
Authenticating learning - looking at the workplace
Authenticating learning - learning in the workplace.

The current interest in situated cognition has largely manifested itself in research and theorising directed towards improving the processes of formal education. These efforts are guided by a desire to remove the distance between the environments in which the knowledge is learnt and applied. However, natural settings, such as the workplace, provide attributes such as authentic activities and access to experts which are so highly prized in the current research and theorising about cognition. Consequently, workplaces should provide optimal settings for the development of vocational skills and expertise. This paper reports the findings of a study conducted within the coal mining industry in Queensland which examines perceptions of skilled workers about environments and conditions which are supportive of acquiring vocational skills. The study compares perceptions about different modes of skill development and concludes that the current research on learning in natural settings is generally supported by skilled workers in this industry. These findings are used to speculate about theories which emphasise the socio-cultural and environmental contributions to learning.

A Paper Presented at the 1992 AARE & NZARE Joint Conference
"Educational Research: Discipline and Diversity"
Deakin University
Geelong Victoria
22-26 November 1992

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October 1992

1.Introduction

The coal industry, like many others in Australia, is considering implementing remuneration and career advancement procedures based on the acquisition of skills. Consequently, there is heightened interest in effective methods of skill development which carry formal recognition. This study, conducted within the coal industry in Central Queensland, is part of an on-going project to determine and implement effective methods of skill development for workers at all levels within a major coal mining enterprise. The research activity aimed to determine approaches to learning that were most likely to be effective using data from the company's personnel and also considering recent research into instruction and learning.

This paper commences with a consideration of a theoretical approach to learning within the workplace. It then describes the research activity and examines the theoretical and practical implications of perceptions of skilled workers within the coal mining industry about methods of skill acquisition. The research was framed by recent research into learning which stress activities as a basis for learning. The study indicates a strong preference for learning in the workplace by actually undertaking tasks with guidance from other workers. The significance of this finding is evident across the workforce regardless, of how the respondents had initially acquired their skills. This finding provides support to current research and theorising about learning which emphasises the socio-cultural basis to learning. The paper concludes by considering the utility of an emerging concept of learning which has guided authentic activity as a key functional attribute.

1.1Learning in workplaces - a framework

Currently interest about learning in informal settings, such as the workplace, is growing. Research and theorising within cognitive psychology, cultural psychology, sociology, ecological psychology and cognitive anthropology is suggesting that informal or natural settings provide a basis for rich learning experiences. Within these disciplines learning is now being viewed as a process of knowledge and procedure acquisition within a socio-cultural framework, rather than being solely the product of internal workings of the mind. Consequently, these bodies of theory can be examined to provide a framework to consider learning arrangements for informal learning settings such as the workplace. Learning within the workplace is also attracting interest for more pragmatic reasons. An increased demand for vocational skill development opportunities has arisen from governmental initiatives such as award restructuring, industry restructuring and multi-skilling (Deveson, 1990). Given the limitations of the nation's TAFE systems' capacity to provide for this increase in demand the use of the workplace is being proposed as an option to formal learning settings such as TAFE colleges (Billett, 1992).

However, this paper proposes that learning in the workplace should be seen as something more than an option to formal learning settings. It is argued that workplaces, have the capacity to optimise the acquisition of the rich base of applicable skills, knowledge and understandings required of vocational experts. To examine the basis for this claim it is necessary to briefly review some of the recent theoretical contributions.

1.2Some theoretical contributions

According to Glaser (1989) cognitive science has been preoccupied over the last three decades with efforts to understand what drives complex human performance or expertise. An understanding of the significant role that types of knowledge play in complex human performance was a key outcome of this work. The notion that expertise arises from generalised thinking processes is being increasingly challenged. Studies on expert-novice difference indicate that knowledge and procedures that are domain-specific play a central

role in expert performance (Chi, Feltovich & Glaser, 1981; Glaser, 1984; Wagner and
Sternberg, 1986; Eylon & Lin, 1988; Glaser and Bassok, 1989, Rogoff 1990).

Accompanying this examination of knowledge types is also an heightened appreciation of
the socio-cultural influences on cognition (Rogoff & Lave, 1984; Rogoff & Gauvin 1984;
Scribner, 1984, 85, 86; Lave 1990; Rogoff, 1990; Lave and Wenger, 1991). Central to
this proposition is the belief that knowledge is socially and culturally constructed. The
basis for these assertions is that human activity is configured by the cultural and social
context in which it occurs. Activities, tools and practices are defined by the culture of

the people who use them. Tasks are embedded within a culture and are central to the
practices of that culture. The utility and standing of activities structure the hierarchy of
the culture and, as a consequence, influence the structuring of cognition (Lave, 1990).
Given the primacy of activities in the social and cultural construction of knowledge the
authenticity of those activities is paramount for learning arrangements. It is proposed that
the outcomes of learning through socially and culturally authentic activities have the
potential to be robust and highly transferable because the process has the capability of
developing deep layers of propositional and procedural knowledge. These are paramount
for transfer and adaptability (Stevenson and McKavanagh, 1991). The cultural context
for learning requires some further consideration.

Cross-cultural studies stress this contextual contribution to learning. Work in a range of
diverse activities such Liberian tailors' apprentices (Rogoff 1990), Japanese abacus
counters (Stigler, Barclay & Aiello, 1982), Navajo indian weaving practices (Rogoff &
Gauvin, 1984) and dairy workers in the United States (Scribner 1985) has led to some
significant outcomes. The primary outcome of this work is the proposition that the nature
of activity undertaken in a particular setting is instrumental for learning and thinking.

The ecological psychologist Barker (1978) supports this and states that environments could not be dismissed as probabilistic. Environments had an influence on human behaviour. What is being suggested now is that activity has a role in structuring cognition. The quality of that activity and its socio-cultural setting can now be seen to have a significant role in learning.

Learning is central to the maintenance and development of any culture. The process of teaching novices demands that the culture and its values are continually justified and reiterated as novices are informed about its utility and application of its tools and processes (Moore 1986). This justification involves the novice as an active and constituent participant in the evolving nature of the culture. This co-participation is seen as being integral to the learning process by Lave and Wenger (1991) as the interpersonal exchange, between leaner and expert is seen as a precursor to cognition. This is consistent with Vygotsky's view of learning and notion of Proximal Development. Central to this concept is the idea that the relations between the learner and the teacher / expert / parent are socially constructed. Consequently, the quality of the relationship will determine what type of knowledge the novice has access to and is allowed to learn. For instance parents may avoid telling children information which they think is inappropriate, males may frame information for women differently than for other males, experts may attempt to maintain their authority over a novice by providing incomplete knowledge.
Outside of these socially constructed interventions each culture will have a hierarchy of tasks that the novice is guided through, usually from least important to more important.
Again Lave's study of Liberian tailors provides an insight to this process (1991) as the apprenticed tailors move from the peripheral through a series of tasks.

1.3Considering learning settings

Using this research and theorising it is possible to contest assumptions about the efficacy of formal learning settings - schools, TAFE colleges and universities. For

example
research on with street children in Brazil has shown that their highly developed maths
skills, when changing money on the street, are not translated to paper and pencil maths
tests within the classroom (Carraher, Carraher and Schliemann, 1985). These
mathematically competent children were unable to use their skills in a formal educational
setting. Scribner's study which compared dairy workers and school students carrying out
real life mathematical calculations indicated that the students were bound by processes
that could not be effectively applied a non-classroom maths problem (1985). Conversely,
the dairy workers used tools from within their environment, milk crates, to effectively
respond to mathematical problems. This work questions assumptions about the utility of
general strategies taught in formal learning settings. Other cross cultural research into
informal learning processes such as navigation in Puluwat and weaving in Zinacanteco
and those mentioned above have also resulted in challenges to the main claim of formal
learning settings - the development of robust and transferable knowledge (Scribner,1984).
Comparative studies suggest that learning in both formal or informal settings has limits in
its transferability (Rogoff & Lave, 1984). What these writers infer is that no setting has
a monopoly on learning, albeit a setting which has teachers and claims learning as its

primary function.

Limits on transfer posses a challenge for all learning processes and settings. It is
suggested that the key to transfer resides in a rich base of higher order procedural
knowledge (Stevenson, 1991, Stevenson and McKavanagh 1991). Learning in workplaces
with its authentic activities embedded within a purposeful cultural and social context may
offer the optimum path to these higher levels of cognitive activity (Pea, 1987). The
development of procedural knowledge is through a propositional base (Anderson, 1982)
and can best be facilitated by engaging in activities that require learners

to acquire the
procedures by engaging in higher order cognitive activity (Stevenson, 1991). So instead
of informal learning settings, such as the workplace, being presented as pragmatic, adhoc
and incoherent (Resnick, 1987) they need to be re-assessed in terms of their provision of
an optimal location for the development of robust and transferable skills.

This optimal quality resides in the capacity to provide authentic activities, access to
experts and other learners thereby providing the socio-cultural setting which, along with
undertaking of relevant activities, configures learning. The types of knowledge and
procedures are postulated as a framework of cognitive structures, comprising types of
knowledge and procedures (including higher order procedures) which have an
interdependent relationship with social and cultural cognition.

1.4Implications for vocational education.
Research conducted within schools to improve learning processes has attempted to
determine ways of making the learning more transferable to applications outside of
schools. Some of the more widely reported work has been focused on attempting to teach
students to think and act as experts, through the development of propositional and
procedural bases. Examples of these include work on cognitive apprenticeships (Collins,
Brown and Newman, 1989), the reciprocal teaching of comprehension, (Palinscar and
Brown, 1984) and Gott's work on apprenticeship instruction for real-world tasks (1989).
In varying degrees these research activities try to provide authenticity in activities and
impart the contextual contributions to expert thinking.

The implications of these theoretical developments are particularly significant to
vocational education. The goals of vocational education, are closely linked to the
development of knowledge and understandings within particular vocational activities.
(This is often erroneously seen as being narrow and specific.) Consequently, authentic
settings such as workplaces appear to offer the optimal setting for

learning the
propositional and procedural base for the activities that occur within that setting. There
will, however, be resistance to such a suggestion. Learning in informal or natural
settings, such as the workplaces, has been characterised as being adhoc, pragmatic and
incoherent. Descriptions such as incidental or accidental accompanies any learning that
transpires (Gott, 1989; Marsick, 1988; Marsick & Watkins, 1991; Lave 1990). These
sort of perceptions appear to be, in part, the product of the existence of a comprehensive
and extensive provision of formal educational institutions (Resnick, 1987). The
continuing trend for vocational skill development to be conducted within formal settings
continues in this country as the example of recent `formalisation' of nurse education
illustrates, with a move from the authentic environment of the hospital to a remote and
quite different socio-cultural setting within universities.

However, informal learning processes have been and continue to be highly valued,
particularly outside of formal learning settings. Try entering the major professions
without learning informally as an articled clerk or hospital intern. The apprenticeship
method of learning was developed and exemplified by the trades as a means of learning
skills while working. The involvement of formal learning institutions in apprenticeship
programs is recent and far from universal. Cultures are maintained through informal
learning processes. Consider how the child learns most of the skills required to be a
success in school in informal ways between the first and the fifth year of its life, in a
spectacular learning process whose characteristics are a meaningful context, mediation of
parents and friends and participation in meaningful activities (Bransford, Sherwood and
Hasselbring, cited in Pea, 1987). It seems possible to speculate that the guided learning
process that occurs within these examples may provide a basis for considering the
development of vocational skills in the workplace. This is because learning takes place
within activities that are purposeful and guided implicitly and explicitly

by interaction

with the culture of the workplace.

The richness of the workplace as a learning setting has the potential to provide a coherent and activity-based approach to cognition. This is not to suggest that all workplaces are havens for learning appropriate and desirable skills. What is being proposed is they offer a potential which may warrant further refinement. It is unlikely that formal learning settings will be able to provide activities which are authentic in terms of their application. Consequently the subject of this refinement is likely to be a consideration of the particular qualities that makes informal learning settings so potent, and also how activities can be structured and organised to optimise learning. While this paper does not seek to answer those questions it describes perceptions of skilled workers that might be helpful in conceptualising those research questions.
Consequently, the claim tested in this research activity is to determine if a group of skilled workers in the coal mining who had acquired skills through a number of different modes would substantiate the value of the type informal learning processes referred to above.

2. Research Method

The research method comprised two stages. In the first stage four mines were visited and individual and group interviews were conducted with approximately sixty personnel. In the first phase responses to broad and general questions about preferred modes of acquiring skills were recorded. The questions also focussed on how they currently learn skills for their work within the industry and also how they thought skill development could best be provided for workers within the industry. The responses from these visits provided the basis for a set of proposed principles for skill development processes and were used in the second phase of the research program to structure a formal questionnaire. The questionnaire was distributed to three mines sites, none of which had

been visited during the first phase. Of these three mine sites, two were open cut and one a combination of open cut and underground operations. The information gathered in these questionnaires was subsequently analysed quantitatively and qualitatively. This analysis provides the conclusions and recommendations within this paper.

2.1Phase One of Research Activity

In June 1992 during a three day visit to mine sites in Central Queensland a series of interviews were conducted which involved approximately sixty wages and salaried personnel. These interviews were either specifically structured for the purpose or were part of an already convened meeting. The questions used in the interviews varied slightly because of the nature of the group meeting or the individuals being interviewed. However, questions were used consistently to determine how skills were currently being developed and how they could be most effectively developed for personnel at the mine sites.

3. Results of Phase One

The verbal data recorded during the interviews were refined and divided into a taxonomy with four categorises which reflected some broad issues suggested by the responses. These categorises are i) environmental issues; ii) existing training provisions; iii) desirable qualities of future skill development programs, and; iv) assessment processes. These findings were detailed in an earlier document - A preliminary report on findings of visits to Central Queensland coal mines, June 1992. A Summary of the first stage follows.

3.1Environmental Issues

A series of the responses alluded to the industrial and organisational context of the mining industry in Central Queensland. The following were reported. Higher pay was commonly stated as the greatest incentive to gain skills at the mine sites. However, it was frequently stated that rotating shifts make access to skill development programs difficult. There was a strong and frequently

reiterated
emphasis on learning-by-doing, and this was accompanied by a widely reported
belief that the useful expertise was already on-site. Some supervisors were
nervous about their future under the changes to work organisation and indicated
keenness in the need to `upskill'.

3.2Existing training provisions

One of the questions specifically focused on the existing training provisions to
determine how these were valued by the respondents.

Off-site training was valued only if skills gained could be immediately applied at
the mine sites. This training was also valued because it provided an opportunity to
meet other people. Some subjects reported the importance of being able to get
away from the site, "to get some peace because you cannot get away on-site". It
was suggested that the external training provision was useful for learning new
technology. However, generally external training was not valued because the
external trainers rarely had appropriate expertise.

There was an exception. Vendor training (that accompanying the purchase of a
new piece of equipment) was valued, particularly by supervisors, because it
provided prized specific knowledge, and the instructors had usually been able to
respond to specific requests, also it was seen as being cost effective. A commonly
reported failing of vendor training was the lack of formal recognition. However,
the benefits of vendor training were restricted to maintenance of the pieces of
equipment. The respondents commented that they knew more about utilising the
equipment more effectively than the vendors. Anecdotes were provided about
ways in which feedback from mine site operatives to the machinery manufacturers
had been incorporated in subsequent designs of equipment.

The TAFE provision was seen to be too general, artificial and the

instructors too
removed from the needs of the mine. The only reported quality of the TAFE provision that was valued was the provision of formal recognition. Some on-site
training was perceived by the subjects as being merely to transfer the legal
responsibility of safety, rather than to develop skills.

3.3Desirable qualities of future skill development programs
The respondents were asked to state what they thought would be an ideal approachto developing skills within the workforce. This was used to gauge perceptions
about preferred modes of skill development processes.

It was frequently emphasised that trainers have to be familiar with the settings,
have relevant expertise and be able to effectively communicate orally. Manuals or
learning resources would need to be written plainly and sparingly. The notion of
learning on-site through normal activities seemed to be supported as the way
people had usually acquired their skills. While generally supporting the notion of
learning on-site as part of everyday activities the following were stated as issues to
be addressed. Firstly the use of a number of people to teach skills, rather than
one, to gain access to a range of broader skill capability; secondly, the need to
recognise that there was no one right way of doing things; and thirdly the need to
work with and observe somebody else. Mentoring arrangements such as those within the sponsoring company's Graduate program were stated as being effective.

Classroom type of training was not widely valued. Where it has to be used it was
recommended to be of limited duration, possibly staged, with the use of a variety
of stimuli and be directly integrated with practice with site activities.

It was also stated that the administration of any skill development processes would
have to be easily managed. Involvement of workers in generating skill development processes was suggested as a key to facilitate the acceptance and the
success of skill development processes.

3.4Assessment processes

During the interviews the issue of assessment was constantly raised. With workers receiving increased remuneration on the basis of the acquisition of skills this is a sensitive issue which is configured by the quality of the industrial relations on the mine sites.

It was reported that clear standards will be required for effective and reliable

assessment. A number of supervisors emphasised this given the industrial relations climate within the industry. Again there was a preference for operative involvement in the development of these standards. This was usually suggested in terms of their expertise, which could not be found elsewhere. The qualities of the people and processes of doing assessment were characterised as follows. The assessors would have to be able to do the job being assessed, they would require standards as benchmarks, and be assessed by doing the job. The legislative requirements of assessment for workplace safety, with supervisor liability was stated as being an issue.

3.5Implications from Phase One

The following implications were inferred from the first phase and constitute a set of proposed operating principles for the development and assessment of skills at the mine sites.

One general inference emerging arising from the data is that skill development activities (teaching, facilitating, guiding) and assessment should only be conducted by those who have, and are seen to have, a strong base of the skills in the specific area (a content expert). The second strong inference is that processes to develop and assess skills should be situated as much as possible within the natural setting of the workplace, and should closely reflect the activities that are used as part of everyday practice in the workplace (authentic activities). These inferences are supportive of much of the research mentioned above which emphasises the role of both natural settings and authentic activities in the

development of robust and transferable knowledge (Glaser 1984; Glaser & Bassok, 1989;
Collins, Brown & Newman, 1989; Brown, Collins & Duguid, 1989; Gott, 1989; Raizen
1991; Rogoff, 1990).

The following are a set of proposed operational principles which were inferred from the
phase one data.
3.5.1Skill development and assessment should utilise experts and optimise the
authentic activities of the natural setting.

3.5.2 The preferred learning process favours the development of practical skills or
`know how' (procedural knowledge) with `knowledge about' (propositional knowledge) being seen as subordinate. This is of concern as higher order activities such as problem-solving requires both types of knowledge (Evans, 1991;
Stevenson, 1991). However, there is no reason why the principles and conceptual
understanding (propositional knowledge) cannot be effectively acquired as part of
the workplace activity.

3.5.3A structure will be required to help ensure that a coherent and consistent range of
experiences are provided to assist the `trainer' and the learner. This structure will
essentially be the product of the syllabus development process with consideration
to the specific nature of the instructional design.

3.5.4Assessment be undertaken by whoever has the expertise using a processes that is
valid and reliable, but supported by an audit process and an appeals mechanism.

To validate and extend these findings a questionnaire was distributed to subjects at three
further mine sites, which had not been involved in the initial data-gathering exercise.

4.Phase Two
Three mine sites, which had not been the subject to the earlier visit, were selected for the
survey. Fifty questionnaires were sent to a co-ordinator at each mine site, accompanied

with separate envelopes to return the responses (see appendix one for example of questionnaire). Typically, these mine sites have between 450-600 personnel. The co-ordinators were instructed to distribute 30 of the instruments to wages staff and 20 to salaried staff as this approximated the composition of the mine site personnel. A total of 71 completed instruments were returned, constituting a 47% return. The return was differentiated across the three sites with returns of 14, 21 and 36 questionnaires.

The distribution of the returns between identifiable wages and salary staff was 51% and 49% respectively, which indicates a disproportionately heavier response from salariedsubjects, given the typical ratios. This categorisation between salaried and wages subjects was conducted, on the basis of their types of work to determine if there were different perceptions between the groups of subjects.

Table 1. Participation in survey

Wages Personnel n = 34 (51%)Salaried Personnel n = 33 (49%)
Quantitative data was drawn from the questionnaire and was manipulated using a Statistical Analysis System (SAS) software package. Qualitative data was analysed and categorised manually.

4.1Nature of Skilled Work
The first set of responses from the questionnaire were descriptions of what it means to be a skilled worker in subjects' area of work. Each respondent was asked to state five qualities of a skilled person in their area. This question had two functions, firstly to gain insights into the breadth of qualities perceived to be required by a skilled worker in a mine site. Secondly, it was anticipated that the questions would reveal what was valued in the culture of this workplace. Each of the five responses were initially placed into one of 32 descriptors provided by the subjects. These responses were further refined into three broad categorises of Technical Skills, Personal Skills and Other Qualities (see table 2). Approximately 33% of the responses related to Technical Skills, and included

responses such as - understanding of work, experience, being competent, effective, and being qualified/authorised. However, Personal Skills comprised 59% of the responses and included such qualities as - adaptability, safe working, problem solver, independent worker, responsible, valued and communicator. Other Qualities such as - satisfaction with work, confidence, happy and team member comprised the remaining 7% of the responses.

Table 2. Perceptions about qualities of a skilled worker

Categories of `skilled work' qualities	% of total responses
Technical Skills eg. understanding of work, experience, being competent, qualified/authorised	33%
Personal Skills eg. adaptability, safe working, problem solver, independent worker, responsible and communicator	59%
Other Qualities eg. satisfaction with work, confidence about work, happy	7%

The responses categorised under Personal Skills infers that being a skilled worker at the mine sites goes beyond the possession of useful technical skills. The way in which workers uses their skills determines whether they are described by peers and supervisors as skilled worker. This data infers the necessity of skill development processes to deal with the development of personal attributes such as adaptability, independence, responsibility, problem-solving and communicativeness.

However, there is significance in this data that goes beyond an expression of need and the requirement to address that need. Within the socio-cultural construction of knowledge the notion of value has a constructed meaning that is a product of the cultural and social setting. Those things that are valued within the culture are likely to the focus of activity and attention, and as Lave (1990) has noted, even structures the culture in terms of who is able to undertake tasks that are more or less valued. Unless skills are

valued in a
particular setting it would seem unlikely that an individual would expend the effort or be
encouraged or guided to acquire those skills. Goodnow suggests that we do not learn to
solve problems rather we learn which problems are worth solving (1990). The strong
emphasis on Personal Skills, which determine how the Technical Skills are applied -could be used to infer that the failure to develop about how these skills should be applied
would reduce their effectiveness in a particular setting. Given the size of the equipment,
the scope of the operation and the emphasis on safety within coal mining it is easy to see
how somebody whose skills reside in another setting may have difficulties being effective.
Having gained an insight about the qualities of skilled workers it is appropriate to
consider how these skills have been developed.

4.2Acquisition of skills and preferred methods for skill development
Data about methods of acquisition of skills was the primary aim of the study. The
questionnaire sought to elicit information on how the respondents had acquired their
skills; what components of the skill acquisition processes had been particularly valued;
and determine into what was considered an `ideal' method of acquiring skills for the coal
mining industry. A three-tier process of elicitation and refinement was used which
compared responses about the subjects' method of skill acquisition to qualities of a range
of typical methods.

The respondents initially indicated how they had acquired their skills, through one of four
options - 1. Integrated on and off job (eg. apprenticeship) - 2.College or University-based
followed by learning on-the-job - 3.Learning on the job or 4. another mode. Table 3
states the distribution of modes of skill acquisition and compares this response with the
ideal method of skill acquisition. Approximately 42% of the respondents had acquired
their skills through integrated (eg. apprenticeship) type arrangements; 18% through
college or university and then learning on-the-job and finally 39% acquired their skills by
learning On-the-Job. (see table 3)

The responses to the ideal mode were refined into the four groupings used for mode of acquisition. Within the `Integrated' category responses included combination of theory and practice; appropriate experience and advanced training. The `On-the-Job' category included, training courses with hands-on; experience; other skilled workers; and practical experience. `Other methods' was categorised to include, attend courses, off-site training and "on-the-job for clerical and external for technical". (see table 3)

Table 3. Comparing Mode of Acquisition with Ideal Method of Learning

Means of AcquisitionIdeal Method of Acquiring Skills

Frequency
Percent
1.
Integrated2.
Uni/College3.
On-the-job4.
OtherTotal1. Integrated
(n =28)5
7.690
0.0021
29.232
3.08 28
41.792. Uni/College
(n = 12)3
4.624
6.15 4
6.1511.54 12
17.913. On-the-Job
(n = 26)2
3.08 0
0.00 23
35.381
1.54 26
38.804. Other
(n = 1)0
0.000
0.00 1
1.540
0.00 1
1.49Total 10
14.924

	5.97	49
	73.14	
	5.9	67
100.00		

This comparison indicates some significant statements of preference. Of the approximately 42% of those who acquired their skills in an Integrated method of skill development 29% suggested learning on-the-job was the ideal method. Only approximately 8% of these subjects suggested the way they had learned their skills was ideal. A similar pattern, although not as strong was reported in the Front-end (Uni/College) method with On-the-Job learning being as valued as the actual means of acquisition. The group that reported the greatest congruence between acquisition and ideal modes was the On-the-job learning group with 35% of this 39% grouping stating it as the ideal method. The overall significance of this data is that 73% of the subjects suggest that learning On-the-job is the ideal way of learning skills in the coal mining industry.

It is possible to speculate at the significance of these results. The emphasis given to learning on-the-job is highly significant and the degree of support is quire surprising. The coal mining industry has a segmented workforce with tradespersons and professionals being conscious of their identity. Consequently, it would be expected that they would have been quite supportive of the Integrated and Front-end methods of skill acquisition which, respectively, were the way they acquired their skills. This protectiveness was not apparent and, it could be conjectured, adds to the significance of the preference within this data. This data provides an initial indicator of preference which is refined in the next stages of the study.

4.3Utility of different methods of skill acquisition

The respondents indicated the usefulness of five modes of learning, some of which had been reported in the first phase as being used to develop skills for the

coal mining
industry. The five modes are Vendor Training, Primary or High School, College or
University, External Training Courses, Other workers on site, and Just by doing it. The
respondents indicated whether these provisions were Not Applicable, Ineffective, Not
Very Useful, Quite Useful and Very Useful.

Table 4. Usefulness of Methods

Mode of LearningN.AIneffectiveNot Very
EffectiveQuite
EffectiveVery EffectiveVendor Training 18
28.1% 2
3.12% 4
6.2% 25
39% 14
21.87%SHS 4
6.25% 3
4.69% 5
7.01% 32
50.0% 20
31.25%TAFE/UNI 25
39.06% 6
9.36% 2
3.12% 15
23.44% 16
25.0%External
Provider 7
10.94% 1
1.66% 3
4.69% 25
39.0% 28
43.75%Others 3
4.69% 1
1.56% 5
7.81% 20
31.25% 35
54.69%Just by doing it 0
0.0% 0
0.0% 0
0.0% 21
32.81% 42
65.52%Total 57 13 19 138 155

Learning from Others at the worksite and Just by doing it received the strongest

responses. What was significant was that the lowest categorisation of Just by doing it was
Quite Useful. This is indicative of the consistently high value that practical learning
activities have at the mine sites.

4.4Which methods are most valued and why
The respondents also prioritised the various modes of skill development by selecting the
three modes they most valued and t en indicated why they were valued. The responses
were recorded, and analysed quantitatively and qualitatively. The data was also
delineated between those of salaried and wages staff; with a further delineation of
tradespersons within the wages area. This was undertaken to determine if these groups
responses were markedly different. The data, indicating why modes were valued, were
recorded and a number of common factors emerged from each type of provision. These
are illustrated below in table 5.
Table 5 Selected Modes on basis of Usefulness

ModeStaffTradeOther
WorkersTotal PercentVendor8672112.2%Primary/SHS9281911%Uni/
TAFE8741911%External14462414%Other Workers156204123.8%Just doing
it185254827.9%Total713070172100%

The data within Table 5 supports the general tendency of valuing learning activities at the
mine site that is evident in the two previous comparisons. Other workers and Just by
doing it were the most recently favoured form of skill development with 23.8% and
27.9% respectively. Of significance was the difference in perceptions between personnel
in the salaried and wages categories. Two trends emerged outside of the general supportgiven to Other Workers and Just by doing it. Firstly, the perception of the value of
External training is differentiated between the salaried and wages groups. Secondly, there
is greater belief in the value of learning from "Other Workers" and "Just by doing it"
among wages subjects than salaried subjects. However, the relatively small samples
means that inferences need to be guarded. What might be of concern is a situation arises
were supervisors and managers, who had responsibility for implementation of skill

development processes, vary in their perceptions of what is the most effective way than
their subordinates. It might be inferred from the Phase One data that this may have been
the case in past skill development activities.

4.4.1 Why the different methods are considered effective.
The data provides some qualitative statements of why the different methods are
considered effective. All comments with more than one respondent are mentioned below,
with the frequency in parenthesis.
Vendor Training

* Valued as a means of "picking up additional technique", getting the how and
why" (Total 16 respondents)

Compulsory Education

* Valued because "basic skills used everyday" (Total 16 respondents)

External Training

* Valued because "acquiring other perspective and expertise" (8), also the acquisition of specific knowledge in greater detail (8), "relevance of work and
study" (2), "first hand information" (2) and "when they stress practical applications" (2). (Total 24 respondents)

Other Workers On-site

* 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)

Just by doing it

* Valued because "to be able to see at first hand & to practice the given knowledge and skill for operators to perform their work" (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)"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)

This data provides some quite specific references. "Other workers on-site" and "Just-by
doing it" were again highly valued as indicated by the number of responses. Significantly
the respondents were able to state quite specific reasons why these methods of skill
development were valued. What could be inferred is also being stated is that "Just by
doing it" without "Other workers on-site" may be inadequate. The combination would
seem to be a powerful combination.

4.5Learning On-the-Job
The responses to the questions "What has been useful in learning through on-the-job
experiences" and "Why was it useful", produced responses that were similar to some of
those above. When responding to the first question the following were elicited:-

a) What was useful?
The following are the statements which had two or more responses. The first statement
was recorded and those following which reflected the same idea were categorised
accordingly. The statements are " everything that has been learned on the job has been
successful - good & bad" (3), "variety" (3) "by doing the job you are not just being told

how to do the job you are experiencing it first hand" (4), "you are learning from someone
who knows the practical side of the job, and can answer any questions" (10), "things that
look `ideal' on paper or in discussion are more often than not considerably harder to
implement in reality" (2), lots of non-technical skill development (2),

"practice and
guidance" (5) better and practical understanding (9), "learnt something I didn't know
before and passed it on" (2), "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)

What is evident from these quite concrete statements is that actual behaviours can be
identified in being supportive of learning. Such statements when they are repeatedly
asserted must, at least indicate a clear preference and provide guidance in the selection of
strategies which could be optimised.

b) Why was it useful?
The following statements are also those which had two or more responses, using the first
recorded statement as a category. The statements are "the ability to perform the main task
efficiently, the ability to assist others in their tasks", the ability to be productive (3) "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) " because of
hands on experience" (3) "smooths the day - allows maximum achievement" (2),
frequency of use, practice (6), "better understanding of job" (10) "easier to do the job if
you have done it before, - avoid traps for new players" (3)

Again concrete statements about utility are presumably being made because they are seen
to be effective by the skilled workers.

Formal Recognition
The respondents were finally asked about the importance of receiving formal recognition
for any skill development. They were asked to whether formal recognition was Essential,
Very Important, Quite Important or Not Important. The responses are illustrated in Table
6 below.
Table 6

Perceptions of value of Formal Recognition of Skills

ValueNumberPercentEssential3954.9%Very Important2231.0%Quite Important7
9.9%Not Important3 4.2%71100%
This data indicates that approximately 86% of the respondents stated that formal
recognition for their skills wa either Essential or Very Important. Given the relationship
between skill acquisition and remuneration, formal recognition of skills is seen as a way
of legitimating, recording and certifying skills. This would indicate that any mode of
skill development would need to consider formal recognition. This is significant because
formal recognition is being increasingly demanded.

5Discussion
There appears to be three major outcomes from this research activity. Firstly the notion
of socio-cultural values of the setting were articulated by the respondents. Being a skilled
person meant much more than being technically competent. The respondents defined
qualities that were valued, and rejected those that were not, in a both phases of the
research activity. In statements about the definition of a skilled worker a range of
attributes were defined which had particular emphasis within mine site work, not the least
being a concern for safe working practice. Equally, the respondents were quick to reject
those modes of skill development they did not perceive to understand the context of mine
site work. This would seem to support the idea that knowledge and skills cannot be
objectively defined but exist a social and cultural definition and value system (Goodnow,
1990, Lave 1990, Goodnow and Warton 1991). The context in which those skills are
deployed are significant and have a direct influence on how tasks are undertaken and
skilled work configured (Rogoff 1990). This emphasis is congruent with the theoretical
propositions at the beginning of the paper.

The way skills and tools are utilised is determined culturally (Brown, Collins and Duguid,
1989). Knowledge has to be socio-culturally configured to make it proceduralised
effective - robust and transferable (Pea, 1987). Further studies, in other

industries, might
reveal the degree to which the mix of skills in other industries is context bound.

Secondly, strong support for on-the-job learning was evident at all three levels of
elicitation and analysis. When comparing the method of acquisition against ideal (table
3), the usefulness of a range of methods and then selected approaches (tables 4, 5 & 6)
the consistent outcome was that learning in the workplace by undertaking activities and
learning from others were strongly supported. The preference for learning by "Just doing
it" and "Learning from others" permits inference about the acceptance of the theoretical
concepts of situated cognition and authentic activities (Collins, Brown and Newman,
1989; Brown Collins and Duguid, 1989; Gott 1989). This finding was most significantly
supported by the comparison between method of skill acquisition and the ideal method
(table 3); supporting the notion that undertaking activities and guidance by others in asocio-culturally authentic environment was supported (Lave 1990). Overall the data
provided a strong preference for learning at the workplace. Undertaking actual activities
related to everyday practice at the mine site received a significant degree of support. The
access to appropriate expertise was also supported as being essential for the development
of skills a consideration emphasised by Collins, Brown and Newman (1989). The process
of observation, guided action and movement to autonomous action is inferred in much of
the data. Guidance provided by the expert appears to accepted as a highly functional
approach to learning for this industry. These are the qualities of the apprenticeship model
of learning which is well supported in the current research into learning by Gott (1989)
Collins, Brown and Newman (1989) Brown, Collins and Duguid (1989). The workplace
gratuitously provides the very qualities which formal learning institutions are trying to
develop by complex interventions.

Thirdly and finally, the significant response about `Learning from Others' who can do the
job (experts) supports the notion of learning as a social construction.

The expert would
have to be accepted as such, and a key requirement of this was the ability to have a range
of skills associated with the mine site. Vocational experts who lacked this cultural or
contextual knowledge were not valued. Consequently, there is a social relationship
between the learner and the expert which is constructed within the interaction (Lave,
1990; Goodnow 1990; Lane and Wenger 1991). It would seem that a quite different
relationship would exist when an expert was presented as such, perhaps as a trainer, but
not accepted by the learner.

Having considered the congruence between theorising and perceptions of practice, it is
worthwhile speculating about the implications for learning arrangements. The findings
within the second phase of the research activity support the set of principles outlined after
phase one, albeit with a greater emphasis on the preferred learning process. The quality
of the outcomes of the learning process would seem to be dependent upon two key
factors, learning tasks and guidance by experts.

The learning activities have to provide experiences in such a way that the learner is

pressed into developing responses to practical problems (Stevenson and McKavanagh,
1991). These activities promote the development of procedural knowledge, which is
robust and transferable. The activities should be authentic, challenging but ultimately
achievable - being within the learners' proximal development (Luria, 1976). The scope
of the activities should also allow the learner to see the process and product of the actions
they are learning within the mine setting (Gott, 1989).

The quality of interaction between the learner and experts in the activities requires that
the expert should be the mentor rather than the teacher. For example, the learner would
need to be encouraged to approach the expert with an approximation of action. So rather
than the learner saying to the expert "this is what I have to do, how do I

do it?" the
learners will have considered what they think is an approach to the problem. They will
have developed a response and will seek guidance from the expert - "this is what I have
come up with, can I explain it to you and hear what do you think of it?". This type of
approach ensures that the learners are actively engaged, they initiate the activity, they
develop an approximation of a conceptual and practical approach to the task, - in short -
they are doing the thinking not the expert. The experts' role is not to teach but to guide,
with an emphasis on assisting the learner to learn, rather than teaching them something.

6. Conclusion.

It is possible to conclude that the current research and theorising into the use of authentic
activities to support situated cognition is sustained by perceptions of workers in the coal
mining industry. Equally, the theoretical notions of guided learning within those
authentic activities appears to be supported by skilled workers in this industry.
Underpinning this support is the socio-cultural role of the setting. This is an initial study
which was undertaken in an industry which has a tradition of informal learning. However,
the degree of acceptance of the value of learning in the workplace, by engaging in
activities with the support and guidance of others was significant enough to suggest that
its acceptance and implications may not be limited to the coal mining industry. Further
work is required to validate and generalise this research. This work might also seek to
clarify ways of actually effecting the means of acquiring skills.

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