This article advances an approach to evaluating learning as social practice through an examination of learning in workplaces. The current interest in learning situated in social practice and the utilisation of workplaces as sites for the acquisition of vocational knowledge provides an opportunity to examine how best to evaluate environmental contributions to learning. Adopting a constructivist perspective, the paper draws upon formative studies of understanding learning in workplaces to develop an approach to evaluate learning as engagement in social practice, such as workplaces. These studies are used to appraise theoretical principles and in doing so provide a basis for the evaluation of this view of learning. The article concludes by advocating an approach which accommodates ongoing contributions from the social and physical environment in the development of knowledge and in doing so advocates the evaluation of approaches to learning which are often dismissed as being informal and, hence, adhoc and concrete.

1. INTRODUCTION
Concerns about the paucity of transfer of knowledge from formal learning settings to other settings is causing a reappraisal of approaches to teaching which has implications for the evaluation of settings and arrangements for learning. This reappraisal includes a shift to consider apprenticeship types of approaches to learning as a means of bridging the gap between formal learning settings (schools, TAFE and universities) and other settings (e.g. workplaces) (Raizen, 1991). Interest in this approach has been enhanced by a growing focus within educational research on situated cognition and sociocultural theories of learning. Within current theorising, convergence is occurring between cognitive theories, which emphasise the internal processes of the mind, and contributions from cultural psychology, sociocultural theory, sociology, ecological psychology and anthropology which focus on the social and cultural sourcing and appropriation of knowledge. Learning, within such a view is now being conceptualised as a reciprocal and transformative construction process through which the individual appropriates knowledge (Rogoff, 1995). Such a view suggests that the evaluation of learning needs to focus on social and cultural factors which influence the appropriation of knowledge and that these factors should be included in frameworks which aim to evaluate learning environments, such as workplaces.
To advance this view, the concept of learning is first discussed from sociocultural and cognitivist constructivist perspectives. This discussion necessarily includes association between social practice and the construction of knowledge, thereby providing a focus for evaluation. Following this, the outcomes of a series of formative studies on learning in workplaces are provided to support an approach for the evaluation of arrangements intended to promote learning. Finally, factors for evaluating learning as social practice are advocated. The ideas in this paper should assist with evaluation of programs that aim to develop the skills and knowledge required for effective work practice. In particular, they have a direct relevance to those interested in work-based learning programs, such as those that aim to develop management or productive skills for particular applications.

2. Learning and social practice
Within the evolving understanding about thinking, acting and learning is an increasingly common belief that knowledge is constructed by individuals as they engage in socially structured activity (Goodnow, 1990). Although the process of this construction is individual and unique it is extricably associated with engagement in activities within social practice. The concept of activity structuring cognition (Rogoff & Lave, 1984) is being advanced by a more complete understanding about how social sources shape activities which, in turn, have cognitive consequences. Given this association, an emerging concern is for access to learning activities which are authentic, in order to maximise the prospect of the transfer of knowledge to like situations or the settings where the learnt knowledge is meant to be deployed. Given concerns about the paucity of transfer from formal learning settings, the notion of authenticity in activities and social partnerships is becoming a key source of interest for policy makers and researchers (Raizen, 1991), as these circumstances are seen to assist in the construction of knowledge which is at least transferable to target sources. However, rather than this approach to learning being seen as socialisation, the construction of knowledge is viewed as being an interpretative, transformative and reciprocal process, or as Valsiner (1994) refers to it as the co-construction of knowledge. A cognitive psychology view is that this transformative process is problem-solving of both a routine and non-routine kind (Anderson, 1993; Billett, in press). Routine problem-solving contributes to making knowledge coherent and reinforcing its viability, whereas non-routine problem-solving is associated with the transformation of existing knowledge and the development of new. The social practice in which the problem-solving occurs not only provides the problems but also the solution, thereby making strong links between learning and social
practice (Brown, Collins & Duguid, 1989). These views need to be considered in the evaluation of arrangements for learning. Firstly, it is suggested that the situation and social partnerships in learning are significant. The idea that the context for learning is unimportant and that transfer would follow is challenged by such views. Secondly, within the constructive nature of learning, the focus for evaluation has to consider the learner as the 'meaning maker'. It is no longer possible to countenance the view that learners somehow internalise knowledge presented by teacher or instructional media, in some uniform and faithful way. Thirdly, that ongoing problem-solving of both a routine and non-routine nature are required for the construction and reinforcement of robust knowledge which is likely to transfer to other situations. Fourthly, the need to consider authentic social situations and partnerships becomes particularly salient where specific forms of transfer are desirable, such as the transfer from one situation to another (e.g from formal institution to the workplace; one type of workplace to another). The relations between the learner and the teacher / expert / parent are socially constructed (Goodnow, 1990), with the quality of the relationships playing a role in the appropriation of knowledge (Rogoff, 1995). It is important to acknowledge that formal learning settings are just another type of social setting with their own culture and social practice (Brown, et al., 1989; Lave, 1993; Wertsch, 1993). There is no basis to argue that activities in these settings inherently lead to the construction of knowledge which is more transferable than that accessed in any other social practice (Carraher, 1986; Childs & Greenfield, 1980; Lave, 1977, 1990; Rogoff & Lave, 1984). Therefore, it is salient to consider how best the development of robust and transferable knowledge can be constructed in social practice.

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 and conceptual (propositional) domain-specific knowledge (Stevenson, 1991; Stevenson, McKavanagh & Evans, 1994). Learning in social practice, such as workplaces, with their authentic activities embedded within a purposeful cultural and social context may offer an environment to promote the construction of these attributes (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 (non-routine) activity (Stevenson, 1991). Yet, learning, such as that realised by engaging in authentic activities in the workplace, are often portrayed as being pragmatic, adhoc and incoherent (Resnick, 1987). Perhaps, a fresh appraisal is required as the contribution of the
setting to provide authentic activities, access to experts and other learners thereby furnishing the sociocultural setting which, along with undertaking of relevant activities, promotes the construction of expert knowledge. As the types of knowledge and procedures required for expertise have a social as well as a cognitive dimension this becomes part of how arrangements for learning need to be evaluated.

It is worth noting that informal learning processes have been and continue to be highly valued. Try entering the major professions without learning informally as an articled clerk or hospital intern under the guidance of more expert practitioners. The apprenticeship method of learning was developed and is exemplified in tradeswork as a means of learning skills while engaging in practice under the guidance of an expert. Cultures are maintained through informal learning processes (Pelissier, 1991). Moreover, consider how children learn 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 an authentic context, mediation of parents and friends and participation in purposeful activities (Bransford, Sherwood & Hasselbring, cited in Pea, 1987). It seems possible to speculate that these guided learning processes referred to above may provide a basis for considering the development of knowledge in social practice, using the construction of vocational skills in the workplace as an basis for inquiry. This is because, in these settings, it is postulated in the literature that learning takes place through engaging activities that are purposeful and guided implicitly and explicitly by interaction with the culture of the workplace. However, this is not to suggest that all social practice, such as workplaces, are havens for learning appropriate and desirable skills or that there are no shortcomings to this approach.

Therefore, given the relationship between individuals' construction and engagement in social practice, it is necessary to determine how this relationship should be evaluated. To undertake this task the paper draws upon a series of studies of learning in workplaces.

3 Workplace learning: case studies

Two case studies of learning through participation in social practice are described below. The first, conducted in the coal industry (Billett, 1993a), was an exploratory study used to identify those factors or conditions which subjects viewed as being salient to learning in the workplace. This study was replicated across a range of other industries (hospitality, transport, secondary
processing, retail) in another study (Billett, 1993b), not detailed here, with the findings being upheld. The second study was conducted in a secondary processing plant (Billett, 1994) using and extending the findings from the earlier studies. This study made comparisons between data on learning through everyday practice and those associated with a set of instructional interventions used in the workplace.

3.1 Coal mining Study

The first study (Billett, 1993a), which was conducted in central Queensland across seven coal mines, comprised two stages. Firstly, sixty worker interviews were conducted across four minesites. Responses to open questions about how workers had acquired and maintained their skills were elicited. Although the phrasing and sequence of the interview questions varied slightly, because of the nature of the group or individuals being interviewed, the questions were consistent in their focus on how skills were developed (what is happening) and how they should be most effectively developed for workers at the mine sites (what should be happening). The responses from these interviews provided a set of tentative principles for workplace learning which were subsequently used to formulate a questionnaire used in the second phase of the study. The questionnaire was distributed at three different minesites than those where the interviews had been conducted. The data elicited by the questionnaires were analysed using quantitative and qualitative methods and deductions.

3.2 Findings

Existing training provisions

Off-site training was valued when the knowledge could be immediately applied in work activities and the opportunity it provided to meet other people. Moreover, 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". Overall, however, external training was not valued because the external trainers rarely had appropriate expertise. External training was perceived as being useful for learning knowledge which could not be found on the minesite. Vendor training (that accompanying the purchase of a new piece of equipment) provides an exemplar of this. This form of training was valued as it provided specific knowledge which was inaccessible elsewhere. The instructors were reported as being able to respond to specific requests. Interestingly, the value of this training was restricted to equipment maintenance, with respondents claiming that they knew more about the effective utilisation of the equipment 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.

Technical and Further Education (TAFE) courses were valued only because of their provision of formal qualifications, with these concepts being viewed as being too general, unauthentic and the instructors' knowledge remote from the mines' needs. On-site training programs, such as health and safety, were viewed by some respondents as being the transfer of legal responsibility for safety onto the workers, rather than to develop skills. Therefore, outside expertise was valued only when it could provide what was unobtainable in the minesites. There was strong support for 'learning by doing' and 'with the assistance of others' in the coal mining activities.

**Desirable qualities of skill development programs**

Trainers' familiarity with the setting, their relevant expertise and ability to communicate effectively were frequently reported in the data. Learning on-site through everyday minesite activities was advocated frequently as being the way workers usually acquired their knowledge about coal mining. While there was strong support for this approach some conditions were advocated. These conditions included, the use of a number of people to teach skills, rather than one, in order to gain access to a range of broader skill capability; the acknowledgment of adaptive practice, that there was not one right way of doing things, and; the need to work with and observe a more expert co-worker.

Classroom teaching was not viewed as being useful. If used, it was recommended to be of limited duration, having a variety of instructional media, with a variety of stimuli and be directly integrated with practice with site activities. It was frequently stated that text-based learning guides would need to be written plainly and sparingly. The involvement of workers in generating skill development processes was suggested as a key to facilitate the acceptance and the success of skill development processes.

The data provided some quite specific endorsements of approaches to acquiring knowledge. Interview and questionnaire respondents consistently and frequently referred to learning from other workers, observing and listening, everyday work activities, direct instruction, and the work environment. Respondents were able to state quite specifically reasons why these methods of skill development were valued, particularly other workers and observation and listening (Billett,
However, given the interlinkedness of these contributions it was inferred from the data that "Just doing it" without "Other workers on-site" may be inadequate. The combination would seem to be potent.

The deductions from the data in this first study are as follows. Firstly, the values of the setting were clearly articulated by the respondents. Being a skilled person meant much more than being technically competent, with respondents being quick to reject that which they believed did not account for the minesite context. Secondly, support for on-the-job learning was evident in all levels of data analysis. Undertaking activities related to everyday practice at the mine site received a significant degree of support. When comparing actual modes of acquisition against ideal and the usefulness of a range of methods the consistent perception was that learning in the workplace by undertaking authentic activities and learning from others was strongly supported. The access to appropriate expertise was also supported as being essential for the development of skills. 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 supported in current research into learning by Gott (1989) Collins, Brown & Newman (1989), Brown, et al., (1989). It seems that the workplace gratuitously provides the very qualities which formal learning institutions are trying to develop by complex substitute interventions such as simulations, practical tasks and apprenticeship teaching approaches.

Thirdly, the significant response about 'Learning from Others' who can do the job (experts) supports the notion of guided learning as social mediation. 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 particular social practice - the mine site. Vocational experts who lacked this contextual knowledge were not valued (e.g. TAFE teachers). Therefore the social relationship between the learner and the expert influences engagement in joint problem-solving activities which is viewed as being central to learning from the sociocultural tradition (Lave, 1990; Goodnow, 1990; Lave & Wenger, 1991).

From these data, participation in workplace activities provided experiences which pressed the learners into routine and non-routine problem-solving (Stevenson, et al., 1994). These activities promote the development of vocational knowledge, which is robust and transferable. So this
study emphasised learning through ongoing participation in social practice. The findings from this study were mirrored in those from a cross-industry study (Billett, 1993b) which indicate that these phenomena were not unique to coal mining.

However, in order to advance understanding further it was necessary to engage in a study which sourced more substantial evidence. The danger is that, because the data was based on interview and self-reporting data, the first two sets of findings could be dismissed as mere opinion.

4. Study Two - Secondary Processing

This study was conducted on-site at a secondary processing plant over a four month period involving 15 employees of the plant as participants (Billett, 1994). The study examined the nature and outcomes of workplace learning arrangements, which comprise formal structured learning arrangements (text-based resources, videos, computer based learning, instruction) and informal learning arrangements (everyday activities, guidance, observation) experienced as part of everyday work practice.

Sample

The participants were 15 full-time employees (14 males, 1 female) whose length of service and experience varied, from 2 days employment, to extended involvement which included employment during the construction and commissioning of the plant. The participants were all shift workers, who rotated through cycles of twelve-hour shifts, usually comprising three consecutive day and two nights shifts. The plant operates 24 hours a day, every day of the year. Program participants were interviewed either during work time, between shifts or sometimes on their days off. The sample was selected to provide one experienced operator and novice workers from each work area.

Procedures

Two types of investigative procedures were used: those determining changes (learning) occurring as a consequence of engagement with the learning arrangements, and; those which sought to determine the effectiveness of the learning processes accessed during the program. The first set of procedures comprised a survey of the participants' previous method of acquiring skills, concept maps (Novak, 1990), the perceived ideal method of acquiring knowledge, and an attitudinal survey. Data on the effectiveness of the learning arrangements was gathered through
structured interviews at regular intervals over the four month period. The interviews gathered information about the efficacy of learning arrangements contributing to the participants' ability to perform routine and complex work tasks. In addition, the participants responded to a survey of how a range of attributes could be developed by the training system. The attributes, were determined in an earlier study (Billett, 1993a), as being those required for competent work at this particular plant. These are now elaborated upon as they may provide the basis for an approach to evaluation.

**Interviews**

The interviews were used to determine the outcome of participants' interaction with the planned learning arrangements used at the plant (learning guides, mentors, videos and computer-based learning aids) and the learning that resulted from daily work practice. The learning guides are modularised text-based instructional media, which included text, diagrams, questions and recommended learning activities. The computer-based learning media comprise a text and graphics-based approach, with an interactive question and answer interface. The everyday experiences in the workplace were examined through the categories of learning from *other workers, observing and listening, everyday work activities, direct instruction, and the work environment* derived from the earlier studies (Billett, 1993a).

The validity of verbal data has been questioned as it is based on self-reporting, rather than actual events or changes in behaviour (Ericsson & Simon, 1984:36). To improve validity of reporting, a critical incident approach was adopted, which induced the participants to ground their responses in actual events. It was expected that these learners would experience moments when they were able to achieve task goals for the first time, and be aware of it. Also, that they would experience problems that were beyond their capability to resolve, and they would discover assumptions they had made or understandings they possessed, were not sufficient for problem situations.

Correspondingly, during the interviews participants were asked, *Consider when you had a 'high moment' recently (when things went really well); What happened? Why were you able to be successful? How did you acquire this knowledge?* They were also asked to recount problem situations - *Consider when you last had a problem to solve in the your work. How did you go about resolving that problem? What didn't you know? Who or what helped? Why was that
helpful? To complete the critical incidents they were asked about 'low moments' in their recent work practice, Consider when you had a 'low moment' recently (when things didn't quite work out). What happened? What didn't you know? How could you have best acquired this knowledge? Having recounted these events, the participants were asked to rate the contributions of the formal and informal elements of the training system to these situations, on a survey instrument. The data from this procedure were used to make judgements about aspects of the learning arrangements.

Attributes inventory
During the interviews, participants were presented with an inventory of attributes required by skilled workers at the plant. This inventory had been generated in an earlier study (Billett, 1993b) by forty workers at this plant. These attributes were categorised into propositional knowledge - facts, assertions and propositions - knowledge about (Anderson, 1982), procedural knowledge - ability to secure goals - knowledge how (Anderson, 1982) and dispositional knowledge (Prawat, 1989) - values and attitudes. The participants were asked to rate the usefulness of the learning arrangements, in the development of those attributes.
4.1 Findings
The findings reveal everyday participation to be highly valued for its ability to assist success with tasks and resolve problems. The frequency with which these elements were reported as being ‘very useful’ indicated a strong preference for particular elements of the learning system and also the modal responses report the most frequent response within a category, thereby offering deductions from the data.

Overall, mentors, direct instruction, everyday activities, other workers, observing and listening were consistently perceived to be of great utility for the resolution of problems and securing of goals in the workplace. The data concerning the contribution of guidance provided evidence of the efficacy of the proximal forms of guidance. This data was in contrast to the data of the planned arrangements with modal frequencies for all forms of guidance being perceived to be ‘very useful’. The frequencies are consistent across this category of learning aids with them modes and the overall pattern of responses indicating that guidance of others are effective to a degree that the planned arrangements were not. The perceived contributions of activities and the physical context of the plant were grouped together to gain insights into the distal guidance of the culture of practice and the physical context. Participants reported valuing the contribution of work activities and the workplace in resolving problems and achieving goals.

As stated above, participants rated the utility of elements of the learning system against a list of work attributes. The findings reflected a similar pattern to those reported above, with the contributions of "Everyday Activities", "Observing and Listening" and "Other workers", being perceived as being the most potent in the development of a range of knowledge types.

However, there were concerns about learning through engagement in social practice. Firstly, the ability of informal learning situations to develop conceptual understanding about vocational activities and secondly concerns dispositions associated with engaging in learning activities. It would seem from the data above that workplaces provide rich opportunities to generate different levels of procedural knowledge. However, participants emphasised a need for engagement in everyday activities to provide means by which they can develop an understanding about the activities in which they were engaged. These concerns suggest that a totally informal learning process may lack the development of understanding, particularly in situations were tasks are hidden from the learner. The concern is that the tacit understandings, enjoyed by more skilled
workers, may need to be made deliberately explicit in everyday practice. There is evidence from cross-cultural studies that although much learning is undertaken as part of everyday activities, explicit instruction is included. For example, Pelissier (1991) reports that learning navigation in Palawat includes direct instruction, with substitute artefacts, such as stones and shells, being used to represent star patterns. Therefore, explicit use of explanation, diagrams or stories may be required to develop understandings in learning situated in a culture of practice.

It became evident that participation was differentiated across the sample, with personal and motivational factors playing a key role. Some participants reported being engaged far more actively in their approach to learning, than others. Some participants emerged as highly active learners and maximised their involvement. Those participants that set out to be active, are likely to have developed greater understanding and more finely-honed procedures, than those taking a passive role in the learning arrangements (Stevenson, et al., 1994). These participants indicated a reluctance to be involved, which was reflected in their reported low levels of development on expert derived task.

The decision to be active may be linked to notions of beliefs about benefits, which are likely to be differentiated among individuals. Individuals' perceptions about their ability to be successful may also be a determining factor. Whereas some individuals saw participation as the opportunity to learn and excel, it appeared that others perceived the opportunity as a threat. Concerns about dispositions are forcefully argued by Goodnow (1990) who suggests that the willingness of learners to participate in learning processes needs to be considered in both learning theory and instructional practice. Given the notion of learning that is conceptualised in the definition of appropriation, provided above, is a matter of individuals constructing meaning rather than simply internalising externally generated knowledge (Rogoff, 1995), personal dispositions need to be considered more adequately.

To conclude the data gathered in this study suggests that learning arrangements which are situated in social practice, is not, by itself, a sufficient quality for the optimum appropriation of skills and knowledge. Rather, for situated learning to be effective it needs to be embedded in the authentic activities and social relations which comprise cultural practice. This does not exclude instructional interludes to deepen individuals' understanding of vocational activities, but suggests
that learning activities which fail to access and engage in a culture of practice are less likely to be generative of effective learning outcomes.

5. Conclusions

The discussion and studies reported above provide the basis to draw some deductions about learning through social practice. These lead to considerations for the evaluation of learning which can be seen as being fivefold. Firstly, there is a need to account for ongoing everyday activity as a basis for learning, not just those activities which purport to privilege learning. Secondly, arrangements which press individuals into effortful thinking and acting, regardless of where they occur, need to be considered central to how arrangements for learning are to be evaluated. Therefore, routine and non-routine problem-solving within social practice which is authentic in terms of the targeted circumstance along with direct and indirect guidance are proposed as key foci for evaluation. Thirdly, and leading from this, the focus needs to be on the learners, because ultimately they are the interpretative and constructive meaning makers. Fourthly, the studies above have provide a basis to consider how learning through social practice might be evaluated. The constructive process of appropriation is highly individual with the disposition of the learner playing a role. The complex of authentic activities, proximal and distance guidance, movement through activities and the access to knowledge which may be opaque, are all elements that could be considered. Finally, the concepts discussed above about a widening focus for evaluation have applications outside workplaces as they are likely to be useful across different types of social practice. In particular, the view of learning advocated here and its social genesis may assist with discussions about evaluating the prospects for the transfer of knowledge. One outcome of such a view is that it may be unreasonable for the degree of transfer expected from formal education settings to be as high as some expect.
References


