocultural and community levels, is likely to permit performance within a particular situation and promote the prospects of the transfer of this knowledge to others. It seems unlikely that the sociocultural level of knowledge can be realised without also acquiring the forms of knowledge which permit performance in a particular situation. Consequently, a key goal is to develop higher order procedures and deep conceptual knowledge of a domain (e.g. nursing, hairdressing, carpentry), in a particular situation, and, in doing so, secure long-standing truths of the vocation (sociocultural knowledge). It is these forms of knowledge which should be carefully stated as more general forms of curriculum intents, whereas the specificity of these intents can best be negotiated in the particular circumstances where the activities are undertaken.

(ii) Providing guidance

In developing these forms of knowledge, the guidance of expert others and peers will be necessary to provide both close and indirect forms of guidance, to engage in interactions and to monitor progress. The guidance of peers and expert others, does more than serve as modelling, it mediates learning, provides structure, highlights task relevance and enhances connections, not only to particular circumstances, but also to others (Pea 1987). The indirect guidance of peers and the physical environment will need to be supplemented by the dual guidance of expert others and peers who are able to provide access to knowledge which is unlikely to be constructed, without its access being made available, or without support in the development of procedures. Models of guided learning such as those provided by Collins, Brown and Newman (1989), Rogoff (1995), and Brown and Palinscar (1989) are likely to be useful because they seek to secure strategic forms of knowledge in combination with situationally-specific knowledge. The use of analogies, stories and examples may well reduce the transfer gap. Analogies appear to be particularly useful in making links between what the learner should know and what they already know, thus making transfer 'near'. Perhaps one of the most useful roles for guided learning is to make transfer 'near', thereby establishing a basis to develop new cognitive structures.

(iii) Opening up possibilities for knowledge application and transfer

Consistent with the above, an important role for instruction and guided learning is to emphasise the possibilities and variations in situations in which the knowledge is likely to be applied. Rather than emphasising the 'one best way', variations could be referred to and activities constructed to consider the prospect of different use of the knowledge, thereby exploring the parameters of the domains in which the knowledge is to be deployed. What is the difference between a carpenter's need to locate levels during the construction of a new house compared with one that is being renovated? Or, for example, what are the different roles and duties of nurses in rural and metropolitan hospitals? So while embedding the learning for a particular circumstance is necessary, an emphasis on how that knowledge might be used in other circumstances is also important. So, in this way, a process of instruction which focuses on embedding and disembedding knowledge may assist transfer by broadening the field of potential applications.

iv) Pressing learners to abstract principles

Central to the views of learning and transfer provided above is the assumption that learners are 'meaning makers'. Much of cognitive constructivist instructional practice emphasises pressing learners into playing an active rather than passive role in problem-solving activities. Part of the purpose of this is to draw out salient principles for practice, so that these are not wholly located in the circumstances of their acquisition. Questioning dialogues and analogies are ways in which this goal could be secured (Pea 1993). It is also necessary to develop the ability to abstract principles at the sociocultural level in ways that are likely to inform practice across applications of this

knowledge in different communities of practice. Glaser (1984) holds that understanding (deeply associated conceptual knowledge) is a product of reflective and critical skills. It is this ability which is likely to aid the disembedding of knowledge from a particular circumstance, thereby permitting transfer to another embedded circumstance.

(v) Provide access to authentic application of knowledge

Providing access to, and engaging learners in, authentic activities, in those circumstances where the knowledge is to be applied, is likely to assist the embedding of knowledge at the community of practice level. In a study which compared modes of vocational skills development, the students who had a structured mixture of both an institutional instructional environment and the workplace (apprentices), reported the greatest ease of transfer of knowledge between those environments, than did those learners who had experienced only the workplace or only participation in formal learning settings (Billett 1993).

These approaches to instructional practice have common and compounding roles, namely: embedding knowledge in particular circumstances; providing for learners to disembed knowledge and transfer it elsewhere; and presenting transfer as being 'near' rather than 'far'. Thinking skills alone (Sternberg 1989) will not be sufficient to permit transfer, because it needs to account for the social and cultural aspects of thinking and acting, as similarities and abstracted meaning are not objective or singular. Rather, meaning is embedded in circumstances and situations. Hence, the social and cultural aspects of cognition need to be accounted for in expectations of transfer and considerations of how it might be improved.

Conclusion.

In conclusion, much of the transfer across different communities of practice is likely to be 'far'. This is the case even when the same sociocultural practice (e.g. hairdressing, nursing, carpentry) is the focus of the activities. The knowledge required for performance in different communities is likely to have distinct qualities. Hence, it will be constructed differently by individuals. There is no reason to believe that, on its own terms, any particular setting is likely to provide access to inherently transferable knowledge. Rather, it is the sort of intents that are stated as goals, understandings about what is possible, guidance and activities that are key determinants as to the transferability of knowledge. In adopting an interpretative, but 'situated' and embedded view of knowledge construction and transfer, it is necessary to consider ways in which instruction and curriculum practice can best be used to embed knowledge in one circumstance in order to develop the array of representations of knowledge required for performance, yet also disembedding them in ways which maximise the prospect for transfer. Some suggestions have been advanced about how this might best proceed. Fundamental to the curriculum and instructional practice is that the relationship between

social and cultural factors needs to be accounted for more adequately in the development of the knowledge intended for transfer.

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