

## **Constructing Knowledge in the Workplace: Potential and Pitfalls**

### Author

Billett, Stephen

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### **Constructing knowledge in the workplace: potential and pitfalls**

Workplace learning is commonly used as a means of securing skilful vocational knowledge. This approach to learning, which is usually characterised by guided access to authentic vocational activities, now finds support within the literature of the anthropological and sociological orientations to the study of thinking, acting and learning. It is proposed in this literature that access to a rich source of knowledge is provided by constructing knowledge in the circumstances of its utilisation. Yet imposing questions remain unanswered about both the potential and limits of informal learning processes, such as workplace learning. These questions remain central to the evaluation of learning arrangements which aim to develop skilful vocational knowledge. This paper draws on the findings of three recent studies of workplace learning conducted in Queensland, Australia. These studies are used to examine notions of guided learning situated in the workplace, through undertaking authentic vocational activities. To understand further the efficacy and limits of these arrangements, and in order to develop theoretical principles of workplace learning, the findings of these studies are examined from cognitive and socio-cultural perspectives. The paper concludes by identifying some strengths and weaknesses associated with workplace learning.

Stephen Billett  
School of Continuing Education and Technology  
Faculty of Education  
Griffith University  
Brisbane, Queensland  
Australia

## 1.INTRODUCTION

The use of the workplace as a learning setting is far from being a novel idea. There exists a significant commitment to learning in settings where the knowledge to be acquired is utilised. This commitment is exemplified by the apprenticeships of tradepersons, internships of doctors and with novice lawyers working as articled clerks. Moreover, in Japanese corporations workplace learning plays a key role in the development and maintenance of a skilled workforce, and is viewed as being a part of everyday work practice (Dore & Sako, 1989). In cross-cultural studies the development of culturally-significant knowledge, such as navigation, weaving, tailoring, is reported being undertaken in situations and settings which might be described as being authentic, in terms of how the knowledge is used (Pelissier, 1991). Indeed, it is only a relatively recent innovation to take the development of vocational skills from places where those skills are utilised and locate it within educational institutions (Resnick, 1989), a process which continues. For example, nurse education in Australia has been removed recently from hospital wards and transferred to universities.

Perhaps to justify the relocation of these instructional arrangements to formal educational institutions there have come claims that workplace learning is ad hoc, concrete and pragmatic, although little evidence is offered to substantiate such claims (Resnick, 1989). These claims echo an earlier view of learning (Bartlett, 1958) which emphasised the development of domain-general forms of knowledge which were supposed to be applicable in any context. This view of learning is now being challenged through a growing acceptance that knowledge's origins and transmission are social and cultural products and a product of particular social circumstances (Goodnow, 1990; Pea, 1987). This paper<sup>1</sup> seeks to examine the likely consequences of informal learning in the workplace. What is advanced is that learning in the workplace through everyday activities has the potential to develop in learners a rich base of procedural and dispositional forms of knowledge. Moreover, the development of conceptual knowledge is likely to be premised on access to explicit guidance provided by an expert other. The paper commences with an overview of the current interest in workplace learning, which is followed by an outline of a socio-cultural view of constructivism. Next, some findings of three investigations into workplace learning are briefly reviewed. In particular, the third study provides data about the forms of knowledge that are likely to be developed through workplace learning. Although the studies' findings are consistent and generally supportive of the workplace as a learning setting, the findings emphasise areas of concern or potential pitfalls in these learning arrangements. The

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<sup>1</sup> This paper is a revised version of the one presented at the conference Adult and Continuing Education in a Free Market Economy, Russian Academy of Education, Moscow, 7-10 July 1994.

paper concludes with a summary of some of the potential and pitfalls of workplace learning, synthesised from these studies.

## **2.LEARNING IN THE WORKPLACE: CURRENT INTEREST**

From an Australian perspective, there appears to be four reasons why there is a current interest in workplace learning arrangements. Firstly, for many industries the option of skill development in formal educational settings, regardless of its desirability, is simply unavailable. The public vocational education systems often lacks the expertise and/or infrastructure to secure the development of vocational skills for a range of industries (Billett, 1992a). For these industries, and their employees, the most likely learning setting, is the workplace. Secondly, with the increase in specialisation and complexity of vocational activity (Berryman, 1993) it is evident that the nature of occupational duties, and hence vocational education provisions are becoming increasingly specific. For example, in Australia the widespread introduction of enterprise-based industrial agreements is likely to assist the move away from industry-based occupational activities. As government policy in Australia (Dawkins, 1988; National Training Board, 1992) and other free-market economies (Jackson, 1993) continue to explicitly, and re-actively, link vocational education to industry demands, it is likely that vocational educational arrangements will reflect the specialised requirements of enterprise activities. Thirdly, the demand for greater access to skill development processes, brought about by linkages among remuneration, career progression and skill development, (Deveson, 1990) has precipitated a search for cost-effective options for the development of skills. In this environment the workplace is now being re-evaluated as a highly accessible learning setting. Finally, the fourth interest resides in an emerging view within learning theory which emphasises the construction of knowledge being mediated by the social and cultural context in which knowledge is experienced (Lave, 1990; Rogoff, 1990; Scribner, 1985). This view emphasises the authenticity of the activities being undertaken in order to access, utilise and construct robust knowledge. Such a view has precipitated a re-examination of the contextual nature of learning arrangements, and when considering the development of vocational knowledge, the workplace presents the optimum setting for this examination (Scribner, 1992).

Of the areas of interest in workplace learning mentioned above, the fourth is the key focus of this paper - advancing an understanding of the consequences of workplace learning. This is proposed as a priority because despite theoretical advances a range of salient questions about learning in 'informal' settings, such as workplaces, remains unresolved. For example, what are the potential or likely outcomes of learning in the workplace? What types of knowledge are likely to be privileged in such a setting? These questions remain to be adequately addressed within the

literature and further insights are required to assist with making workplaces effective as learning settings.

### **3. CONSTRUCTING KNOWLEDGE: A SOCIO-CULTURAL VIEW**

Constructivist views of learning, such as those proposed by Piaget and Vygotsky (1978), are becoming increasingly favoured within current research (von Glasersfeld, 1987; Roth & Roychoudhury, 1993). These views asserts that individuals construct knowledge through an interpretative interaction with the world as it is experienced. The Piagetian and Vygotskian perspectives are often differentiated by the degree which the source of knowledge is viewed as being socially constructed (Rogoff, 1990), with the latter perspective placing greater emphasis on the inter-psychological process, those between individuals. The socio-cultural construction perspective contends that knowledge is sourced through the individual's interaction with a world that is socially and culturally shaped. Such a contention is based upon two sets of assumptions. Firstly, the construction of knowledge is mediated by the socio-cultural context of its acquisition, a view which particularly emphasised within Vygotskian perspectives (Engestrom, 1993; Leontyev, 1981; Rogoff, 1990; Scribner, 1985;1990; Vygotsky, 1978). This mediation of cognitive development emphasises the guidance of the social and cultural context. This guidance is seen as being either proximal - the direct interpersonal guidance provided by a more expert other, and, distal or indirect forms of guidance, such as social norms and practice or the physical setting. Specific contexts, which create and utilise norms and practices, within which individuals interact are described as communities of practice (Lave & Wenger, 1991), cultures of practice (Brown, Collins & Duguid, 1989), or activity systems (Engestrom, 1993; Leontyev, 1981). Workplaces can be seen as cultures of practice as they are delineated by different norms and practices. Within the Vygotskian constructivist perspective it is maintained that individuals appropriate knowledge or as Leontyev (1981) states - makes it their own - which is differentiated from the 'internalisation' of knowledge (Goodnow, 1990; Rogoff, in print). Appropriation involves the appraisal, interpretation and construction of knowledge by individuals as they seek to make the new knowledge viable with their existing knowledge.

The second constructivist assumption is that this appropriation of knowledge is based on the on learners' personal histories and epistemologies (Greeno, 1989; Pea, 1987, Posner, 1982). Thus it is argued that individuals' representation of knowledge cannot be the same, but is the product of an idiosyncratic process of construction. The mediation of acting within particular socio-cultural contexts provides coherence for the construction of knowledge which permits it utility in the social world (Newman, Griffin & Cole, 1989).

So within the socio-cultural view it is claimed that all categories of knowledge are, more or less,

sourced by the specific situations or cultures of practice of the application of that knowledge (Lave & Wenger, 1991). Therefore vocational knowledge, is most likely to be accessed and appropriated through engagement with authentic activities of vocational practice. Learning is not viewed as a process which is restricted to teaching, instructional activities or particular settings (Lave, 1993) but rather as cognitive change as individuals confront everyday tasks, whether in the home, at work, or school. In this way learning is ubiquitous in everyday activity through changing participation in culturally-designed activities and settings (Lave, 1993:5-6). It has been proposed that the authenticity of activities, and the direct and indirect guidance provided by workplace practice is likely to develop knowledge, which is at least as transferable as knowledge developed in any other setting (Rogoff & Gauvain, 1984). Utilising this evolving Vygotskian view of learning, instructional strategies have been developed which are based on guided participation in a culture of practice. These strategies include cognitive apprenticeships (Collins, Brown & Newman, 1989), reciprocal teaching (Palinscar & Brown, 1984), guided participation (Rogoff, in press) and legitimate peripheral participation (Lave & Wenger, 1991), which although differing in epistemological assumptions, commonly favour the learner undertaking authentic activities which are sequenced, monitored and guided by a more expert other. A key outcome of these strategies is reported as being the development of procedural and strategic knowledge (Prawat, 1993).

#### **4. STUDIES OF WORKPLACE LEARNING**

This next section reports the findings of three studies which aimed to determine the efficacy of the workplace as a learning setting. The first study undertaken in the coal industry (Billett, 1992b) reports workers' perceptions about the development of skills for the workplace. The second study compared outcomes of participation in three forms of skill development across a range of industry sectors (Billett, 1993a & b). The third and more detailed study evaluated actual workplace-based learning arrangements and the types of knowledge that are generated (Billett, in press). In these studies three forms of knowledge are referred to - *propositional knowledge* (Anderson, 1982) - facts, concepts, information and assertions; *procedural knowledge* (Anderson, 1982) - techniques, skills ability to secure goals; *dispositional knowledge* - values & attitudes (Prawat, 1989). The development, organisation, and deployment of these forms of knowledge are seen as being interrelated and interdependent. Within a domain of knowledge a highly developed base of these knowledge types is viewed as being the key attribute of expertise. Together these forms of knowledge provide the principled understandings and procedures required for complex performance which includes the ability to represent and applying knowledge to new situations.

#### 4a Coal Workers Study

In the first study coal workers in open-cut mines were interviewed, and others surveyed, about how they had acquired and developed further their skills in the workplace (Billett, 1992b). The sample was balanced between supervisors and coal workers in various occupational classifications at the mine sites. A consistent finding was that workers, regardless of whether they had acquired their skills through university-programs, apprenticeships or by learning on-the-job, supported the workplace as a preferred learning setting. It was commonly claimed that external training providers did not understand how skilful work is conducted in coal mines. For example, vocational college teaching and teachers were viewed as being too general and divorced from the requirements of the mine sites. However, outside expertise was valued when it could provide knowledge that was unavailable at the mine site. This was particularly the case if the knowledge accessed could then be developed through immediate application at mine sites. The example of vendor training, that which accompanies the purchase of new equipment, provides insights into the value placed on external expertise. When this training provided an understanding of how the new piece of equipment worked it was highly valued, whereas it was not valued in terms of how the equipment should be used. It was claimed that the workers knew more about utilising the plant effectively than the manufacturers.

In addition to providing evidence of the significance of the socio-cultural context in the learning arrangements the data revealed insights into perceptions of the efficacy of workplace learning. Coal workers constantly referred to learning which involved the direct or indirect guidance of other workers on-site, and, by simply engaging in everyday workplace activities, or as it was described by the respondents, just-by-doing-it. These initial findings were then used to survey coal workers at other sites. The data reported in Figure 1 are aggregated responses using the respondents' descriptions for categorisation.

**Figure 1**

The guidance from 'other workers on-site' was valued because *"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 35 respondents)

Engagement in authentic activities or 'just by doing it' was valued because workers were *"able to see at first hand and practice the given knowledge and skill for operators to perform their work"* (3); have *"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); *"sometimes its easier to do and learn things by just doing the job at hand"* (3), *"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 40 respondents)*

It was evident that the contributions of more expert others was accepted and welcomed, when they were viewed by fellow workers as being credible sources of knowledge. The value of 'guidance of others' is illustrated in the reports of observation and listening, modelling and joint problem-solving. These experiences reflect the concept of guided appropriation of knowledge (Rogoff, in print). The utility of workplace activities, as learning experiences, was accounted for by the provision of authentic work activities, contextualised goals and access to credible models and on-going practice. The quality of these reported work activities, by stressing variety, autonomy, practice, hands-on experience, self-directed approximations of the task, and engagement with the task, placed learners in a highly demanding and constructive situation. These circumstances were advanced by the respondents as being characteristic of a potent learning situation.

#### **4b Modes of Skill Development**

The second study (Billett, 1993a) extended the work conducted in the first study to determine, among other things, if the findings of the coal workers' study were applicable to other industry sectors. This second study investigated what forms of knowledge workers utilise and how these can be developed through three common modes of skill development - formal pre-employment, an integration of attendance at a formal learning institution and learning in the workplace, and, learning on-the-job. The study used interviews and surveys across a range of industries including secondary processing, hospitality, retailing and transport. Findings which reported the contributions of workplace learning activities are classifiable into learning classifiable into: i) authenticity of activities; ii) quality of learning activities; and iii) guidance of experienced others. In the following section these findings are briefly overviewed.

##### **i) Authentic activities**

The respondents reported that authentic work activities contributed to their development of skilful vocational knowledge (see Figure 2). It was claimed that undertaking authentic work tasks and having to respond to the actual demands of work activities, provided positive learning experiences. The authenticity of workplace activities 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. The authenticity of the physical setting was claimed to provide rich clues for learners. In one example, a warehouse worker referred to the library of examples of how to pack pallets that was available all around the warehouse. It was also claimed that the authentic workplace activities provided learning experiences which resulted in outcomes



that are robust and have strong retention. The following extracts from interview transcripts indicate respondents perceptions of the value of authentic work activities as learning experiences.

### **Figure 2. Authentic activities**

*. "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".*

#### **ii) Quality of learning activities**

The active and engaging nature of workplace learning was emphasised by respondents, who referred to learning by 'doing', 'trial and error' and 'being able to try'. The value of learning autonomously was reported as being highly engaging and useful in developing understanding about workplace activities (see Figure 3). It is postulated that these type of activities press learners into a highly active thinking role, not only in the initiation of the task, but also in the monitoring and self-regulation of task performance (Rohrkemper, 1989; Stevenson, 1991; Stevenson & McKavanagh, 1994)). This approach to learning, when supported by the guidance of expert others, with undertaking tasks within the learners' Zone of Proximal Development (Vygotsky, 1978) - that is what they are able to achieve with some guidance - assists with the development of the array of procedures required of experts. Learners are engaged in activities which press them into complex thinking, but have the scaffold of guidance in place to extend and maximise their development.

**Figure 3. 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"*

**iii) Guidance of others**

Notably, respondents emphasised the utility of learning through the guidance of experts and other workers (see Figure 4). Access to expert others and their direct and indirect guidance was highly valued. On-going everyday work practice was reported as providing guidance and support, which assisted in responses to problem situations, and also permitted guidance of an indirect nature. Additionally, the presence of more and less experienced peers, permitted another form of modelling, as novices compare their performance with those of their peers. The culture of work practice is also evident in the daily activities of the workplace which provides norms and exemplars for appropriation of skilful knowledge about work practice (Lave, 1990).

**Figure 4. 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"*

The forementioned qualities of authenticity of activities, quality of learning activities and guidance by expert others need to be seen as being interdependent. This second study supported the findings in the earlier study. Although not intended as learning activities, these experiences were reported as engaging the learner in accessing knowledge that are analogous to those reported as pressing students into higher order thinking in practical activities in college settings (Stevenson and McKavanagh, 1994). The guidance provided by expert others together with the work activities, allowed learners to observe, conceptualise and attempt increasingly mature approximations of tasks. An additional outcome from this study was the claims by socially-isolated learners about their difficulty of gaining guidance in the development of knowledge. They highly prized expert guidance. Their interest in discussing problems with others was more than just sharing ideas it was to seek expertise to appraise their ideas and gain insights which were unavailable to them. These isolated learners reported using strategies by which to access expertise.

#### **4c Workplace-based learning arrangements**

The third study was a four-month investigation of workplace learning in a secondary processing plant, which focussed on the process and outcomes of workplace learning,. This investigation involved eliciting data about and comparing the contributions of `formal' learning arrangements (computer-based learning [CBL] materials; text-based materials; videos and appointed mentors) with the `informal' learning occurring in the workplace through everyday experience. Data about informal learning experiences were elicited and analysed under the categories of *other workers, observing and listening, everyday work activities, direct instruction, and the work environment*, generated in the two fore mentioned studies.

This investigation utilised the stimulated recall of problem situations or critical incidents, from work practice, to elicit data about the effectiveness of the learning arrangements. The

participants were asked to recall recent critical incidents in the workplace which they had a) enjoyed success; b) problem situations which they had difficulty resolving and c) problem situations which were beyond their capabilities. This approach was adopted to avoid some of the limitations of verbal data (Ericsson & Simon, 1984) being dismissed as mere opinion. The respondent were asked to recount actual incidents which elicits realistic data. Having recounted the incidents the respondents were asked to grade the various learning aids in terms of their assistance with the problem situation, or whose contribution was most likely to provide resolution. The 'informal' learning activities were consistently viewed as being highly effective in providing experiences which permitted the resolution of workplace problems (see Table 1).

#### TABLE 1 ABOUT HERE

Table 1 which presents the data about the learning experiences accessed by the respondents are classified between groupings referred to as instructional media-based, and, direct and indirect guidance in the workplace. The latter grouping reflects key components of the situated approach to learning. In the first group, instructional media, the modal responses, for CBL and videos are 'not useful'. The responses to learning guides produced a bi-modal response between 'very useful' and 'not useful'. The perceived lack of efficacy of the instructional media, are contrasted with those to be found in the categories of learning experiences concerned with direct guidance and those concerned with actual workplace activities. Direct interpersonal guidance was highly valued, by the participants in terms of achieving goals, and solving problems and its absence was seen as detrimental to resolving workplace problems. The contributions of the more indirect guidance of the culture of practice and the physical context-everyday activities and work environment were also highly valued.

Table 2 reports the responses to a set of workplace attributes generated at this site in an earlier study (Billett, 1993a). The attributes were classified into categories of knowledge; propositional, procedural or dispositional knowledge. The knowledge category which most effectively reflected the attribute was used to classify the responses. In Table 2 where a particular learning aid scoring a frequency of 7 or more (out of 15 respondents), 'very useful' responses is indicated in this table. The findings in this table reflected a similar pattern to those found in Table 1.

#### TABLE 2 ABOUT HERE

This data again indicates perceptions of the potency of "*Everyday Activities*", "*Observing and Listening*" and "*Other workers*", in the development of a range of knowledge types. In a further

analysis of the same data, workplace attributes requiring access to higher order procedural knowledge were identified. An important facet of accessing this higher order form of procedural knowledge is its role in the application of existing knowledge to new situations or adaptability (Stevenson, 1991). This form of knowledge is central to vocational expertise and responding to new and complex situations. Such a requirement, as well as being referred to in the cognitive literature, was also frequently alluded to by participants at this site as being a requirement of competent work practice. The data presented in Table 3 reinforces the pattern previously revealed in Tables 1 and 2.

### TABLE 3 ABOUT HERE

A more detailed account of the contributions of the informal learning processes are now briefly outlined.

#### **Other workers**

The contribution of "other workers" was highly valued as they were able to tell, explain, and make explicit things that were not immediately observable, thus providing a useful contribution to participants' understanding of work activities. Useful 'mentors', were reported as being those who provided opportunities for learners to engage in learning activities, and, then monitor their progress or provide close guidance. Other workers were also regarded as being able to assist in developing attitudes and values towards work practice that were conducive of effective work performance.

*...the main thing is just having to work with someone you can approach. (novice)*

*Explains everything fully. Not too technically. Not afraid to go over something a few times. (experienced)*

*A good mentor is someone who's willing to go over and over it until you've got it. I know I find it hard to learn things first up. If I'm shown a couple of times, I'm on the train. Plenty of patience, a mentor's got to have. (experienced)*

*Because he pointed me in the direction of it and let me loose with it. And working with him, we sorted it all out. (novice)*

*I find it very hard to grab things straight up. It takes me a couple of times to work it out and then I'm right. If someone just tells me, boom that's how you do it, and walks away, I just tend to scratch my head. (novice)*

#### **Everyday Activities**

On-going practice provided by everyday work activities, was reported as allowing work tasks to

become 'second nature'. This is interpreted as referring to knowledge becoming proceduralised or compiled for smooth performance (Anderson, 1982). Activities were contextualised by the requirements of the work. Participants reported that this context was useful for making explicit the standards and values associated with work practice.

*"It's the only way you can get the pressure of grinding right. And get the knowledge of when everything's right. After a while, with the grinding, you can just tell by the way your moulds slide on the pads whether it's ground enough. It's the only way you can get to learn this job. You can understand the job from the books but, work activities would be one of the only way you can learn it. It's all hands on". (novice)*

*"Being in the lab helps you get a good sense of how, the priority of things, they have to accurate. Everything has to be done to the letter. And it has to be done correctly and everyone has to do the same. Inconsistencies are problems and to keep up, to maintain the reputation of the lab, you have to consistently put out accurate results". (novice)*

The second example illustrates how values associated with work practices can be appropriated by a novice, through engagement in workplace activities and the guided support of other workers. The repeated and explicit nature of external reinforcement, which coincides with what novices experience, provides a strong base for access to and further development of dispositional knowledge (Prawat, 1989). Possession of this type of knowledge is a moderating factor determining the quality of daily work practice, as was reported above.

### **Observing and Listening**

Guidance from more 'experienced others' did not always involve direct interaction, but through more indirect forms of guidance, such as observing and listening. "Observing and listening" was reported as providing a bridge between 'knowing about' something to 'knowing how' it can be undertaken. Whereas observing and listening, in the context of a classroom, are seen as being passive learning experiences, in the workplace, it is proposed as an active mode of engaging knowledge as it was linked to actual vocational activities. This on-going form of learning is essential for the sharing of knowledge that could not be accessed or communicated in other ways.

*You have to always be listening to what's going on, without detracting from the concentration on your work. Because there's always different things going on that aren't - can't be communicated, there's so many things as it is. That different things have to be communicated by word of mouth. (novice)*

Respondents were able to detail situations in which they were able to learn indirectly in this way.

*"Well, we've got some tradesmen that've been around for a long time. They are very skilled group of people. Watching and learning from them is good". (novice)*

*"When Steve's talking to any of the other guys, I sort of listen in. I normally draw something on the board. I just look and listen to whatever is going around. You know, just look and listen". (novice)*

*"I'm always listening to the two-way. And I'm always listening to, what's going on. And, what they're doing to solve the problem, and have a listen and then I go over and ask the bloke what was going on. I say what were you doing over there. Were you having trouble. And he'll tell me. And I might pick something up that way". (novice)*

Learning through listening and observing, was not restricted to novices, with experienced workers reporting it's utility.

*You can never quit learning anything, so your always, looking for different methods of doing things, listening to what other guys are saying, and picking up new trends and methods of doing things. (experienced)*

*Where techniques are involved. With doing various tasks. Particularly, where the technique can vary from person to person. Observing that sort of situation and evaluating that, as long as you do evaluate it. (experienced)*

Moreover, the informal nature of 'learning from others' was illustrated by the communication with other workers in non-work situations. This suggests that accessing knowledge is not forced, but is a normal component of discourse between workers, even during breaks from work.

*At smoko talking about things. I reckon that's when you learn a lot. Just listening .... to the blokes. Like you can't big note yourself. You just listen to what's going on.*

### **Direct Instruction**

Direct instruction was valued when it provided access to knowledge that would have been otherwise inaccessible. For example, production processes that are opaque required being made visible or accessible. According to Berryman (1993) this will be increasingly the case in skilled occupations. Explanations of an explicit nature, were described as being very useful when knowledge was inaccessible.

*There was a steel bar - it was just worn out. But I didn't see it so I didn't fix it. Now if they wouldn't of told me, I wouldn't of seen it, and I wouldn't a fixed it. (experienced)*

*...when the place is operating and during start-up or shut-down. That's about the times that it's most helpful to you because you can actually see, or somebody is actually showing you, while the place is in operation - you can actually see what they mean. It's a lot better than any written text at all. (novice)*

In these ways the respondents reported how these informal learning experiences had influenced their approach to solving particular problems, and other workplace activities. The findings from these studies provide a basis for determining the utility of workplace arrangements. Yet, in addition to these supportive responses a number of concerns about workplace learning were also reported. These concerns are discussed in the next section.

## **5.LIMITATIONS OF WORKPLACE LEARNING**

Some respondents in all three studies were critical of workplace learning. Two sets of concerns emerged, particularly in the second and third studies. These are firstly, the ability of informal learning situations to develop deep conceptual understanding about vocational activities (propositional knowledge) (Anderson, 1982) and, secondly, concerns about the role of personal dispositions associated with engaging in learning activities (Prawat, 1989). Significantly, both of these concerns have relevance to all forms of learning arrangements.

### **Concerns about understanding**

The most commonly expressed concern about workplace learning advanced by respondents was about understanding, that is developing the requisite depth of conceptual or propositional knowledge. Concerns about understanding were twofold, gaining enough access to the 'expert others' and the effectiveness of informal learning, of itself, to develop the depth of understanding required for competent practice. The concerns about the guidance of other workers were associated with availability, access and willingness of expert others to provide guidance and support. In addition, a form of structure was requested by some respondents to remove the "ad hocery" of learning experiences. This suggestion accords with a view that argues for the necessity of moving the novice from the periphery to full participation in practice (Lave & Wenger, 1991). This structuring of experiences involves providing opportunities for the novice to become proficient in peripheral activities and then to move through the increasingly complex activities of a community of practice. However, respondents emphasised the need to develop theoretical or conceptual knowledge and expressed concern about the ability of workplace learning to develop an adequate base of conceptual knowledge. The following statements are expressions of this concern, as reported by some participants.

*"You are probably shown the quickest way to do the job, but not the correct way. They show you the shortcuts. ....not knowing why your doing what you've been told to do ie. changing? a diverter, why are you diverting material and where to? (novice)*

*".. didn't understand what the job was all about - I just done a job. (novice)*

*".. did not provide an overall understanding of material ie. subject matter and technical*



*problems with matters, characteristics, contaminations, etc". (novice)*

These examples of concerns about the lack of access to conceptual knowledge illustrates a need for workplace learning arrangements to explicitly address this lack of access. Although workplaces provide rich opportunities to access procedural knowledge, they may fail to elicit deep understandings, unless access to this knowledge is explicitly addressed. Prawat (1993) has argued that authentic problem-solving activities can be used to rigorously assess procedural and strategic knowledge, that they may be less effective with the development and assessment of conceptual understanding. The tacit understandings of more skilled workers, may need to be made explicit in workplace learning. Evidence from cross-cultural studies suggests that although the learning of culturally significant knowledge is undertaken as part of everyday activities, explicit instruction is also used. Pelissier (1991) reports Hutchin's work on learning navigation in Paluwat which includes direct instruction, using artefacts, such as stones and shells to represent star patterns. Equally, Vygotsky (1987) argued for a direct role for instruction in scientific concepts and noted the capacity of this conceptual knowledge to elevate knowledge acquired through experience. Consequently, explicit use of explanation, diagrams or stories may be required to assist access to conceptual knowledge in workplace learning.

### **Personal dispositions of learners**

A confounding issue for all learning processes, and one which was particularly evident in the third study is the individual differences in the levels of participation in the workplace activities, and hence accessing knowledge. Some participants engaged very actively in their approach to learning, maximising their involvement in the activities, and, were subsequently credited with having made substantial progress in the development of their knowledge. It would seem reasonable to infer that those who actively accessing knowledge developed greater understanding and more finely honed procedures, than those who accepted a passive role (Stevenson & McKavanagh, 1994). However, it was evident, from some participants' comments on the learning processes and aids, that they did not welcome, enjoy or value the array of learning opportunities being made available to them. This reluctance to be involved was reflected in the low levels of development reported in post-testing, as assessed by on-site experts.

Willingness to participate in learning arrangements is usually attributed to personal values and dispositions (Dweck & Leggett, 1988). The decisions about participation are linked to ideas about the benefits of participation. Individual's perceptions of the likelihood of success may be a determining factor. The significance of dispositions is also advanced by Goodnow (1990) who states that appropriation is problematic, rather than benign, with the learner determining the degree and nature of the engagement in the learning process.

The forementioned studies provide claims about the efficacy of workplace learning arrangements. These have been probed by the use of surveys, interviews and stimulated recall of work-based problems. They have indicated the types of knowledge that are most likely to be generated through workplace learning experiences, and the types of experiences that are likely to assist in that development. Although not complete or conclusive the findings generated in these studies lead to some tentative conclusions which themselves require further and more detailed inquiry.

## **6.POTENTIAL AND PITFALLS OF WORKPLACE LEARNING**

### **Potential of workplace learning**

In the studies reported above the potential of learning in the workplace is advanced in terms of the development of a range of knowledge types associated with vocational activities. This development goes beyond that of procedures (how to do it) knowledge, which are claimed to be best developed in the workplace (Gott, 1989), and through the provision of authentic problem-solving activities (Prawat, 1993). The findings above report the respondents accessing propositional and dispositional types of knowledge, through workplace activities, as well as procedures. The access to these types of knowledge is realised through learning experiences that are authentic and guided by other workers, qualities which are usually available in the workplace. In addition, the very active, and constructively learner-focussed nature of workplace activities is postulated as pressing learners into a mode of knowledge acquisition, which is conducive to accessing higher orders of procedural and deeper conceptual knowledge (Stevenson & McKavanagh, 1994). From a constructivist view the press of this engagement affords another key quality - reinforcement. Reinforcement, from a constructivist perspective, consists of the satisfaction that individuals experience when they are able to adapt new stimuli to their existing knowledge structures, or put more simply 'making sense' of the stimuli (von Glasersfeld, 1987). As individuals acquire knowledge they experience reinforcement as procedures become more effective, predictions are realised through monitoring and task goals are achieved to a standard required by the culture of the workplace practice.

These studies then present some evidence of the potential that exists within the workplace for the development of vocational skills, a potential which can largely occur as part of everyday work practice. However, there are shortcomings or pitfalls associated with workplace learning which need to be addressed.

### **Pitfalls: some cautions offered**

Firstly, not all types of knowledge accessed may be desirable. Learning may occur, which might relate to work practice, or the development of attitudes and orientations which may reflect inappropriate behaviours and beliefs. For example, avoidance of recommended safe work practice might be encouraged which places the novice in danger. Of course individuals may well question understandings and procedures which they view as being 'wrong', however the press of the culture or desire to conform may result in deleterious outcomes. Most forms of situated learning occur in circumstances of unequal relationships between participants.

Secondly, the strength of the situated nature of learning, embedded in a culture of practice, is likely to be determined by access to activities which press learners into effortful thinking assisted by the guidance of expert others. An inability to access either activities or guidance will likely have negative consequences. If individuals are denied engagement in activities which are challenging and lead to other challenging activities, it is likely that the outcomes, in terms of knowledge development, will be restrictive. For example if individuals are only able to access routine work activities this will inhibit the types and quality of knowledge accessed by the learners, as the learning experiences present no challenge or opportunity for development.

Thirdly, reluctance by expert others to provide insights which would otherwise remain hidden, may restrict the outcomes of workplace learning. A workplace environment where learners will be encouraged to access models, coaching and insights is, again, likely to provide stronger outcomes for participants and organisations. Yet in some work situations expert workers may be reluctant to share their knowledge for fear of loss of status or even concerns about displacement by those whom they have assisted. Significantly, in Japanese corporations although supervisors' role includes training subordinates they do so in the knowledge that promotion is based on seniority (Dore & Sako, 1989). Consequently, experts provide learning experiences for their subordinates without concerns about displacement, by those whom they have trained.

Fourthly, absence of expertise may present particular problems for workplace learning. With the advent of new technologies or processes access to expertise may be restricted or even not available. In this situation external expertise may be required to provide a modelling and coaching role. However, the experiences within the third study was that expertise can be developed quickly if the appropriate conditions are in place. At this site, technology was introduced from another country, with the plant's operators working alongside the overseas engineers during the plant's installation and commissioning phases. These experiences seem to have provided a basis for the operators' expertise. These operators now manage both routine and non-routine events associated with the plant's operation.

The fifth concern is the one mentioned above, about understanding. Although some levels of propositional (conceptual) knowledge are likely to be developed through guided everyday activities in the workplace, some explicit intervention is likely to be required to develop the appropriate depth of understanding. As mentioned above the explicit development of knowledge is most likely to be required when the knowledge is opaque or hidden - inaccessible. Consequently, explicit intervention, which makes knowledge accessible, may be required to assist learners access deeper levels of conceptual knowledge. These interventions might include verbal descriptions, analogies, diagrams or even linkages between disembedded theoretical principles and actual applications of those principles.

The sixth and final set of concerns is the efficacy of instructional media in workplace learning arrangements. In the third of the workplace studies, some of the limitations of the text-based and computer-based learning arrangements became apparent (for an elaboration see Billett, in press). These learning arrangements are becoming commonly proposed as training solutions for workplaces. However, a reliance on such processes is cautioned by both the empirical data and theoretical analysis. These arrangements have inherent problems. They are developing knowledge which is disembedded from the activities which they claim to be addressing. This means that the individual has to transfer the knowledge from the context of acquisition to their application in the workplace. Transfer is likely to require some depth of understanding in the target context. Hence the very disembedded nature of these arrangements is problematic. Moreover, these types of learning arrangements are most likely to be generative of certain types of knowledge, particularly very specific procedures and low-level propositional knowledge, which are not of themselves, likely to assist with achieving complex work performance. These arrangements then are unlikely to develop the rich array of knowledge types required for complex performance. Such text-based instructional approaches to learning require the integration with learning arrangements which develop, in learners, deeper forms of conceptual knowledge and robust procedures.

## **7.CONCLUSION.**

This paper has provided an account of recent investigations into workplace learning. It has described how the everyday activities in the workplace has the potential for the development of skilful vocational knowledge. These activities are structured by the culture of practice and consequently opportunities for participants to access knowledge must be sought. From these studies it is concluded that the qualities of cultures of practice most likely to secure these skills are those that structure activities which assist the individual to move from peripheral vocational

activities to those which are more central to the functioning of the particular work practice; that provide expert guidance which presses individuals into accessing more complex forms of knowledge and that explicitly illuminate that which is not readily revealed. Ironically, these instructional qualities are those shared with what might be aimed for by educational institutions. The key difference is the authenticity of the social and cultural context in terms of its relationship to the knowledge to be developed, and its direct application to work practice rather than demanding high levels of transfer to be applied between the circumstances of the knowledge acquisition and its application.

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**Table 1**  
**Ratings of utility of aids to learning**  
**during critical incidents (frequencies)**

<b>Aid to learning</b>	<b>5<sup>1</sup></b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>1<sup>1</sup></b>
A.Learning guides	6 <sup>3</sup>	1	3	1	6 <sup>3</sup>
B.Computer-based learning		1			4 <sup>2</sup>
C.Video				1	2 <sup>2</sup>
D.Mentors	15 <sup>2</sup>	7	8	1	2
E.Direct instruction	17 <sup>2</sup>	9	9	3	3
G.Observing & listening	30 <sup>2</sup>	10	3	5	
H.Other workers	22 <sup>2</sup>	7	17	3	2
F.Everyday activities	21 <sup>2</sup>	8	11	5	3
I.Work environment	11 <sup>3</sup>	11 <sup>3</sup>	10	4	3

Notes

1. Rating from 5 to 1 = very useful through to not useful
2. mode
3. bimodal

**Table 2**  
**Learning aids rated 'very useful' in developing**  
**different knowledge types <sup>1</sup>**

<b>Learning Aids</b>	<b>Propositional Knowledge<sup>2</sup></b>	<b>Procedural Knowledge<sup>3</sup></b>	<b>Dispositional Knowledge<sup>4</sup></b>
Learning guides	1	3	0
Computer-based learning	0	0	0
Video	0	0	0
Mentors	2	5	0
Instruction	2	7	2
Everyday Activities	2	13	5
Observing & Listening	2	15	5
Other workers	2	11	5
Workplace	2	3	6

notes

1. Frequency of item scoring 4 or 5 by seven or more participants
2. Maximum possible for Propositional knowledge = 2
3. Maximum possible for Procedural knowledge = 16
4. Maximum possible for Dispositional Knowledge = 7

**Table 3**  
**Learning aids rated very useful in**  
**developing higher order procedural knowledge<sup>1</sup>**

Learning Aids	Higher Order Procedural Knowledge
Learning guides	1
Computer-based learning	0
Videos	0
Mentors	4
Instruction	5
Everyday Activities	6
Observing & Listening	<b>7</b>
Other workers	6
Workplace	2

note

1. Frequency of item scoring 4 or 5 by seven or more participants.

AUTHENTICITY OF ACTIVITIES

QUALITY OF LEARNING ACTIVITIES

GUIDANCE OF EXPERIENCED OTHERS

*."learning while you are actually experiencing the job"*

*."...thrown in at the deep end, having to deal with people straight away"*