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Authenticity in Work Place Settings

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CHAPTER 2

AUTHENTICITY IN WORKPLACE LEARNING SETTINGS

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by

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INTRODUCTION.

The growing interest in vocational education and the development of a wider range of vocational education settings have brought with them questions about how and where vocational skills can best be learnt. This chapter proposes a basis for the development of vocational skills using the workplace as a learning setting. A view of learning is adopted, which emphasises the role of social and cultural context in the construction of knowledge. It is argued that learning experiences in workplaces have the potential to develop the knowledge, understanding and dispositions required for skilled vocational practice. It is also argued that this development requires access to guided learning experiences in the workplace that are socio-culturally authentic, with authentic activity being defined as the ordinary, everyday practice of the culture (Brown, Collins & Duguid, 1989).

The chapter reviews pertinent literature and draws upon two recent studies of skilled workers' perceptions of workplace learning. The findings of these studies support the view developed from the literature that guided learning, within an authentic culture of work practice, embeds the development of vocational knowledge in the context of its use. The chapter concludes by discussing implications of this view of learning for instructional practice within vocational education.

THE CONSTRUCTION OF KNOWLEDGE

The recognition that learners play an active role in their own development has helped displace behaviourist views that learning is something akin to an empty vessel being filled with knowledge that somehow enables performance. Learning is both active and individual (Posner,

1982). Moreover, knowledge acquired by individuals is not objective or 'given', but is constructed and represented in ways determined by personal dispositions and histories (Belenky et al. 1986; Dweck & Leggett, 1988; von Glasersfeld, 1987; Greeno 1989). This construction of knowledge is mediated by the social and cultural context in which it is acquired, which includes the socially and culturally derived norms of a community of practice (Lave, 1990; Lave & Wenger, 1991). A community of practice is defined as a set of relations among persons, activity and world over time, and in relation to other tangential and overlapping communities of practice (Lave & Wenger, 1991:98). The culture of practice refers to the activities that comprise and distinguish a practice and the social relations within that practice. These norms and practices are central to the conduct of, and participation in, vocational practice, and, as such, need to be accounted for in learning arrangements aimed at developing vocational knowledge. To examine these ideas, and their application to workplace learning, a review of learning theories within cognitive science is presented and their social and cultural orientations are identified. Firstly, the constructive nature of becoming knowledgeable in vocational practice is discussed. Views developed in this section about the processes of learning are then compared with views from related disciplines.

A 'constructive' view of learning emphasises active and interpretative knowledge acquisition, as individuals integrate and extend their knowledge in an effort to maintain its viability. The viability of knowledge is defined in terms of a 'fit' between the existing internal organisation of individuals' knowledge, based on previous learning and dispositions, and their on-going interaction with the world (von Glasersfeld, 1987). This process is analogous to Piaget's (1966) notion of the learner's quest for equilibrium. Individuals seek to 'make sense' of what they see and experience. The viability of knowledge depends on the fit between the existing knowledge of the individual and the way it reflects what the learner continuously observes and experiences. The structure of knowledge is based on what the individual experiences and how it is interpreted through their filters of interest, values and affect. These interpretations lead to the prioritisation and categorisation of what the learner experiences.

Hence, an individual's representation of knowledge in memory would be unique to that individual, being dependent on their experiences, interests, values and affect. However, although a constructivist view of learning presents an idiosyncratic approach to the organisation of

knowledge, this does not necessarily imply a chaotic ordering, which impedes communication with others. Only when individuals' concepts manifestly clash will they fail to be compatible enough to form the basis of communication (von Glasersfeld 1987:7). Moreover, it has been suggested that different interpretations are a necessary part of any social encounter because, if interpretations were identical, there would be little need to communicate (Newman et al, 1989).

To illustrate this constructive process, consider two individuals acquiring an understanding about a piece of equipment, by looking at it, and hearing about it. The task of understanding the purpose and operation of the piece of equipment is likely to be different among learners, given each individual's previous knowledge and experience (Posner, 1982). Understanding might be similar in terms of the equipment's function, where the function is highly visible, whereas understanding may differ about the equipment's operation. For instance, one individual might have developed an understanding about the operation of pistons from a text book diagram, while the other from using a bicycle pump. Although a discussion about the function of the equipment may not reveal differences in understanding, a more detailed interchange about its operation may reveal variation in understanding. That variation might be based on a range of factors, for example, a misunderstanding about what actually makes the equipment operate. Such a situation might be resolved by providing access or insights which helps establish a 'fit', to render the two forms of understanding viable. Yet alternatively, understanding might be based on experience with critical factors of the equipment's operation. In this circumstance, assurances, from someone without such experience, that a particular component is not troublesome are unlikely to be accepted as viable by an individual whose experience with that component has been one of constant breakdowns.

A second dimension of this interpretative view of learning also needs to be taken into account. This relates to the values of the learner. The worth that individuals place on knowing about a piece of equipment will determine whether they will even bother to consider its operation and function. Learning, particularly when it involves undertaking any active thinking, is effortful. As a consequence, the amount of effort expended by individuals in learning something will be related to the value placed on acquiring that knowledge (Goodnow, 1990; Pea, 1987).

How then do knowledge and understanding develop so that communication and engagement in

the common practices of a vocation occur? Two perspectives are commonly acknowledged within a constructivist view of learning, the Piagetian and the Vygotskian (Glaser & Bassok, 1989; Rogoff, 1990; Roth and Roychoudhury, 1991). Each perspective makes a valuable contribution to an understanding of cognitive development. However, they can be differentiated by the roles they ascribe to social interaction, in the learning process. They also differ about whether cognitive development is a precursor to, or dependent on, knowledge. Taking the first difference, Piaget proposed that individuals seek to secure equilibrium between antagonistic viewpoints in order to generate viable knowledge (Taylor, 1991). On the other hand, Vygotsky (1978) viewed knowledge as being collaboratively constructed, through a process of joint problem-solving and decision-making. Taking the second difference, Piaget referred to cognitive development in terms of stages, with each stage permitting increasing levels of complexity in the general application of cognitive processes. However, Piaget's notion of development has been challenged by the significant role now being afforded to domain-specific knowledge in thinking and learning (Glaser, 1984), and the failure of general applications of knowledge to be upheld (Carey, 1984; Chi, 1978; Rogoff & Gauvain, 1984). That is, whereas Piaget argued that the development of necessary cognitive structures is a precursor to stage transition and learning, Vygotsky claimed that learning precedes, and makes possible that development (Taylor, 1991).

From the Vygotskian view cognitive development is realised through social interaction which results in the appropriation or internalisation of culturally-determined knowledge by the individual (Rogoff, 1990:150). Appropriation is defined here as the individualised process of constructing meaning from socially and contextually defined knowledge, using the individual's idiosyncratic structuring of knowledge and understanding. This process has been likened to the intra-individual phase of Piaget's concept of knowledge development (Roth & Roychoudhury, 1991). Rogoff (in press) argues that appropriation and internalisation are not synonymous. She suggests that internalisation implies the passing of external knowledge intact from the outside to the inside, whereas, appropriation is premised on how individuals participate actively with, and interpret, external knowledge - "gaining facility in an activity" (in press:15). This view emphasises again the notion that knowledge is not 'given', but is actively acquired, interpreted and represented by the individual.

Whereas the Piagetian perspective is that learning is essentially self-regulated and intra-individual (within the individual), Vygotsky viewed learning as being social or inter-individual (between individuals), and emphasised the interaction between cognitive and social activity, a view which is becoming widely accepted (Goodnow, 1990; Newman, et. al., 1989; Rogoff, 1990; Stigler, et al., 1990; Wertsch, 1984). Thus, while much of what has recently been proposed by Glasersfeld (1987) is consonant with Piaget's notion of equilibrium, as learners attempt to integrate new information with what they already know and understand, the explanation is not totally adequate.

The Vygotskian notion of appropriation enables a more comprehensive account of learning, by including the social and cultural mediation of knowledge and understanding, and is therefore used as a basic starting point in this chapter. The choice of approaches has implications for instructional processes. Whereas a Piagetian view of instruction might focus on the actual developmental level of the learner, the Vygotskian view addresses the area of learners' development which can be realised with guidance - the Zone of Proximal Development. Instruction, from this point of view, is a process that seeks to advance the development of the learner rather than being dependent upon the level of development (Vygotsky, 1978). However, as with Piaget's view, this social learning process is not regarded as benign. Appropriation is not simply the enculturation of learners who are helpless to resist. Instead, it is an active encounter between the individual's knowledge and understanding and socially-mediated, culturally-derived knowledge. Thus, as Piaget would argue, it is likely that learners will contest and challenge the externally-derived knowledge with which they are confronted, as they attempt to establish the compatibility of their understanding with what they experience. That contestation is likely to be stronger when existing understanding and beliefs are challenged. Consequently, this learning process is viewed as being problematic, rather than benign (Goodnow, 1990).

A SOCIO-CULTURAL BASE FOR CONSTRUCTING KNOWLEDGE.

Vygotsky's view of knowledge construction is founded on two key principles: social relationships and the socio-historical nature of knowledge (Rogoff & Lave, 1984). To consider the significance of a social basis for learning, it is necessary to acknowledge the contribution of

both immediate interpersonal interactions and more distant social and cultural contexts.

Immediate or proximal social relationships, for example between master and apprentice, provide a basis for a collaborative process of problem-solving and decision-making. Rogoff (in press:11) refers to this process as guided participation, which is defined as an interpersonal process in which people manage their own roles and those of their social partners, and they collaboratively help to structure situations in which they observe and participate in cultural activities. The relationship between the learner and the 'teacher' (master to novice, parent to child or teacher to student) is socially determined, which influences the nature of what knowledge is shared with the learner and how it is shared. Skilled workers may share with novices only information which they determine to be appropriate - in much the same way that parents may withhold information about personal, financial or sexual matters from their children. The reason for withholding information might be in consideration of novices' limited experience and understanding, with a judgement being made that the learning is outside their Zone of Proximal Development. Alternatively, withholding might be to maintain status in the expert-novice relationship. Collaborative problem-solving might also be made problematic by a learner's lack of interest, and hence reluctance to make the effort required to engage in problem-solving.

The social relationship is also shaped by more distant or distal forms of social organisation, such as social influences, the cultural practices which organise work activities, and associated priorities and values, the nature of the physical setting and the institutional structures of the setting. Even the most apparently solitary task is embedded in social practice (Cadzen 1993) or, as Scribner exemplified, (1992:92) "I think of Marx's example of the lighthouse keeper on solitary watch in the beacon tower as a paragon of social labour".

Vygotsky's second principle is that knowledge has a socio-historical basis. What is useful or useless, what should be learnt, what is worth passing on to novices and what practice is inappropriate, are the product of a community of practice (Lave, 1990). Cultural practice, having evolved through application and time, is socio-historical in origin. For example, electricians' work and use of tools are based on the requirements of their vocational activities, which have a hierarchy of tasks based on their complexity. How a particular community of practice guides workers to undertake tasks and use tools is different from other cultures, because the tasks they

perform are different (Brown, et al, 1989). For instance, issues to do with safety have a particular significance for electricians and are a central part of the culture of their work practice. It is this socio-historically derived practice that is expected to be appropriated by novices, as has been demonstrated in a range of cross-cultural studies (Lave, 1990; Lave & Wenger, 1991; Rogoff & Lave, 1984; Rogoff & Gauvain, 1989; Rogoff 1990).

In summary, cognitive development from a Vygotskian perspective is through appropriation, as the individual constructs knowledge and understanding from socially-derived norms and practices, through proximal and distal forms of guidance (Rogoff, 1990:150). The appropriated knowledge leads to a more socio-culturally oriented, and less idiosyncratic, structuring of the individual's knowledge, as the personal history and experiences of the individual merge with understanding within a community of practice. It is proposed here that the degree of appropriation is dependent upon the nature of learning experiences. That is, it is likely that the learner will seek justification of viability from experts, others and particularly from their own experiences as they appropriate knowledge.

VIEWS FROM RELATED DISCIPLINES

Support for the view that knowledge is mediated through social and cultural sources is found within other related disciplines, such as ecological psychology, cultural psychology, sociology and anthropology. These disciplines, in contributing to current understanding about learning, have strengthened the concept of a social and cultural basis for acting and thinking. The ecological psychologist Barker (1978) proposed that setting and behaviours are linked and cannot be dismissed as probabilistic. He concluded that environments consist of structured, highly organised phenomena, which are not passive or probabilistic. He argued that these environments are arenas for events, and a causal relationship exists between the environment and behaviour (Schoggen, 1992:78). This view is consistent with those that suggest understanding and knowledge are influenced by the circumstances of their application - their settings.

Work being undertaken from anthropological perspectives is also supportive of a contextual basis of learning, in that cognitive properties are regarded as being embedded in contexts, rather than in isolated minds (Pellissier, 1991:80). The idea that cognition is structured by activity,

with cognitive processes being tied to applications, or put more succinctly - that activity structures cognition - also finds support within sociological work (Scribner, 1985). Lave and Wenger (1991) have emphasised the significance of learning processes within a community of practice, which involves novices in increasing levels of participation, as they move from peripheral activities to more complex elements of practice. Moreover, in emphasising the social and cultural basis of practice, it is argued that full participation is more than being technically competent; it is also concerned with being able to function within the community of practice (Lave & Wenger, 1991). Thus, participation requires the possession of understanding, in order to be able to engage in the culture's discourse.

COGNITIVE SCIENCE CONCEPT OF EXPERTISE

Despite the similarity of shared concerns between cognitive psychology and the socio-cultural theories of learning, full resonance is still lacking between these bodies of literature. In this section some links between the literatures are advanced, using the concepts of representation and problem-solving, which are acknowledged in both sets of literature as being central to expert performance.

As argued above, the way an individual interprets or represents events and experiences (Posner, 1982) is fundamental to the construction of knowledge. Representation is defined as embodiments or interpretations of ideas and can be verbal, pictorial, diagrammatic or physical (Prawat, 1989). The quality of representations has a range of consequences for cognitive activity, particularly because representations are central to complex performance or expertise. For instance, being able to apply skills in novel situations distinguishes experts from novices (Ericsson & Simon, 1984; Wagner & Sternberg, 1986). This requires possession and use of appropriate cognitive structures for solving problems. For instance, experts' abilities to categorise problems effectively are based on how they represent the problem, and this categorisation assists their solution (Glaser, 1984). Cognitive scientists also recognise that which is common between previous experience and problem states is not 'given' or objective, but is individually interpreted (Gelman & Greeno, 1989; Pea, 1987; Posner, 1982; Prawat, 1989).

Prawat (1989:3) argues that representations play an important role in problem-solving as "they

can give meaning to an abstract concept by highlighting certain properties of the concept", and, in the form of analogies or metaphors, they can facilitate the transfer of knowledge from one domain to another. Extensive prior knowledge and understanding provide a base upon which experts are able to draw when categorising problem states and/or breaking problems down into workable and solvable chunks (Chi, Feltovich & Glaser, 1981). Some parts of a problem will require greater attention than others. More familiar parts can be addressed more easily, even tacitly, freeing the thinking processes to concentrate on the unknown parts of the problem. Representations which are strongly indexed to purposeful applications are those more likely to be recalled and utilised than those which are substitute or artificial (Brown, et al, 1989). Consequently, socio-culturally authentic learning experiences where applications are clear are more likely to generate purposeful representation and categorisation and, hence, facilitate problem-solving.

To illustrate these concepts, consider the following example. The mechanical problem faced by novice motor mechanics will be different from that faced by their more expert counterparts. Expert mechanics will categorise the problem by its means of solution (Sweller, 1989), which is made possible by their possession of a highly developed and organised array of procedural knowledge. The way the problem is represented is central to the categorisation process as it enables the most appropriate solution strategies to be selected. Once a solution path has been selected, the expert actively monitors for anticipated patterns of responses, as the vehicle is being repaired, to validate the initial choice of solution strategy (Eylon & Linn, 1988). If unanticipated events occur during the task, the monitoring informs the expert that the initial diagnosis was incorrect. This leads to further exploration and monitoring and, possibly, a change of strategy. However, the actions of the expert are not guided solely by general problem-solving heuristics; rather they are guided by an interaction among domain-specific propositional knowledge and procedures, conceptual knowledge and higher order procedures (Perkins & Salomon, 1989).

In contrast, novices may not be able to categorise the problem, determine if it is crucial or trivial, choose strategies for its solution or monitor solution progress. These limitations are due in large measure to the kinds of representations available to novices. For instance, they do not have the extensive experience necessary to form culturally sensitive and authentic representations of different kinds of mechanical problems. Nor would they have the experience in solving such

problems or knowing when the solution strategies need revision.

Thus, underlying these processes, is the idiosyncratic nature of individuals' representation of problems. These representations are partially dependent upon the observed socio-cultural context, within which motor mechanics work, the artefacts and tools of their practice, and the tasks they have to undertake (Brown, Collins & Duguid, 1989); yet experiences are still interpreted by individuals as products of interactions with cultural practices and artefacts.

TRANSFER

A criticism advanced against the use of highly specific learning situations is that learning may become bound to that setting eg. learning in informal situations, such as the workplace (Resnick, 1978). However, lack of transfer of learning from one setting to another is an issue for all forms of learning. Research has indicated a lack of transfer between many situations. For example, professional Abacus counters perform poorly when asked to complete paper and pencil maths tests (Stigler, Barclay & Aiello, 1982), and Brazilian street children, with no formal schooling, are able to perform complex calculations as street vendors, yet perform poorly in school-type maths problems (Carragher, Carragher & Schliemann, 1983). Moreover, limits of transfer from formal learning settings, such as schools or vocational education colleges, to other settings has been well documented (Raizen, 1991).

While transfer should and does take place between situations and settings, certain considerations need to be acknowledged. The significance of domain-specific knowledge has been recognised only relatively recently (Glaser, 1984), as has the embedded nature of learning processes (Rogoff & Lave, 1984). Consequently, expectations about sweeping transfer of knowledge may need to be reconsidered, given these advances. What is important is that transfer within a domain is maximised, and that limits of application be extended by abstracting principles from one learning situation to another (Pea, 1987; Perkins & Salomon, 1989). It follows, then, that concerns about the degree of transfer ascribed to any mode of learning should not be based on whether the setting for that learning is formal or informal. A more useful basis may well be the potential of a setting to generate learning experiences that lead to robust and transferable learning outcomes.

Such a requirement is premised on the development of, and interaction between propositional and higher order procedural knowledge (Stevenson, 1991). It is proposed here that socio-culturally authentic learning experiences which drive the learner into activities embedded in the context of their use are generative of procedural knowledge, indexed richly to conceptual understanding, which should facilitate recall, transfer and application.

The next section presents a study of the claims of workers about how they acquire and maintain their skills in informal learning settings - workplaces. The purpose of this investigation was to examine whether the theoretical views discussed above are supported within informal learning situations, in which the participants acquired and developed further their skills. Do these workers report acquiring skills in ways which reflect the constructivist and socio-cultural views outlined above? What lessons are there for the design of learning arrangements from the perceptions of these workers and the literature reviewed above?

RECENT STUDIES

Learning in informal settings, such as the workplace, can be dismissed as being ad hoc and peripheral (Resnick, 1987). However, such views are counter to what amounts to common practice within our community. Most apprentices' time is spent learning in the workplace. Surely, the 84% of apprentices time spent learning informally in the workplace cannot be dismissed or discounted? Moreover, the major professions have continued to value the extended periods of workplace practice provided for interns and articled clerks. Surely, these situations are not primarily examples of 'doing time', rather than learning professional skills and attributes?

Two recent studies which surveyed skilled workers' perceptions about the acquisition of their skills produced consistent findings. When skilled workers are asked how they acquired their skills, they frequently state that they have learnt "through experience", by "just doing it", "hands-on", or "listening and observing" (Billett, 1992, 1993a & 1993b). Skilled workers also report valuing learning in the workplace because of the contributions of that particular learning setting - the guidance of experts and the authentic nature of learning activities. The perceptions of these workers appear to be consonant with the social and cultural basis of the theoretical position

outlined above. These two studies are now outlined.

Study 1 - Coal Workers

Method

The first study, conducted in the coal mining industry of central Queensland in 1992, used interviews and a survey to elicit responses from coal workers about the nature of their work and the way they acquired work skills. The interviews, which preceded the survey, were conducted on-site with individuals or groups of workers, and were used to determine what sorts of learning arrangements were valued by mine site workers and why they were valued. In order to verify and elaborate on these data, a survey instrument was developed and administered at mine sites which had not been the locations for the interviews. The respondents to the survey were first asked "*Describe what it means to be a skilled person in your area of work*". The responses to this item were categorised into three types of knowledge - propositional, procedural and dispositional (defined below). The respondents were then also asked how they had acquired the skills for the work they were currently doing by nominating among *Integrated on and off job* (eg. *apprenticeship*); *College or university-based followed by learning on-the-job*; *Learning on-the-job*; or *Another method*. The survey also elicited perceptions about how useful different forms of assistance had been in developing their skills (eg. *External training courses*, *Other workers on site*, *Just by doing it*). In addition, the respondents provided perceptions of the effectiveness of aspects of on-the-job learning experiences. These data were analysed by examining perceptions of the contributions of activities that the respondents had engaged in, and how the support they received from others assisted their learning. Finally, perceptions about the ideal way to acquire their skills for the coal mining industry were elicited. A more detailed description of this study is reported elsewhere (Billett, 1992).

Sample

The sample comprised experienced coal workers. Approximately 75 workers participated in the interviews. These workers comprised a vertical slice of mine site staff. An additional 70 workers from mine sites, different from those where the interviews were conducted, responded to

the survey. Although a representative sample of workers was sought, respondents who held supervisory positions were disproportionately represented in the survey instruments which were actually returned.

Findings

Interviews

The interviews, which were used to gauge perceptions of how these workers acquired and developed their skills, provided a number of insights. Respondents emphasised the value of learning in the workplace and learning from other workers while engaged in everyday work activities. It was reported that for skill development processes to be effective they had to be pertinent to the activities, culture and social relations within the mine site. Instructional processes, as well as instructors, that failed to take account of the values and requirements of the setting were likely to be ignored or dismissed by coal workers.

"Trainers don't know - have different knowledge" (coal worker)

"TAFE out of depth, not relevant" (coal worker - supervisor)

"NMEC (national metal's modules) not relevant - "1,2,3,4, hydraulics are no good, they are over-specified, cover the wrong material - these people need to know how to trouble-shoot, not know about the different systems which they are not concerned with" (coal worker - supervisor)

In only a few situations was expertise external to the mine site valued. For example, the expertise of vendor trainers, whose services accompanied newly-purchased software and equipment, was reported as providing valued insights into how these products functioned.

"Vendor training hits the mark - its specific - hands-on.." (coal worker)

"...its specialised, teaches you how to trouble shoot and is conducted on-site" (coal worker - supervisor)

"Vendor training allows you to look at machine when its stopped, allows you to apply prior knowledge - it's practical and applicable" (coal worker)

However, support for external expertise was qualified. It was not, for example, valued in terms

of how the newly purchased equipment could best be utilised at the mine site. In the areas of earth and coal moving equipment, it was claimed that mine site workers knew more about the effective use of the equipment than the manufacturers.

"Vendor training for operations is `no good'.. we know more about it than they do - operations expertise resides on-site" (coal worker - supervisor)

The interviews disclosed a consistent concern by coal workers about learning arrangements needing to address the context of mine sites. Learning experiences dissociated from mine site activities were not valued.

Survey

(i) Nature of skilled work

The responses to the survey question about the nature of skilled work were categorised into three forms of knowledge: propositional knowledge - information, facts, assertions and propositions (Anderson, 1982); procedural knowledge - techniques, skills, ability to secure goals; and dispositional knowledge - values and attitudes (Prawat, 1989). The categorisation was undertaken by allocating the reported quality to the knowledge type, which was most reflected in the response.

However, this approach has some limitations. Firstly, it is problematic to allocate many of the reported attributes into just one of the categories. For instance, values are influential in the enactment of skills and procedures (Goodnow, 1990). Moreover, some attributes categorised under procedural knowledge include aspects of value and affect. Secondly, some activities classified as dispositional also contain procedural and propositional aspects eg. "independent worker", "team member", "communicator". Thirdly, many facets of skilled work are tacit, and not immediately conscious to the skilled worker (Ericsson & Simon, 1984), which may account for the low frequency afforded to propositional knowledge. Nevertheless, despite these limitations, the findings are of considerable interest (see Table 2.1). The strong response to procedural knowledge is perhaps expected, but the perceived value of dispositional knowledge provide interesting insights into perceptions of the nature of skilled work. These coal industry

workers perceived that being skilled is more than having useful technical skills. Being skilled also included the ability to use those skills within the mine site, independently and inter-dependently, being able to work with other people and being mindful of the context within which work in coal mining is conducted. Further, the attribute that was most commonly reported was the propositional item of "*understanding about work*", which was referred to by 38 participants. It is inferred from this response that these workers valued the importance of conceptual understanding about their work.

TABLE 2.1 ABOUT HERE

These findings support the need to develop the understanding and procedural ability of skilled workers, and address the dispositional aspects of values and attitudes. However, it needs to be emphasised that these different categories of knowledge do not refer to generic capacities; the cognitive structures were reported in terms of their being embedded in the context of their application.

(ii) Acquiring skills

The survey responses to perceptions about how these workers had acquired their skills, and what they believed to be the ideal mode of acquisition, provided some verification of what was reported in the interviews. Coal workers who were interviewed suggested that the workplace was the most useful setting to learn within. In Table 2.2, a comparison between the *Method of Acquisition* with perceptions of the *Ideal Method* for acquiring skills illustrates perceptions of work places' utility for learning. It is noteworthy that many respondents, who had acquired their skills through apprenticeship or full-time university/college, claimed workplace learning as the 'ideal' way of acquiring their skills. Although a number of these respondents claimed their initial method of acquisition was the ideal mode, they were in a minority. There was substantial preference for the on-the-job learning by the integrated mode of acquisition group. Moreover, a majority of those respondents, who had acquired their skills in university or college preferred either on-the-job or the integrated approach.

These responses are interesting for two reasons. Firstly, the status of workers, who had acquired

skills in the integrated or university/college approach, is linked to their vocational preparation. Consequently, these data provide even stronger support for work place learning, given that the preference is for lower status preparation. Secondly, as these workers engage in activities which are perceived to be highly complex, it may be that these respondents believe that workplace learning has more potential to develop complex vocational skills.

TABLE 2.2 ABOUT HERE

To examine further perceptions of the efficacy of workplace learning, survey respondents were asked to report what they perceived to be effective about this mode of learning. The responses were allocated to one of three categories: those that refer to i) authenticity of activities, ii) the quality of workplace learning activities, and iii) the guidance of others (Table 2.3). The categorisation was based on statements from the survey. Other statements interpreted as having the same meaning, as one already categorised, were aggregated and their frequency reported.

TABLE 2.3 ABOUT HERE

All three kinds of contributions to learning are well supported. The responses to the authenticity of work place activities referred to the reality of tasks which provide contextualised goals and access to models and practice. The quality of work activities stressed variety, autonomy, practice, hands-on experience, self-directed approximations of the task, and engagement with the task. These reported qualities of workplace learning experiences are consonant with those which have been shown to press students, within the practical settings of formal learning settings, into higher order thinking activities (Stevenson, 1986a, 1986b, 1991; Stevenson & McKavanagh, 1991). It is suggested that the quality sought in learning activities is a product of the everyday practice at the mine sites - authentic activities. However, the contribution most frequently reported was the 'guidance of others'. It was suggested that more experienced others provide both direct and indirect guidance. This guidance was reported in the forms of observation and listening, modelling and joint problem-solving. It was also evident that the contributions of more expert others was accepted and welcomed. Presumably, this facilitates guided appropriation (Rogoff, in print) of the knowledge and understanding required by coal workers.

These data are interpreted as being supportive of learning being an active, constructive and social process, as learners derive meaning from what they experience using direct or indirect guidance of others and expert others. Moreover, respondents in this study suggested that workplaces provide the sort of learning experiences which are effective in pressing learners into high order cognitive activities. It is representations, developed from these sorts of cognitive activities, which are possessed and deployed effectively by vocational experts.

This initial study was conducted within an industry which has a strong and pervasive culture and identity. These factors are likely to be exacerbated by the geographic isolation of coal mine settings and communities. Consequently, the findings of this first study could be challenged, as being peculiar to that industry and workplace culture with a tradition of informal skill development. Nevertheless, the study indicates that, for these workers, workplace learning is perceived as being effective. The responses about the efficacy of the learning arrangements support the theoretical discussion outlined earlier, with learners actively engaged in culturally-derived tasks, being indirectly guided by what they observe and hear, and approximating tasks under direct guidance of expert others. The learners' experiences were situated in a community of practice, being mediated by direct and indirect guidance of others, with tasks and activities being influenced by the broader or distal social or cultural context of the mine site. This initial study prompted a further and broader study to determine whether similar findings would be evident in other industries and occupations.

Study 2 - Workers in Other Industries

Method

The second study was conducted across a range of industries in Queensland. The study used a survey and interviews of workers with five years or more experience. Data were elicited about the attributes of skilled¹ workers, characteristics of skilled work and the ways in which workers had initially acquired, and continued to maintain, their skills. A survey instrument was developed, trialed, refined and administered in a range of industry settings to groups of skilled

¹. 'Skilled' here is taken to include all forms of skilled work, no matter how sub-classified - unskilled, semi-skilled, non-trade, professional. See below for categories.

workers (see Billett, 1993a).

Instruments

The survey instrument sought to elicit information about the nature of the respondents' work, what it means to be a skilled worker in that type of work, how the skills were acquired to undertake those work activities, the utility of this mode of skill development, how it could be improved, and preferences for the ideal method of acquiring the skills needed to become a skilled worker in those occupational areas.

Procedure

The survey instrument was distributed in a range of industry settings, involving secondary processing, hospitality, retailing and transport work. A supplementary group of forty tradespersons and para-professionals was also surveyed to assist with achieving a more balanced sample. In all, 249 useable responses were coded and analysed.

The interviews aimed to gauge more detailed perceptions about experiences with the methods of skills acquisition and development, across a wide range of occupations. The interviews comprised two sections. The questions used in the first section reflected those in the survey, as detailed above. In the second section, interviewees were asked to think about the last time they had to solve a problem for which they did not have the necessary skills or knowledge. The following questions were then asked.

- . *How did you go about learning what you needed to know?*
- . *Who or what in the organisation helped?*
- . *Did it work?*
- . *If so why?*
- . *When has this type of learning failed to be useful?*

This procedure was adopted to improve the quality of self-reporting, which has been criticised for a lack of validity (Ericsson & Simon, 1984). By responding to a particular situation, it was

thought that the interviewee's responses would be more likely to be accounts of events, rather than mere opinions.

Samples

The respondents to the survey were classified into one of four common sub-categories of work types - unskilled & semi-skilled, non-trade skilled, tradeworkers and professionals. The term 'unskilled and semi-skilled' refers to common classification within workplaces, not their actual required levels of skills or competence. Examples of 'unskilled and semi-skilled' work types included process and production workers and shop assistants. The 'non-trade skilled' category included work types commonly categorised as having a greater degree of autonomy, although not being classified as trade-skilled, for example secretaries, clerks and shop managers. The third category, tradeworkers, included electricians, hairdressers and builders. The final category was professional workers, such as doctors, stockbrokers, and engineers.

Interviews of forty-two workers were also conducted. As stated above, the respondents were required to have had at least five years experience in their work areas. However, exceptions were made in some cases where this was not possible. The range of interviewees' occupations was diverse in order to gain insights from different kinds of occupations. The occupations included a stockbroker, forensic scientist, teacher, artist, tradesperson, retail worker, clerical worker, store manager, police officer, nurse, union official, warehouse worker and assistant station master.

Findings

Nature of skilled work

The data on the nature of skilled work reported by respondents were again categorised into *propositional knowledge* (Anderson, 1982) - facts, concepts information and assertions; *procedural knowledge* (Anderson, 1982) - techniques, skills, ability to secure goals; *dispositional knowledge* (Prawat,1989) - values & attitudes (Table 2.4). Procedural knowledge was most

frequently reported, providing 62% of the responses. Dispositional knowledge followed, with this category totalling 30% of the responses; and propositional knowledge, with 9% of the responses. The low rating of propositional knowledge is of particular interest. Explanations may be that either the respondents did not value conceptual understanding or, perhaps, the tacit nature of propositional knowledge conceals its value from the workers. The high frequency of non-cognitive dispositions, which are often dismissed or ignored within vocational curriculum and learning theory, are again particularly noteworthy.

TABLE 2.4 ABOUT HERE

These perceptions of attributes required for skilled work provide a basis for evaluating the effectiveness of different modes of learning and learning experiences designed to develop these different categories of knowledge. However, the data have some limitations, similar to those in the coal workers' study. Firstly, many of the reported attributes cannot be easily placed in just one of the categories. Secondly, some of the attributes classified as dispositional contain procedural and propositional aspects, for example working without supervision, self-evaluation, skill development, and working as part of a team. Thirdly, as stated above, many facets of skilled work are tacit, and not immediately conscious to the skilled worker (Ericsson & Simon, 1984). This may account for the low frequency afforded to propositional knowledge.

Yet, these limitations do not explain the frequency with which dispositional knowledge is reported in these findings. Dispositions seem not to be addressed adequately within the cognitive literature. Although the roles of perceived self-efficacy and strategic procedural knowledge - knowing how and when to apply knowledge - have been acknowledged within cognitive psychology (Evans, 1991, Gott, 1989), this recognition alone does not adequately account for all the personal dispositions reported in these two studies. Strategic knowledge is more concerned with the efficacy of securing goals, rather than whether the learner thinks they are worth securing, as Goodnow (1990) has argued. Moreover, values and attitudes are generally marginalised in current vocational education curricula. These dispositions cannot be adequately addressed in pre-specified performance outcomes which form the basis of current governmentally-sponsored initiatives in vocational education (National Training Board, 1992). Moreover, dispositions, values and attitudes are not objective or given; they are generated from

individuals' personal history and epistemology, and the community of practice in which they engage (Greeno, 1989).

Perceptions of workplace learning

The interviews provided a variety of perceptions about workplace learning arrangements. The reported contributions of workplace activities to learning were categorised using the same categories as for the coal workers' study: i) authentic of activities; ii) quality of learning activities; and iii) guidance of experienced others (Table 2.5).

TABLE 2.5 ABOUT HERE

i) Authentic activities

The interviews provided perceptions of how authentic work activities contribute to the development of knowledge and understanding. The utilities of actually undertaking work tasks and having to respond to the genuine demands of the work activities, were endorsed as positive learning experiences. The authenticity of the setting was also reported as having pressed learners into situations where they had to solve problems and develop understanding about the nature and quality of work performance. In addition, it was claimed that the authentic experiences provided learning which resulted in outcomes that are robust and aid retention.

ii) Quality of learning activities

As reported in the previous study, the active and engaging nature of workplace learning was emphasised by the interviewees. Phrases, such as 'doing', 'trial and error' and 'being able to try', connote a form of learning which is active and engaging. Moreover, the value of learning autonomously was also reported as being highly engaging and demanding in developing understanding. It is postulated that these type of activities press learners into higher order thinking and place them in a highly active role, not only in initiation of the task, but also in the

monitoring and self-regulation of task performance (Stevenson, 1986a, 1986b, 1991). This approach to instruction, as long as the tasks are within the learners' Zone of Proximal Development - that is where they are able to achieve with some guidance - could assist with development of the array of procedures required of experts.

iii) Guidance of others

A number of interviewees suggested that access to, and guidance of experts and other workers was of great utility in their learning. It was reported that on-going everyday guidance provided a form of support which permitted monitoring of an indirect nature. Also, the actions of both more and less experienced peers, permit a form of modelling, as novices compare their performance with those around them. The culture of work practice is also evident in the daily activities of the workplace which provides norms and exemplars for appropriation of work practice (Lave, 1990).

Limitations of workplace learning

As with the first study, some respondents in both the survey and the interviews, were critical of workplace learning arrangements. The areas of concern were about maximising benefits from guidance of expert others and the structuring of learning experiences. Concerns about the guidance of other workers were associated with availability, access and willingness of mentors to provide guidance and support (Table 2.6). In addition, it was suggested that some form of structure be provided to remove "ad hocery" of learning experiences. This need accords with that of Lave and Wenger (1991) that, in seeking coherence of learning experiences, it is necessary to move the novice from the periphery of practice to full participation. This involves providing opportunities for the novice to become competent in peripheral tasks and to move through the increasingly complex tasks of the community of practice. Finally, concerns about being unable to access the range of guidance and support were made by learners, who had experienced isolation. Responses to the question about ways of improving workplace learning, included suggestions about more time with 'expert others', more time in the learning process, maintaining currency of trainers' knowledge and the need for structure in workplace learning

programs.

TABLE 2.6 ABOUT HERE

One of the clearest outcomes of the second study was strong support for learning through engagement in authentic occupational activities, supported by the direct and indirect guidance of others, and the active nature of authentic work tasks. Although these activities are not always intended as learning activities, they were reported as engaging the learner in thinking processes that are analogous to those reported as pressing students into higher order thinking in TAFE settings (Stevenson and McKavanagh, 1991). The guidance provided by expert others, in both direct and indirect ways, together with the work activities, allowed learners to observe, conceptualise and attempt increasingly mature approximations of tasks.

Notably, respondents with problems of access to these types of learning arrangements, such as those who are physically isolated in some way, referred to the frustration and slowness of learning without expert support. Some of these latter respondents reported having developed strategies to access support. Moreover, these learners did not want just any support, they wanted assistance by experts who could provide access to information that was otherwise inaccessible.

However, it should be noted that a number of skilled respondents did emphasise the need to develop theoretical knowledge and understanding, and expressed concern about the ability of workplace learning to provide this knowledge adequately.

IMPLICATIONS FOR THE DEVELOPMENT OF VOCATIONAL EXPERTISE

The theoretical discussion in the early sections of this chapter has focussed on the way knowledge is constructed by individuals. It has been argued that this construction is mediated by the social and physical context of the application of the knowledge. It has also been postulated that this process leads to the appropriation of socially-derived norms and practices of occupational activities. However, it has also been argued that the nature of appropriation is problematic. Individuals do not simply 'internalise' externally-generated knowledge, but seek

viability with existing socio-culturally derived knowledge and understanding. Such a view of learning has consequences for the development of expertise in both formal and informal learning settings. In this section, these implications are discussed.

Three general implications flow from the discussions and studies above. Firstly, the development of knowledge for vocational practice needs to be conceptualised as a learning process, rather than a teaching process. Knowledge and understanding are not wholly transferable from one person to another, and communication is not a simple means of conveyance (von Glasersfeld, 1987:11). Secondly, learning processes need to be embedded in the socio-cultural context in which knowledge will be appropriated. This embeddedness allows learners to extend their current understanding through experiences that will make the understanding coherent and applicable to vocational activity. Thirdly, the ability to transfer knowledge is dependent on the development of self-management and regulation skills or higher-order procedural knowledge.

These implications apply also in situations where learning is described as spectacular and transfer common. This occurs when learning takes place in context, is effectively mediated and is functional (Bransford et. al., cited in Pea, 1987). For instance, children in their first five years gain a range of technical and social skills with limited obvious effort. These learners receive immediate feedback on their efforts, while more expert others serve as models for imitative learning and provide structure and connections for learning. In addition, the functional nature of the learning activities assists in understanding the function of information for problem-solving, as it is made explicit to the learner (Pea, 1987:651).

As a way of conceptualising findings from the discussions and studies outlined above and determining implications for practice, it is useful to consider the learning process in terms of activities and guidance. These categories refers to the activities that learners engage in, the guidance of others (industry experts) and the effects of the social and physical context in which that learning takes place.

Activities

It has been argued that learning experiences, which include activities that are socially and culturally authentic, generate viable outcomes. Underpinning the concern for authenticity is the belief that activity structures cognition (Rogoff & Lave, 1984; Scribner, 1985). Consequently, the quality of learners' experiences and the way those experiences are accessed are key factors for learning outcomes. Learning experiences or activities need to stress authenticity in order to be generative of viable knowledge. In the workplace authentic activities are provided gratuitously. However, some structuring and explicit mediation may be required to ensure that learners are provided with a sufficient range of activities to allow development of the complex understanding required for work activities.

The provision of authentic experiences, for learners in formal learning settings, may assist with development of viable understanding. TAFE colleges have attempted to provide authenticity with real-world exercises, simulations and facilities, such as training restaurants and hairdressing salons. Yet these learning experiences, while being useful, remain substitute. Learners are conscious of whether they are working in an authentic restaurant or a training restaurant. Learners are aware that they are students, and the quality of the proximal elements of guidance, observation and demonstration being undertaken are between themselves and their teacher or other students. Learners are also mindful that the activities they engage in are educational, with outcomes, expectations and demands being associated with formal instruction, assessment and certification. Consequently, learners' efforts are focussed on meeting the demands of the formal learning settings, not the requirements of work skills (Billett, 1993b).

Concerns with substitute contexts include the view that it is not sufficient to teach knowledge and procedures in isolation. Learning processes must also focus on conditions of application of the knowledge and skills to be learnt (Brown, Collins & Duguid, 1989). The problems facing learners are embedded in a particular context. Moreover, the solutions to the problem are equally embedded in that context (Scribner, 1985). Hence, curricula for formal setting needs to provide adequate experience with authentic problems and problem-resolving activities. Equally, the nature of work activities makes learning experiences highly active. As stated above, those sorts of activity that allow learners to initiate, trial, monitor and evaluate the effectiveness of approximations of tasks are those that are conducive of developing higher order thinking skills (Stevenson, 1986a, 1986b, 1991; Stevenson & McKavanagh, 1991).

Guidance from others, experts and the social and physical context

A view which suggests learning is a matter of construction, rather than instruction, poses significant questions about the roles of teachers and trainers. Recent innovations and approaches to instruction such as Reciprocal Teaching of Comprehension (Palinscar & Brown, 1984), Cognitive Apprenticeship (Collins, et al, 1989), Apprenticeships Instruction for the Real-World Tasks (Gott, 1989), Apprenticeships in Thinking (Rogoff, 1990), Legitimate Peripheral Participation (Lave & Wenger, 1991), and Guided Participation (Rogoff, in press), all emphasise a social basis for the construction of knowledge and imply the need to place learners in a role which presses them into taking responsibility for constructing meaning and reordering this meaning within a community of practice.

Consequently, the vocational instructor's role becomes one of organising experiences that allow learners to develop their knowledge and understanding, through a process of experience, conceptualisation and refinement (von Glasersfeld, 1987). Such a view extends the concept of teaching practice as making sure the learners are doing the thinking, to one of making sure their thinking is guided towards the effective organisation of viable knowledge. This change in emphasis of the instructional role is exemplified by von Glasersfeld's notion of reinforcement. He suggests that instead of reinforcement being equated to external statements of endorsement or rewards by teachers or experts, it needs to be equated to the learner achieving a satisfactory organisation of knowledge, a viable way of dealing with some sector of experience, and the rewarding consequences of a fit being found within the individual's own system (von Glasersfeld, 1987:15). This does not negate the value of extrinsic rewards, such as verbal reinforcement, but suggests that this is secondary to the inherent rewards that learners enjoy in extending their viable knowledge base.

Teachers in formal learning settings might also consider ways of guiding learners through experiences that facilitate the construction of meaning. Yet, such instructors have the problem of either transforming, or being constrained by, a substitute context. Conversely, informal settings, such as the workplace, appear to be well placed to provide experiences that are generative of a

rich construction of knowledge through engagement in a community of practice; yet they too have problems with making explicit that which is tacit or hidden. Cross-cultural studies have found that, while much learning is undertaken as part of everyday activities, explicit instruction is very much a part of situated learning. For example, Pelissier (1991) reports that learning navigation in Palawat includes direct instruction, with substitute artefacts, such as stones and shells, being used to represent star patterns.

Activities and tasks are central to considerations about the development of robust representations and understanding (Posner, 1982). However, the organisation of experiences is more than setting tasks. What is set for learners may not be what they engage in. The task, set as a problem-solving activity, may well turn out to be a trial and error activity (Posner, 1982). However, guidance from teachers, trainers or content experts can include a focussing of learners onto the purpose of the activity. For example, learners may not be able to address a new situation. This might be because they cannot see the linkages between what they know and how they are representing the new situation. Access to existing knowledge and linkages to the new task can be made through explicitly making the connections (Pea, 1987) and using good examples, analogies, models, and metaphors (Posner, 1982). In these ways, teachers act as guides in the learner's Zone of Proximal Development, with experiences and guidance making viable, and extending, learners' understanding.

The approach suggested within cognitive apprenticeship of modelling, coaching, scaffolding and fading (Collins, et al, 1989) is a strategy which aims to develop expertise, whether in formal or informal settings. In this approach the instructor models the activity, and then provides support for learners to achieve successful performance, through progressively mature approximation of the expert-modelled task. Similarly, the reciprocal method of learning (Palinscar & Brown, 1984) is also an approach which seeks to make explicit the thinking processes of experts. This latter method, along with the modelling, coaching and scaffolding of cognitive apprenticeships, aims to develop the self-monitoring and self-correcting skills possessed by experts.

However, as reported above, because of concerns about generating sufficient conceptual understanding in workplace learning, interventions designed for the formal learning setting may still be needed in informal settings. At the same time, the need to instruct explicitly may be more

a challenge in formal learning settings which lack the indirect guidance experienced in authentic settings. Observation of product and process, availability of visual clues and social contact with a range of experts, which are all usually part of workplace experiences, may need to be provided for in other, and more explicit ways, in the formal setting.

Although the indirect effects of the physical context are not always apparent, they can be pervasive. During an interview in the second study reported above, a warehouse worker commented that if he was ever in doubt about how to pack boxes onto a pallet he had only to look around the warehouse to see a library of approaches to this task (Billett, 1993a). Equally, other workers (eg. motor mechanics) will be reminded of previous problem-solving activities as they observe the engine they are working on and its responses to their procedures. These physical clues are particularly important for novices because, until rich representations have been developed, they are more reliant on indexing the physical context. This development of structural representations involves moving from context-dependent thinking to context-independent thinking (Prawat, 1989:20), a quality possessed by experts. Formal learning settings may not always provide the appropriate indexing. Thus as argued elsewhere (Billett, 1993b), learners whose only experience of vocational activities is provided by the substitute environment of formal learning settings may develop conceptualisation and representations which are dysfunctional in terms of application of vocational skills in the workplace. Consequently, early access to authentic settings of vocational practice is recommended, to achieve the development of conceptual understanding based on the authentic context of the vocational setting, rather than the substitute context of the formal learning setting.

CONCLUSIONS

The studies reported in this chapter provided consistent findings. The frequencies with which different categories of knowledge are reported as being required by workers across a range of different types of work were broadly consistent. In addition, the nature of learning experiences provided in the workplace were reported as being consistent. Also, the participants' responses provided broad support for the theoretical position advanced in this chapter.

When workers in both studies were asked to state the characteristics of skilled workers, they

provided consistent responses in the reporting of the attributes required for skilled work. Procedural knowledge, was most frequently reported (59%, 62%), followed by propositional knowledge (18%, 8%). It is suggested that, as propositional knowledge is often tacit, its value may be concealed from the respondents. The frequent reporting of attributes, that were categorised as being largely dispositional, (23%, 30%) is of considerable interest. It is inferred from both studies that the values and attitudes which underpin skilled performance are crucial. Yet dispositional knowledge is largely ignored in vocational education curriculum. Moreover, current governmental initiatives, in vocational curricula, which conceptualise vocational activities as pre-specified outcomes are unlikely to emphasise this type of knowledge sufficiently. In addition, this type of knowledge is not sufficiently emphasised within cognitive learning theory.

The studies also produced consistent suggestions for improving workplace learning experiences by giving attention to the authenticity of learning activities, quality of learning activities and guidance of others. In both studies it was perceived that authenticity in workplace learning was of considerable utility. It was suggested that engaging in legitimate tasks, being able to observe both the process being undertaken and the product, and having access to extensive practice provided a good basis for effective completion of work tasks. Workplace learning experiences were preferred when activities were active, varied, autonomous and encouraged the learner to be self-initiating and monitoring. It is argued that the self-directed nature of these learning experiences are likely to secure higher procedural knowledge, as learners are pressed into developing and utilising different categories of knowledge required to respond to legitimate problems.

The data broadly support the theoretical propositions developed earlier in the chapter where learning is perceived as an active process, in which the individual takes the primary role, but where the mediation of others (including expert others) contributes to the development of knowledge. It was evident that learners could proceed without others to guide them; however, the direct and indirect guidance of others was highly valued. This guidance provided access to heuristics, or 'tricks of the trade', which helps workers secure goals. In addition, guidance was reported to permit observation and access to discourse which resulted in developing understanding about the nature of tasks and products. Equally, this guidance in an authentic

setting provided access to the dispositions which characterise skilled workplace performance.

However, limitations of this data need to be acknowledged. The data are based on self-reporting, which may fail to address the tacit nature of aspects of expert action. The data are those workers' perceptions and may not accord with those of others.

The studies reported above are supportive of workplace learning. However, generalisations from these findings should be cautioned. Firstly, learning is not benign. The degree to which any learner will engage in, and benefit from, workplace experiences is effected by their personal history and dispositions. Secondly, in aggregating the experiences of a large sample of workers, it is necessary to note that the reality for individual learners might be something quite different. Learning experiences, in many workplaces, may lack expert guidance and engage learners only in peripheral activities. However, the result might be the appropriation of unsatisfactory learning outcomes. Thirdly, whereas the workplace is reported as providing, gratuitously, experiences that are conducive to the development of procedural and factual knowledge, the development of conceptual knowledge may require explicit instructional intervention.

To conclude, this chapter has advanced an approach to learning which draws upon current theorising and finds support within recent research. Its primary aim has been to develop understanding of the effects of informal learning settings, in order to conceptualise the construction of knowledge for the development of vocational expertise. It is proposed that judgements about the value of learning settings should not be made on the basis of their being either formal or informal. Rather, their capacity to provide learners with experiences that are conducive to developing the bases of knowledge structures and dispositions needed in vocational practice, should be the basis of judgements about worth. The workplace provides a range of authentic conditions for the development of vocational skills and these should be garnered.

The concepts of learning examined in this chapter also pose questions about the efficacy of instructional practice in formal learning settings, such as TAFE colleges. While these conclusions might seem to be critical of such formal learning settings, this is not the intention. Rather, it is suggested that if the situated nature of learning, is ignored, education may defeat its own goals of providing useful and robust knowledge (Brown, et al, 1989).

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Table 2.1: Frequencies of use of different categories of knowledge (Study 1)

Types of Knowledge	Frequency	(%)
Propositional Knowledge - information, facts, assertions and propositions	42	(18)
Procedural Knowledge - techniques, skills, ability to secure goals	136	(59)
Dispositional Knowledge - values and attitudes	54	(23)

Table 2.2: Comparing of Mode of Skill Acquisition with Ideal Method of Learning (Frequencies with % in parenthesis - modes in bold)

Method of Acquisition	Ideal Method of Acquiring Skills				Total
	Integrated	Uni/College	On-the-job	Other	
Integrated (n =28)	5 (7.7)	0 (0.0)	21 (29.2)	2 (3.1)	28 (41.8)
Uni/College (n = 12)	3 (4.6)	4 (6.2)	4 (6.2)	1 (1.5)	12 (17.9)
On-the-Job (n = 26)	2 (3.1)	0 (0.0)	23 (35.4)	1 (1.5)	26 (38.8)
Other (n = 1)	0 (0.0)	0 (0.0)	1 (1.5)	0 (0.0)	1 (1.5)
Total	10 (14.9)	4 (6.2)	49 (73.1)	4 (5.9)	67 100.0

Table 2.3: Coal workers' perceptions of reasons for effectiveness of workplace learning (numbers of respondents in parenthesis)

Authentic activities as learning experiences

"by doing the job you are not just being told how to do the job you are experiencing it first hand" (4), "things that look `ideal' on paper or in discussion are more often than not considerably harder to implement in reality" (2) "to be able to see at first hand & to practice the given knowledge and skill for operators to perform their work" (3), "sometimes its easier to do and learn things by just doing the job at hand" (3), frequency of use, practice (6). (Total 18 respondents)

Quality of workplace learning activities

"variety" (3), "because of hands on experience", (3) "easier to do the job if you have done it before, - avoid traps for new players" (3), "need hands-on experience soon after theoretical for faster learning and less frustration" (7), "the best way to do anything in terms of understanding is to do it yourself once you know the right way" (15), "experience" (4) "self-direction and motivation" (2), "once you have spent time on the problem the retention of the solution lasts longer" (4) and "learning by mistakes and experience" (2) (Total 43 respondents)

Guidance of others

"you are learning from someone who knows the practical side of the job, and can answer any questions" (10), "practice and guidance" (5) "watch - pick up a lot by watching; listening - listen to what people say to you, pick up the right way to do things; ask questions -in case you are not sure" (2). "if you have two people you have two different approaches to any job, if you are exposed to this you will soon find the best of both worlds and put them to use" (9) "by observing other workers enables the recognition of good and bad habits, thus providing the opportunity for the person to achieve" (3), "problems are always discussed by the workers and it seems the best way to share experiences and solve problems" (2) "you are able to learn a lot from others", "and not make the same mistake twice" (6); "these people are the source of experience and practical knowledge" (24) (Total 61 respondents)

Table 2.4: Knowledge aspects of skilled work (Frequencies with % in parenthesis)

Types of Knowledge	Frequency	(%)
Propositional Knowledge - information, facts, assertions and propositions	88	(8)
Procedural Knowledge - techniques, skills, ability to secure goals	686	(62)
Dispositional Knowledge - values and attitudes	336	(30)

Table 2.5: Perceptions of reasons for effectiveness of workplace learning**Authenticity of activities**

"learning while you are actually experiencing the job" "Thrown in at the deep end, having to deal with people straight away" "better grounding" "because you are there in the actual store where you are faced with day-to-day problems and you learn because it is on-the-spot training", "We could actually see at the job what is being done to us and we used these skills in each and every day of our working life which is much easier to be taught, especially one on one, than what it was in a classroom", "I had to do it and it was quicker and I learned by my mistakes", "you know its right when it works", "Learning on the job I tend to retain much more than in the classroom".

Quality of learning activities

"its much better you can't beat experience" "the Station Mistress would let you do it yourself. I think I learned a lot more doing that than at the gate school.", "I think being able to try and do it is a lot better than trying to explain it and you can see what is going on", "You probably learned better teaching yourself, because its more thorough, rather than skipping over it with someone telling you" when you teach yourself you go more into the workings of why things do what they do, whilst TAFE just teach you the how not why", "Trial and error has a lot to do with it ... if you make a mistake you will always remember that you have done it wrong - but this is how you fix it", "I threw the manual away. It only took me about a week of relying on myself before I remembered it. Through the manual I learned how to do things but I did not actually remember"

Guidance of experienced others

Access to experts - *"you had them there everyday" - they monitored progress and counselled to avoid bad practice".* Learning on-the-job from people who were more experienced - motivation and initiative emphasised. Observation and consultation with peers - *"you see how other people deal with difficult customers.. follow your example", "Seeing what action other people have taken provides guidance on which way you should go or what action you should take", "Not taken apart from other workers. You are with the other workers who are doing the same thing so you can watch them". "What was useful is that most of the people work the same way within the office so how you are taught here really related to how everyone else works and how everyone else does their job in this company"*

Table 2.6: Suggestions for improving workplace learning**Problems**

- . access to expert staff
- . being given sufficient guidance or tutoring. There are limits to what you can achieve with initiative - guidance is required.

"it depends who you are working with" "not knowing. No support, guidelines. It has just been a process of trial and error." "Learning on-the-job in isolation just takes a long time"

- . more time to learn on-the-job with guidance and support
- . reluctance to ask questions of people in workplace

Suggestions for improving this method (frequency in parenthesis)

- . additional time with experts (16)
- . more time in the learning process (24)
- . currency of trainers' knowledge (9)
- . structuring or formalisation of the provision(11)
- . group sharing of ideas (7)
- . texts to support on-the-job learning (5)
- . availability of specialist or specific courses (13).

[should this be here - perhaps in with studies]

If knowledge cannot be legitimated it is unlikely to be accepted by the novice. However, the expert is not the sole source of contextualised knowledge. The legitimation is provided by clues in the environment such as observation of process and product, an understanding of the relationship between what a worker does and how that contributes to the totality of the occupational activity - the process and product of that activity. Equally, observation of and interaction with other learners and experts can provide strong clues. The workplace provides such concrete clues which are particularly useful for the novice, who has yet to develop strong conceptual knowledge based on experience. In an interview with a warehouse worker, during the second study (Billett, 1993), reference was made to a range of examples within the warehouse of how a pallet might be packed.

Having acquired skills through the on-the-job mode what is the ideal way of acquiring skills for your work?

. "one to one between work mates - having someone else give a staff training session that teaches you" Better than computer type training approach "because you can't ask it specific type of questions". #9 mentor #33

. appropriate background - then hands on #8

"on-the-job training from the person who was previously in that position" "written notes are also useful - familiarising people with not only the particular jobs at hand, or the functions that are there to perform, but also familiarise them with their environment." #7

combination of formal education and practical experience - a lot more practical experience. #5 *"if they went to university first ... and then come and spent some time with people like me for a few years" #24 "Probably work your way through the department in the first instance" - then go on to formal education*

"being thrown in at the deep end" but with supervision #27 "If you are learning at Toowoomba, you would learn everything, but if they sent you to a quieter place you do not learn" #37 "Doing the required skills at the station under supervision - first hand practical knowledge at a station under supervision and performing duties under supervision". #41

"working full-time and studying part-time is a good way to learn." " You get experience and you get a bit of theory" - 18 year old have been in an artificial environment all their lives - they don't understand. #29 similar #32

Another significant outcome was that every category of workers reported engaging in higher order problem-solving activities as part of their work tasks.

Surprisingly, the frequency of higher order activity was reported as being similar across all categories of workers, albeit professionals or 'semi-skilled workers'. From this finding that it could be inferred that learning arrangements for all levels of workers needs to address higher order activities, such as problem solving and transfer. An associated finding was the claim by the majority of the respondents that the ability to undertake higher order cognitive activity had been developed in the workplace (Billett, 1993). Such a claim seems quite significant as the development of general attributes associated with solving problems and transfer of knowledge has been seen as the traditional domain of formal learning environments - schools, vocational colleges and universities, while informal settings have been seen as useful in the development of practical knowledge (Gott, 1989).

The requirement to conceptualise problems and understand invisible elements of problem structures is also different across task structures (Groen & Patel, 1988). It is postulated here that this difference may be based more on the nature of tasks than a hierarchy of conceptual levels. Some tasks are opaque whilst others are more visible

and easier to conceptualise. The degree of visibility may depend on the learner's understanding of what is happening in the opaque elements of task structures and this would depend on the socio-cultural patterning of the individual's understanding.

Hutchins E (1991) Learning to navigate in, S Chalkin & Lave (eds) Situation, Occasion and Context in Activity, Cambridge: Cambridge University Press

Notes.

Scaffolding based on Vygotsy's zone of proximal development

As Rogoff and Lave (1984) have reported from their cross-cultural studies there appears to be little in the differentiation of the general ability of either formal or formal settings to produce robust and transferable knowledge.

* need to determine the qualities that are useful in workplace learning to assist with development of arrangements to maximise the learning process.

* thinking and acting is not given but the product of individual determination and interpretation, yet as this learning is configured within a sociocultural context a coherence provided by a culture of practice guides thinking and acting in a more rather than less consistent way.

* as the notion of learning being influenced by external factors unfolds it becomes important to examine the quality of those external influences.

	Piaget	Vygotsky
learning process	intraindividual (individual)	interindividual (social)
social-interaction	antagonistic - seeking equilibrium	collaborative basis for learning
inter-subjectivity	each operating on the others ideas	move towards identical representations of ideas and objects

* should this be here

The examination of authentic activities' role in the development of skilled work links two distinct, but converging bodies of literature. Firstly, contributions from cognitive psychology will be used to refer to the sort of knowledge types required for expert performance (Evans, 1991; Stevenson,1991). The array of knowledge types are viewed as internal structures which underpin thinking and acting. This literature provides insights to the sort of knowledge types and cognitive abilities required for expert practice. The second body of literature refers to the way in which the knowledge is generated, and proposes a socio-culturally constructed basis of learning. This construction occurs as the learner appropriates knowledge that is constructed by a social and cultural context. However appropriation is differentiated by the individual's interpretation of the physical and social context in which the individual thinks and acts. It is this socio-cultural construction which provides the array of knowledge which forms and develops the cognitive structures. This socio-cultural construction of knowledge has its genesis

within Vygotsky (1978) and anthropological and sociological orientations of cognitive science. Recent work by Lave (1990), Rogoff (1990) and Lave & Wenger (1991) which emphasises learning by engaging in a culture of practice is used to examine the claims by skilled workers that they have acquired complex skills through workplace learning.

The chapter continues by providing an explication and an evaluation of modes of learning situated in a community of practice. The classic model of apprenticeship, (modelling, coaching, scaffolding and fading) is examined from a socio-cultural perspective (Collins, Brown & Newman, 1989). This analysis will particularly focus on guided and autonomous learning activities. The nature of self-initiating and autonomous activities, often undertaken by learners in the workplace, which are conducive of the development of higher order procedural knowledge, required for the transfer of knowledge and applying skills in novel situations are discussed. However, there appear to be limits to the depth of knowledge which can be acquired through a process of observation, listening and approximating mature practice. The lack of development of understanding is often reported by workplace learners. Consequently, the social process of guidance by an expert other which provides a depth of understanding is proposed as being a necessary element of workplace learning.

