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Situating learning in the workplace
- having another look at apprenticeships.

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Abstract

This article examines the acquisition of vocational skills through apprenticeship-type situated learning. Findings from a studies of skilled workers revealed that learning processes that were consonant with the apprenticeship model of learning were highly valued as a means of acquiring and maintaining vocational skills. Supported by current research and theorising, this article, describes some conditions by which situated learning through apprenticeship can be utilised to develop vocational skills. These conditions include the nature of the activities learners engage in, the agency of the learning environment and mentoring role of experts. Conditions which may inhibit the effectiveness of an apprenticeship approach to learning are also addressed. The article concludes by suggesting that situated approaches to learning, such as the apprenticeship model may address problems of access to effective vocational skill development within the workforce.

1. INTRODUCTION.

The increase in demand for skill development in Australia has resulted in the consideration of a range of options for developing vocational skills. These options need to be accessible and be able to address a widening range of specialised occupations which now require skill development provisions (Deveson, 1990). An increasing emphasis is being given to learning in the workplace, whose initial attraction is that it provides access to expertise and infrastructure that is often unavailable through the public training system. In the past, learning in informal settings, such as the workplace, has been dismissed as being ad hoc, incidental and peripheral (Resnick, 1987). However, as current research and theorising is emphasising, it is timely to reconsider utilising the workplace as a learning setting. Central to an acceptance of situated learning is the now increasingly commonly held view that thinking and acting has socio-cultural origins (Goodnow, 1990; Lave, 1990). Within this view of learning the activities of vocational practitioners are derived from a culture of practice, which has developed over time. Consequently, learning arrangements require access to activities and guidance within a culture of vocational practice. Workplaces can offer these qualities, as learners are able to observe, participate and be guided by experts within an authentic culture of practice.

This article commences by describing current research and theorising about the knowledge and attributes required of vocational experts. Next, the nature of learning in workplaces is discussed using outcomes of a study of skilled workers. In this study elements of apprenticeship learning - observation, coaching, scaffolding and fading were strongly supported as a means of acquiring and maintaining vocational skills. Some principles for using workplaces as learning settings while adopting an apprenticeship model are advanced in the next section. In addition, conditions that may inhibit the utility of apprenticeship learning are also discussed.

2. WHAT ARE THE QUALITIES OF SKILLED VOCATIONAL PRACTITIONERS?

In recent years considerable advances have been made in understanding complex human performance - expertise. This understanding has been advanced through an acknowledgment of the significant role that factors external to the mind play in thinking and acting (Brown, Collins & Duguid, 1989; Lave 1990). Rather than being solely a product of internal processes of the mind, it is now recognised that external factors also play a major role in complex thinking. The role of domain-specific knowledge (Glaser, 1989) and in particular, the influences of the socio-cultural context provides a framework for a coherent and purposeful set of actions concerning the acquisition of expertise (Raizen, 1991). What is being proposed is that cognitive processes are mediated by external influences such as social interactions with peers and experts, the activities learners engages in, and, their ability to appropriate the nature and concepts within

vocational practice. 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.

Cognitive processes are defined as an array of cognitive activities deployed by an individual when engaged in any type of information processing - thinking, acting or learning. Cognitive structures, which comprise levels of propositional (*knowledge that*) and procedural knowledge (*knowledge how*) are primary elements of cognitive activity (Anderson, 1982). These knowledge types are conditional upon non-cognitive attributes such as attitudes and values. Propositional knowledge comprises facts, assertions, concepts & propositions (Prawat, 1989). Procedural knowledge comprises techniques, skills, ability to secure goals (Stevenson, 1991). Although, according to Anderson (1982), the development of procedural knowledge is through the propositional base, the propositional knowledge of vocational experts is acknowledged as including layers of deep conceptual understanding (Stevenson, 1991). Procedural knowledge has a hierarchy of higher order procedural knowledge, which, it is postulated, has an executive role in organising, and transferring, knowledge and understanding (Stevenson, 1991). Added to this are the non-cognitive attributes of affect and values which play a significant role in determining how individuals responds to work practice.

Rather than being solely the product of internal mental activity the development and organisation of these cognitive processes and structures are influenced by external factors such as social interaction and cultural practices. Given the influence of socio-cultural dispositions, the role of values (Goodnow, 1990) also becomes a major component of cognition and assists in providing structure and meaning to otherwise idiosyncratic process of thinking and acting. What is important, and why it is important, within an occupation requires more than propositions and procedures it also requires values which supports practitioners' effort - is it worth doing, and if so, how well?

So, from a cognitive perspective skilled vocational practitioners have certain attributes. These include:-

- . **knowledge that** (*facts, assertions, concepts propositions*) referred to as propositional knowledge (Anderson, 1982);
- . **knowledge how** (*techniques, skills, ability to secure goals - which are both specific and general*) referred to as procedural knowledge (Anderson, 1982); and,
- . **attributes and values** associated work skills (*values, attitudes, social values*) Prawat, 1989).

The aim for modes of vocational education and training is to develop these categories of knowledge within the particular domain. These knowledge types and attributes provide a basis to consider the

planning, implementation and evaluation of training arrangements. For example, traditionally it has been the role of formal educational settings to provide a base of propositional knowledge while procedural knowledge associated with vocational skills is claimed to be best developed in workplaces (Gott, 1989). The attributes and values associated with vocational activities are increasingly viewed as being generated by the socio-cultural nature of work activities (Lave, 1990).

A recent study which evaluated modes of skill development provided strong support for the acquisition of the knowledge and attributes required of vocational experts through workplace learning (Billett, 1993). The study consisted of a survey and interviews with a combined total of approximately 300 skilled workers. The survey indicated strong support for the acquisition of a variety of skills, knowledge and attributes through workplace learning. The majority of respondents nominated higher order procedures, such as the ability to problem-solve and apply skills in novel situations as being best developed in workplaces. This was a significant response as these abilities are usually claimed as the contribution of formal learning processes. The workers interviewed stressed the importance of access to experts and being able to participate in hands-on learning experiences. The value of learning from more skilled others (experts) was also supported and in particular by those who worked alone or in isolation. These skilled workers actively sought out appropriate expertise. However, respondents were often cautious about the ability of workplaces to provide understanding about their work activities. Respondents frequently suggested that an 'ideal model' of skill development should integrate practical experience with ways of acquiring theoretical knowledge. Although this ideal is the aim of the apprenticeship model of trade training, with its integration of college and work experiences, this is not available for many industry sectors. Moreover, it seems quite possible that with limited interventions, deep conceptual knowledge can be developed in workplaces (Gott, 1989).

Current research and recent empirical studies suggest that workplace learning has the potential to provide the development of knowledge types and attributes required of skilled workers, although making explicit some tacit qualities may be useful. What follows is an elaboration of guidelines for realising the learning potential of workplaces and principles for workplace learning.

3. WORKPLACE AS A LEARNING SETTING?

Learning on-the-job is differentiated from formal learning, with the latter requiring attendance at a technical college or training centre. The on-the-job mode of skill development is commonly practiced within a wide range of processing, production and service industries. This mode of learning is characterised by employees gaining skills on-the-job, usually in a highly informal way. With workplace

reform and the advent of remuneration and career pathways based on skills acquisition, this mode of skill development is being seen as an accessible option in many industry sectors. Workplace learning is defined as the acquisition of knowledge and skills as individuals attempt authentic vocational tasks supported by more skilled peers or experts. It does not include learning processes organised in a training room at a work site, although this may be used to supplement learning on-the-job. Workplace learning is differentiated from the description of learning on-the-job provided above. The differences reside in the deliberate intention of developing the range of knowledge types and attributes required of vocational experts. This does not necessarily imply a rigid curricula or a requirement of highly trained instructors, rather some deliberate guidance by experts.

The model of workplace learning outlined in this article is guided apprenticeship learning, situated on-the-job. The experiences that can be accessed by learners in workplaces include guided learning by experts and a focussing of learning activities upon authentic tasks conducted in workplace settings. Access to these type of experiences are strongly supported in recent studies of how workers acquired their skills (Billett, 1993).

Apprenticeships as guided learning

The goal of apprenticeships as a situated learning methodology is to assist learners acquire and integrate the knowledge and attributes for skilled vocational practice (Collins, Brown & Newman, 1989). This model of learning is based on assumptions that the acquisition and use of knowledge and attributes depend crucially on interactions between individuals' current knowledge and beliefs, the social and physical environment in which the learner works and confronts problems. In this approach the interaction between the internal elements of cognition and the physical environment in which learning takes place is valued. As a learning methodology, apprenticeship stresses an interplay between observation, scaffolding and increased independence of learners. This process aids learners in the development of self-monitoring and self-correction skills; and integrating skills and conceptual knowledge required for expertise.

Instructional Methodology

The apprenticeship method of instruction involves phases of modelling, coaching, scaffolding and fading (Collins, Brown & Newman, 1989). These phases are now briefly described.

Modelling ®	Coaching ®	Scaffolding ®	Fading
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Modelling involves an expert executing a task so that learners can observe and build a conceptual model of the processes required to successfully accomplish tasks. This may

require the externalisation of internal (cognitive) procedures that experts deploy when utilising their procedural and conceptual knowledge. Put simply, this means that experts may need to verbalise their thinking to assist learners, eg. - *"the reason I have decided to do it this way is because"* *"if you didn't do this now"* *"what I am considering at this point is....."*

So the observation phase allows learners to observe task completion and be informed of how the expert went about doing it.

We have all seen cricket and tennis player rehearse shots, the observation process allows learners to do something similar, they are able to think the task through and mentally rehearse the approach they wish to take.

Coaching consists of a process of observation and monitoring as learners carry out activities.

Experts provides hints, feedback, clues and tricks of the trade to assist learners achieve desired outcomes. Coaching may also involve repeated demonstrations of a task, or part of the task. The provision of supportive comments are also part of the coaching phase. Coaching may serve to direct learners' attention to aspects of the task that is known, but temporarily overlooked. Coaching focuses on the enactment and integration of skills in the service of a well-understood goal through suggestions and highly interactive and situated feedback. The content of the coaching interaction is immediately related to specific events or problems that arise as learners attempt to achieve the target task. The desired outcome of the coaching process is to guide learners' performance to become closer to that of the expert.

Expert might provide learners with guidance in the procedure - *"if you put this in place before you bring the other component over you might find it easier to control"* or ask learners to consider where else they can use a particular strategy or suggest changes in approach given the different application of a procedure or process *"if you were packing a pallet with a different shape of box you would need to"*.

Scaffolding - refers to the support that experts provides for learners, albeit at more of a distance. This support can take the form of providing learners which opportunities to acquire knowledge and skills that are within the scope of learners' ability. Additional suggestions or help, take the form of physical supports such as general reminders might comprise scaffolding *"always start at the centre back and measure down from there and then move down from the*

chest to the waist and hips". Scaffolding may require the expert to carry out part of the overall task that the student cannot yet manage.

Scaffolding requires a co-operative problem-solving effort between the expert and the learner in which the express intention is for the learner to take as much of the task responsibility as possible. A requisite for such scaffolding is accurate diagnosis of the learner's current skill level and difficulty of the task. Monitoring by the expert will assist with this understanding by asking the probing question "*what do you think we should do next?*" "*Why*"

Fading consists of gradual removal of support until learners are able to conduct the task autonomously. This more distant support might lead to decisions about providing opportunities to engage in a range of more complex tasks.

(the concepts described above are adapted from Collins, Brown & Newman, 1989)

This model of learning has a wider application than developing skills for trade work with which it is historically associated. Its general utility resides in its ability to develop the range of knowledge types and attributes required of skilled workers. The next section examines how this can be achieved.

4. APPRENTICESHIP LEARNING - SOME PRINCIPLES.

As stated above workplace learning has a potential to develop the propositional, procedural and dispositional knowledge required for expert performance. The achievement of this goal may be best realised through learning processes that:-

- . provide access to a range of vocational activities that are authentic and allow the learner to experience both the process and product of their actions. (This will assist with the development of conceptual models of task and task structures.)
- . encourage self-initiation and regulation through engagement in relevant tasks which are purposeful for goal achievement.
- . provide access to an expert or a range of experts.
- . provide access to a range of other learners, by which the learner can compare their own performance.
- . allow sufficient time for the learner to become orientated and experience cognitive activities.

Some of the conditions which are likely to enhance the learning processes include acceptance of the value of workplace learning, the quality of the experiences that learners can access and the mentoring role of experts.

An acceptance of the value of learning in the workplace would be supportive of these arrangements. Learning should be valued and seen as an every-day part of work practice, not something that is reserved for and restricted to a training room. This view of skill development is reported as being standard practice in high-performing Japanese corporations (Dore & Sako, 1989). If a culture which is supportive of learning is present in the workplace, learners will probably be more inclined to ask questions, seek solutions and possibly take risks with learning. Expertise should also be valued. In such an environment experts are less likely to view their role in terms of a crude expert-novice relationship, but rather one of being a mentor to learners. The role of the expert mentor is a significant element in the learning process. A recent study into the acquisition of skills in coal mines indicated that if learners do not perceive the mentor to be an expert, the guidance and advice may be treated superficially, at best, by the learner (Billett, 1992).

Organising experiences for the learner

When planning learning arrangements, it is necessary to consider what learners will experience. The selection of approaches, offered below, is based on a synthesis of findings within recent studies (Billett, 1992;1993) and current orientations in research into effective learning processes (Collins, Brown & Newman, 1989; Lave, 1990; Raizen, 1990). These approaches also reflect the principles mentioned above.

Engaging in authentic activities - learners must undertake real activities associated with the occupation.

Being able to observe both the process and the product - learners must be able to develop a conceptual understanding of activities they are engaged in and relate this to the overall activities of the occupation, enterprise or industry.

Opportunities for self-initiation and self-regulation - a focus in learning arrangements should be on maximising opportunities for learners to initiate action, consider consequences and assess performance. Rather than being told, learners should be asked to determine what they think, and, having made an approximation, be guided by the expert mentor.

Access to a range of expertise - experts provide valuable modelling, coaching and scaffolding, consequently access to experts is highly valued. It is desirable to gain access to more than one expert to provide a range of models, coaches and support.

Structuring experiences - moving from the peripheral - learners will need to engage in authentic tasks in a gradual way usually from more peripheral tasks to those tasks which are more crucial. It is probably desirable for some organisational structure to assist with learners being availed of a comprehensive range of experiences.

These, then, are arrangements which should be conducive of learning in workplaces, activities learners should engage in. Beyond activity there is agency. The expert is acknowledged as an agent that can mediate the experiences of learners in a purposeful way in developing vocational expertise. This is outlined below.

Mentoring role of expert

Although this apprenticeship approach to learning focuses on the activity of learners there is also a key mentoring role for the expert. The mediation of the expert is a mentoring role rather than a teaching role. This requires the expert to develop learners' understanding of occupational activities through an interaction that encourages self-monitoring and self-regulation. Such an approach is contrasted to the directive approach of an expert simply telling the learner. Some considerations for how mentoring experts should address this role follow.

Much of what experts do is tacit and hidden from novices. The expert's role is to make what is tacit accessible to novices. Verbal descriptions of a process, drawing a diagrams to show how something, which cannot be seen, works; undertaking the task to reveal what expert performance so learners can set goals are all useful strategies for developing learners' conceptual understanding.

In addition, experts as mentor should allow learner to make approximations of actions, concepts and activities rather than being directive. Asking questions rather than telling or directing should be used to encourage learners to start developing conceptual and procedural understandings and self-regulatory skills. "How will you go about fitting out the bathroom?" "What will you need to consider before starting the machine?" "What will happen if you don't put safety tags on pieces of equipment?" These are examples of how experts can use a mentoring approach rather than an a direct instructional approach. Working closely with the learner the mentor will be able to determine

progress and maintain appropriate provisions of assistance to the learner as they confront different experiences.

Developing learners' conceptual understanding of why things are done in a certain way and what would happen if they were not, is key role for the expert. A common concern about workplace learning processes is a lack of development of an understanding about why things are done in a certain way. A conceptual understanding is necessary as this will allow learners to evaluate the skills, situation, process and determine its application elsewhere. The expert as a mentor must constantly make explicit the reasons why things are done, and consequences of non-compliance.

Given the requirements of activity and agency, outlined above, the ideal sort of situations for the guided apprenticeship model of learning to be most effective are those with a range of people who can provide support for learners, where learners can undertake real tasks, can observe other learners and experts, and also see the outcomes of their work. These conditions are present in many workplaces and industries. However, such workplace conditions are not universal. In the next section, consideration is given to making guided apprenticeship learning work in less-than-ideal situations.

4. GUIDED APPRENTICESHIP-TYPE LEARNING IN LESS-THAN-IDEAL CIRCUMSTANCES.

The apprenticeship approach to learning, may be difficult to implement in some work situations for a variety of reasons. These situations include those who work in isolation (e.g. field officers or one-person businesses); those working in developing situations where expertise may not be available or apparent (new technology, new processes); and perhaps those areas that require a lot of theoretical or conceptual knowledge (eg. computer technicians, engineering). In these circumstances variations of the apprenticeship model, using some external elaboration of task structure and task completion, associated with guidance on how completion can be achieved, should be considered for workers in less-than ideal situations.

The following section discusses some of these situations and makes suggestions on how these limitations can be overcome.

Isolated learners, people working by themselves - finding ways of providing expert support.

During recent studies (Billett, 1992;1993), when respondents working in isolated circumstances were interviewed, they described learning as being a lengthy and frustrating process. They stressed the need to access expertise to gain greater knowledge and skills, and also to solve problems. These respondents had developed strategies to locate expert advice. Some attended seminars, more often to meet with other workers as to gain new product information, or else they have a list of contacts who could be contacted about particular parts of the job. These learners may require more structured arrangements because of their isolation. Certainly the respondents stressed the need for and sought out expert advice. Contacts with appropriate expertise could perhaps be facilitated and the organisation of opportunities for these sort of workers to meet and mix with other workers could be encouraged. Again a workplace culture which is supportive of learning could break down some of the barriers of isolation by encouraging an interchange of ideas. The following case study by Julian Orr (cited in Raizen 1991) illustrates how this can be achieved.

The Xerox company in the US had a problem with developing the skills of their photocopier service personnel. The manuals provided by the company were inadequate because the photocopiers the staff had to service rarely broke down in configurations covered in the service manuals. So Xerox organised information-sharing sessions when more experienced service staff told the newer staff 'war stories' about the ways the photocopiers had broken down and what they had done to repair them. This proved quite effective as the more novice service staff were able to conceptualise the problems and remedies, and thus develop their conceptual and possibly procedural knowledge base. It would seem that this approach would be unsuccessful with service staff who did not understand the components and operation of photocopiers. They would not possess adequate mental models.

Processes that are not visible - make them explicit

Increasingly technology is making many workplace processes and tasks invisible. Activities occurring within computers, 'black boxes' and industrial processes are often invisible. This makes learning about these processes more complex because it is difficult to make task structures explicit. Consequently, the expert mentor needs to use diagrams, analogies or graphics to illustrate task structures. Computer Numerical Control (CNC) equipment in the metals industry, presents just such an example. For the experienced tradesperson who is used to manually manipulating machine tools on a lathe the change to numerically control machinery presents quite a challenge in terms of changed task structure. The outcome is still the same eg. metal being shaped, but the tasks required to achieve that outcome are quite difficult (Martin & Scribner, 1990). Instead of manual manipulations, a series of co-ordinates have to be entered into a computer program. Consequently, it is essential that new

task structures are made explicit so learners can develop a conceptual model of how to operate the machinery. Again this may require the mentor finding ways of illustrating what is hidden.

Lack of available expertise

A significant limitation for learning is when expertise is not readily available. In such situations access to experts in related areas may be useful as they are able to suggest parameters for proceeding while not possessing the expertise needed. For instance, the implementation of new legislation - Equal Opportunity or Freedom of Information presents a problem because of a lack of expertise. However, there will be different sorts of expertise available in terms of procedures and policy that can guide implementation - these may be useful by providing a framework for resolving new problems.

Within the recent study, some workers reported learning alone how to use computer programs from manuals. These respondents stated that the outcomes were quite satisfactory because they developed a clear understanding of how to use the software. However, these isolated learners also reported that this process can be frustrating if a problem cannot be resolved by the manuals. In the interviews a number of isolated workers referred to using their own problem-solving ability up to a certain point and then seeking outside assistance from experts. Again the role of experts was seen to be significant. So peer involvement in problem-solving may be useful, although consideration of external sources of expertise may be well worth seeking out.

Conclusions

This article has outlined an approach to learning in workplaces, which draws upon current theorising and is supported by recent empirical research. Consideration of the value of learning settings should not be made on the basis of them being either formal or informal. Rather their capacity to provide learners with experiences that are conducive of developing the knowledge types and attributes should be the basis of judgements about worth. It has been argued in this article that workplaces have the potential to provide useful learning experiences. However, to realise this potential consideration has to be given to the organisation of learning experiences and mediating role of the expert. The workplace provides a range of conditions for the development of vocational skills, if these conditions are nurtured workplace learning could become a key provision of vocational education and training.

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