

SITUATED LEARNING: RECONCILING CULTURE AND COGNITION

Stephen Billett

School of Vocational, Community and Technology Education

Faculty of Education

Griffith University

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1.Introduction

The last five years have seen a wide interest develop in situated learning. This is learning that is situated in social circumstances which are authentic, in terms of the application of that knowledge. The current interest is partially attributable to Collins, Brown and Newman (1989) and Brown, Collins and Duguid (1989), whose work calls for a greater consideration of the contributions from sociology and anthropology to the understanding of how individuals think and act. As a consequence, the contributions of researchers such as Lave, Rogoff and Scribner, from the socio-cultural orientation of learning theory are now widely acknowledged. Despite this interest, and accumulating work by researchers, there remains an incomplete understanding of the consequences of situated learning. For example, what forms of knowledge and cognitive activities are privileged through this mode of learning? And what aren't? Prawat (1993) claims that situated learning privileges the development of procedural knowledge over that of propositional or conceptual knowledge. Recent empirical work (Billett, 1992; 1993a, 1993b 1994), which investigated the situated learning of vocational skills in the workplace, although providing evidence of the efficacy of this mode of learning, failed to provide a comprehensive account of the consequences of this mode of learning. In two of the studies (Billett, 1993a & 1994) concerns about the development of propositional knowledge were reported.

In an attempt to develop further understanding about the consequences of this mode of learning it is necessary to return to the literature in order to predict what are likely outcomes in terms of the acquisition of knowledge types and their deployment. In doing so this paper seeks some reconciliation between two bodies of literature which represent distinctive views about thinking and acting. Cognitive psychology, with its focus on expertise being realised through the application of cognitive structures, higher orders of procedures and the organisation of knowledge, presents a view of thinking and acting which emphasises the internal processes of the mind. Conversely, the socio-cultural literature presents a view which accentuates the social and cultural genesis and transmission of knowledge. This paper attempts two key goals by advancing a reconciliation between these literatures. First, it seeks points of commonality and complementarity between the cognitive and socio-cultural literatures in order to contribute to understanding further how thinking and acting is influenced by social circumstances. The second goal is to utilise this review of literature to advance an understanding about the consequences of situated learning. In attempting this goal, a framework influenced by Vygotskian perspectives, is used to reconcile the contributions from both literatures. The paper concludes by advocating a greater reconciliation between these two views of thinking and acting in order to advance the understanding of everyday and/or complex human performance.

2 Commonalities and complementarity within the literatures

In this first section a brief overview of the two bodies of literature is offered to determine areas of commonality. This review is led by the contributions of the cognitive psychology literature and is then followed by an overview of the socio-cultural literature.

2.1 Cognitive Psychology literature.

The strength of the contributions from cognitive psychology literature resides in its discussions of knowledge types, cognitive structures, and, the extent and organisation of knowledge in facilitating expert performance. Studies of expertise propose that, within a particular domain of knowledge, the qualities of organisation of knowledge around salient principles and robust procedures are prime characteristics of expertise. For example, problem-solving and learning which are seen as being similar cognitive activities (Anderson, 1993; Shuell, 1990) and transfer (Royer, 1979) are dependent upon access to previous knowledge and the use of higher order or strategic procedures to manage and monitor these activities (Gott, 1989). Underpinning these cognitive activities is the effectiveness of knowledge representation in memory, its recall and the deployment. These activities account for the almost instantaneous ability of experts to solve problems and complete other complex tasks in a manner that novices simply cannot. So in these ways cognitive psychology provides a comprehensive, although not complete, account of complex thinking processes. This account is the product of a sustained inquiry on the differences between novices and expert's organisation and utilisation of knowledge over the past twenty years (Glaser, 1989). However, with some notable exceptions (eg. Greeno, 1989; Pea, 1979, Posner, 1982; Prawat, 1989) there is an apparent lack of acknowledgment in this work of the external social influences, which are interpretively constructed by individuals, and shape the way knowledge is understood, organised, represented and applied.

Although cognitive psychology emphasises types of knowledge and cognitive activities such as problem-solving, it remains underdeveloped in its account of how knowledge is sourced. This remains the case despite a recent emphasis on domain-specific knowledge in the expertise literature. The limited consideration of contextual, personal and dispositional factors has resulted in a preference within cognitive psychology for generic types of knowledge that are disembedded from a particular physical and social context (Newman, Griffin & Cole, 1989), and arguably remote from everyday application (Raizen, 1991). It is difficult to account for the dispositional nature of concepts and procedures without acknowledging their individual and social source. However, recent recognition of these shortcomings has led to a reconsideration of socio-cultural factors, and now it is increasingly acknowledged that factors external to the mind are a part of both problems and their solutions (Brown, Collins & Duguid, 1989; Collins, Brown & Newman, 1989; Gott, 1989; Greeno, 1989a; Pea, 1987; Prawat, 1989).

In sum, cognitive psychology, while making a range of contributions to the understanding of thinking and acting, does not yet present a comprehensive account of how knowledge is sourced and developed. However the beginnings of such work can be found in the recent work mentioned above. It would seem that the acknowledgment of the contributions of external sources to thinking are likely to play a role in the further development of cognitive psychology.

2.2 Socio-cultural literature.

In contrast to the cognitive literature, the social and cultural origins of knowledge are referred to extensively within the socio-cultural literature, and the social transmission of knowledge is also well-researched and theorised (Lave, 1977: 1990: 1993; Rogoff & Lave, 1984; Rogoff, 1990: 1993; Scribner, 1984: 85a: 85b; Vygotsky, 1978). Although quite comprehensive in conceptual

terms of how knowledge is acquired this literature lacks an elaboration of what categories of knowledge are created, apart from dispositions such as values and attitudes (Goodnow, 1990). The genesis and transmission of knowledge is elaborated, albeit focussing on specific outcomes. Greater elaboration about more general or executive forms of knowledge, and, for instance, how learning or transfer occurs, remains quite incomplete, apart from suggestions about the concrete examples provided through analogies and examples (Prawat, 1989). Lave (1993) refers to stripping away the context to abstract meaning but provides no account of how this activity is initiated, monitored or evaluated. This lack of differentiation of forms or types of knowledge is also evident in seminal works. For example, what actually comprises Vygotsky's (1987) concept of higher mental functions? Such is the breadth of his definition, that all worthwhile knowledge is socially-acquired and requires higher mental functions, which leaves little room for differentiation. The application of a general socio-historical sourcing of knowledge has already been challenged and modified by Scribner (1985b) to account for the contributions of the socio-cultural level. Equally, within this literature, there is little acknowledgment of the differentiation amongst types of knowledge and identification of procedures which might permit the abstraction and generalisation required for problem-solving and transfer, apart from recent work by Lave (1993).

Problem-solving, in this literature is referred to as a social process embedded in culturally-derived activities with the germaneness or appropriateness of responses being a key determinant of expertise (Goodnow, 1990; 1993). Yet there is no clear linkages between this view and the extensive discussion within cognitive psychology on problem-solving, categories of knowledge or problem types (Greeno, 1989b). The concept of enculturation has also been proposed within this literature yet has not been wholly treated as problematic. Rogoff, (1990; 1993) and Goodnow (1990; 1993) presents more critical views, arguing that appropriation of knowledge, within a set of social circumstances, is not benign or neutral, instead it is subject to the preferences of learner, culture and guide. In doing so they advocate constructivist views of learning, placing individuals more in the active role of the constructor rather than being helpless before the press of social and cultural circumstances. Such contributions are important as they challenge criticisms of the socio-cultural literature representing a behaviourist or technicist orientation to thinking and acting. Moreover, a more defined analysis of what knowledge types are likely to be accessed and privileged through the mediation of socio-cultural contexts would be a useful contribution to current theory. For example, as mentioned above, situated learning is being criticised for developing procedural knowledge and not conceptual knowledge (Prawat, 1993).

Having teased out incomplete areas of theorising it is apparent that as well as commonality there are also elements of compatibility, which may be mutually beneficial.

In the next section linkages between the internal processes of the mind, as proposed in the cognitive psychology literature, and the social sources of knowledge are reviewed. It is argued, from the cognitive literature, that thinking and acting is dependent on external contributions - social situations. In support of this central claim seven propositions are advanced as linkages which provide a basis for compatibility.

3 Linkages between the internal procedures of the mind and external sources, from the cognitive literature.

It is proposed here that all types of knowledge, with the probable exception of strategic knowledge, are sourced in social circumstances to a greater or lesser degree. In the following

section gaps in the cognitive psychology literature are examined to explore ways in which social circumstances can complement the cognitive literature. In doing this it is first argued that the compilation of procedures occurs in particular social contexts, thus the automated processes reflect the requirements of those circumstances. Dispositional attributes, which underpin representations of knowledge in memory (values, attitudes, interest) and permeate the effortful constructive process of procedures and concepts, are also shaped by the social circumstances. It is also advanced that these attributes are interpretatively constructed in the particular circumstances by individuals based on their personal histories and epistemologies which are themselves social in origin. Next, it is claimed that expertise is relational to a particular domain of knowledge, which, it is argued, has social and cultural origins. Problem solutions are to be located in the social world as much as problem states (Brown, Collins & Duguid, 1989). The representation of knowledge in memory, and therefore the cognitive activities which utilise those representations, are also generated by a constructive and interpretative interaction with the social world. What follows is a brief elaboration of these linkages between the internal processes of the mind and the social circumstances in which knowledge is accessed.

3.1 Proceduralisation is a product of social circumstances.

As foreshadowed above, the proceduralisation and compilation of knowledge, one of the limited number of examples of knowledge development within cognitive psychology, is premised on the collapsing of a series of specific procedures (Anderson, 1982; Stevenson, 1986a). These specific procedures reflect the circumstances of particular practice wherein those procedures are compiled. In this way the specific requirements of particular practice are likely to become automated procedures, albeit through a process of individual interpretative construction. In this way the activities of a particular context become the highly practised, automatic and instantaneously applied procedures of individuals (Ericsson & Simon, 1984; Sweller, 1989). This means that individuals' interpretation of social practice becomes the source of tacit knowledge used in goal-directed activity which is not consciously represented in memory once compiled (Gelman & Greeno, 1989).

3.2 Expertise is domain-specific

Novices do not necessarily lack ability, they lack specific knowledge and experience within a particular domain of knowledge (Glaser, 1990; Wagner & Sternberg, 1986) which allows them to conceptualise and categorise problems and deploy cognitive structures effectively. This situation suggests a more specific view of knowledge and expertise. Domains of knowledge are likely to be shaped by social circumstances and then interpretively constructed by individuals (Posner, 1982). This links the exigencies of a particular culture of practice to expertise, as advanced in both literatures. Given the consideration of constructive approaches to thinking and acting, it is proposed to move from definitions of domains which emphasise formal academic disciplines, as they are often defined (Alexander and Judy, 1988) to one which accentuates individuals' interpretative construction of rule-based domains. This conceptualisation of domains is premised on access to practice and the priority afforded by social and cultural circumstances (Goodnow, 1990; Lave, 1990). Practice, in this way, provides a foundation for a rule-based domain of knowledge. This view moves a domain of knowledge from being an inert set of principles to an individualistic construction mediated through a socio-cultural determined practice (Perkins & Salomon, 1989; Rogoff, 1990).

3.3 Specific knowledge is generated through problem-solving.

Problem-solving is the principle activity which is associated with learning (Anderson, 1993; Shuell, 1990) and transfer. Problem-solving occurs both in routine and non-routine ways, which

have consequences for learning and transfer. Routine problem-solving procedures which are used in everyday activities, and set within the activity system of a particular culture of practice, embed thinking and acting in the context in which the knowledge is sourced (Perkins & Salomon, 1989). Therefore, problem-solving as an on-going activity incrementally sources thinking and acting in particular contexts. In problem-solving activity of a non-routine nature, specific knowledge, generated in social circumstances, is retrieved, utilised and manipulated to resolve the problem. The problem space created by the individual in order to address non-routine-problems are the product of individuals' interpretive construction, which is founded on the circumstances of the knowledge's acquisition and the previous history of the individual (Posner, 1982; von Glasersfeld, 1987). In these ways the generation of knowledge is seen as being sourced through both immediate social circumstances and those which comprise individuals' personal history. It is the engagement in goal-directed activity in particular social circumstances that engenders the purposeful acquisition and organisation of knowledge.

3.4 Representations are dependent upon a rich contextual source.

The way individuals conceptualise problem solutions is dependent upon the quality of the internal representation formed in the problem space (Newell & Simon, 1972). Consequently, learning needs to be viewed as being more than the mere acquisition of knowledge, to include the linkages and organisation which strengthens knowledge and which makes it accessible, retrievable and accessible. Through an examination of indexation and schemata it is proposed that the richness of the context in which knowledge is acquired aids recall and re-presentation (Greeno, 1989a; Pea, 1987), as the linkages and associations (patterned) in ways which facilitates knowledge recall and subsequent reapplication. The contribution of rich learning environments, in the form of artefacts, norms of practice, objects and other visual and physical clues, provide potentially rich learning situations.

3.5 Individuals' effort is determined partially by external factors.

Complex thinking and engaging in activities such as non-routine problem-solving activities are effortful. The management of the cognitive load in complex activities (Sweller, 1990a) is influenced by what individuals determine is worth giving effortful attention to, and, what is not (Goodnow, 1990). These decisions are likely to be determined by the socially-constructed personal dispositions of the learner (Posner, 1982; Pea, 1987), and values promoted in the culture of practice in which the problems are experienced (Goodnow, 1990; Lave, 1990). Consequently, effortful engagement needs to be considered in terms of individuals' dispositions and what is privileged in the social circumstances or cultural practice. This means that the activities that individuals engage in, and are encouraged to acquire knowledge about, may influence what is learned, and also what is given superficial or effortful attention. Goodnow (1990) suggests that not only do individuals learn how to solve problems they also learn what problems are worth solving. It is likely that underlying vocational activities the norms, values and practices of the particular socially-derived circumstances will shape individuals' responses.

3.6 Transfer is socially and culturally influenced.

Given that problem-solving and transfer are viewed as being similar cognitive activities, it follows that transfer is not solely the product of the internal mechanisms of the memory. Rather it is based on the ability of individuals to respond to particular conditions under which the knowledge to be transferred is constructed, which includes its organisation and indexation (Brown, Collins & Duguid, 1989; Pea, 1987). Transfer, then, is underpinned by the needs and demands of social derived circumstances (Scribner, 1985), the idiosyncratic interpretation of those circumstances by individuals (Posner, 1982; von Glasersfeld, 1987), and the ability to

abstract meaning from the situationally determined knowledge and deploy it appropriately elsewhere. Therefore, because what is 'near' transfer to one person may be 'far' for another, it may not be possible to stipulate a task as being 'far' or 'near' without understanding the prior knowledge of individuals engaged in the transfer task. Individuals' interpretative structuring of socially-mediated experiences will determine the nature, and even the possibility of transfer. Moreover, given that far transfer is effortful (Royer, 1979), cultural and personal dispositions will determine whether the effortful search strategy is worthwhile or possible (Anderson, 1993).

3.7 Dispositional factors influence effort, interest and attitude towards thinking and acting.

Dispositions are inherent in construction, organisation and deployment of procedural and propositional knowledge. Only through an appreciation of the sources of dispositional foundational knowledge, from both a personal (Belenky, et. al., 1986) and cultural source (Dweck & Elliot, 1983; Goodnow, 1990) will their contribution be acknowledged. Without this consideration the existing categories of propositional and procedural knowledge, even when accounting for strategic forms of knowledge, do not adequately address issues of values, affect and interest associated with the acquisition, organisation and deployment of knowledge.

In the synthesis of the literature presented above the key concepts are that problem-solving as a cognitive activity, is mediated by the particular social circumstances in which that cognitive activity takes place. These circumstances are socially organised. It is the sort of activities outlined above which Vygotsky (1978) refers to as being the socially prevalent form of interpersonal interaction which results in higher psychological functions.

In these ways it seems appropriate to consider the contribution of both cognition and culture in understanding how knowledge is generated and deployed. Having advanced links between the two literatures, a framework which integrates these two literatures is advanced. This framework has been constructed to appraise the cognitive consequences of situated learning. The framework aims to provide a more substantiated basis for claiming the cognitive consequences of situated learning and emphasises the contribution of socio-cultural factors in the construction, appropriation and development of knowledge and some cognitive functions.

4. Cognitive consequences of situated learning

In the following section a table is presented which characterises the cognitive consequences of situated learning which can be seen as providing access to sources of knowledge, as conceptualised through the contribution of socio-cultural literature. This table attempts to secure complementarity between the two bodies of literature, by articulating how knowledge is sourced through engaging in everyday activities, such as those in the workplace. The descriptions of the sources of knowledge are premised on those identified in early studies of learning situated in the workplace (Billett, 1992; 1993a; 1994) and as synthesised through the socio-cultural literature. These earlier studies aimed to determine the effectiveness of learning as everyday activities situated in the workplace. These studies provided useful insights, about perceptions of direct and distant forms of guidance in the acquisition of skilful vocational knowledge. However, these studies failed to provide a comprehensive and substantiated account of how these situated workplace learning experiences contribute to the construction of knowledge. Therefore, it is necessary to seek an adequate explanation of the contribution of these experiences in the literature. In the following table, the cognitive psychology literature is employed to advance an account of the cognitive consequences of these experiences.

The Table below uses a Vygotskian framework to categorise the socio-cultural sources of

knowledge. These sources of knowledge equate to the concepts of proximal (close) and distal (distant) provided by Vygotsky. The proximal guidance refers to the social interaction with others at a close interpersonal basis and non-direct proximal guidance in the form of observation and listening. The distal guidance is found with the authentic problems situated in the culture of practice, the everyday activities of the situation, and the clues and cues provided by the physical setting. This frame sanctions knowledge being sourced in a particular set of social circumstances and through the interpretative and constructive influence of the personal history of the learner, which has been socially-sourced throughout the individual's life experience (Posner, 1982; Pea, 1987). This individual emphasis does not deny the socio-cultural contributions of knowledge's acquisition. What is advanced is that individuals' construction and organisation of knowledge is the product of their on-going social history which results in a personal value system and set of attributes which underpins the acquisition, organisation and deployment of procedures and concepts. Individuals bring unique sets of socially-derived and constructed attributes to the particular social circumstances and it is these attributes that will be used to conceptualise, interpret and organise the knowledge they choose to access in that setting. So in summary, this framework proposes a mediating role of the physical context, everyday activities, authentic problems, direct and indirect forms of social guidance and the personal histories of individuals as sources of knowledge. It is acknowledged that the mediating experiences referred to below are not distinct. They are, however, conceptualised in terms of theoretical principles and the product of skilled workers' perceptions of how they had learnt through workplace experience (Billett, 1992 & 1993a).

Counterpoised against this array of sources of knowledge are the types of knowledge (propositional and procedural) and their uses (indexing, deployment of structured knowledge and problem-solving) provided by cognitive psychology. Examples of concepts from cognitive psychology are applied to this frame to seek links between the two views in a way that may be applied to improving learning and further empirical work.

What follows is first, a table which seeks to afford the linkages referred to above. Second, a list of examples of literature which pertain to each column is provided. Third, a numerical listing of these same examples is also provided.

A cognitive psychology account of the consequences of situated learning

<i>Sources</i>	<i>Uses of knowledge</i>			<i>Types of knowledge</i>	
Proximal guidance	Indexing of structured knowledge	Deployment of structured knowledge (schemata)	Problem-solving	Procedures	Propositions
Social setting - other workers hints reminders and explanations (social guidance - proximal development (Vygotsky, 1987))	2, 18, 23, 26	16, 19, 21, 24	19,28,29	1, 6, 7, 12, 15, 19, 21, 25, 32	1, 4, 5, 8, 10, 13, 14, 19, 31
Observing & listening - proximal guidance non-direct	2,3,26	16,19	19,28,29	1, 6, 7, 12, 15, 19, 21, 25, 32	1, 4, 5, 8, 10, 31
Distal guidance					
Authentic problems - learning curriculum (Lave, 1990; Lave & Wenger, 1991)	2, 3, 22, 23, 26	16, 22, 23, 27, 29	22, 28, 29	6, 7, 9, 12, 15, 20, 22, 25, 29, 30, 32	1, 4, 5, 8, 10, 14, 22, 24
Everyday activities (Activity system - Engestrom, 1993; Leontyev, 1980) culture of practice (Brown, Collins & Duguid, 1989)	2, 3, 22, 26	16, 23, 24, 27, 29,	17, 22, 28, 29	6, 7, 9, 12, 20, 25, 30, 32	1, 4, 8, 10, 13, 14, 24, 31
The physical setting - the workplace (distal guidance) - (Scribner, 1984; 1985a; 1985b)	2, 3, 26	16	29	6, 25, 32	4, 8, 10, 24, 31
Individual interpretation & construction of knowledge					

Personal histories & epistemologies (Greeno, 1989a; Pea, 1987; Posner, 1982)	23, 26	23, 24, 27, 29	17, 19, 22, 28, 29	1, 6, 7, 15, 20, 22, 25, 29, 30, 32	1, 4, 5, 8, 10, 14, 19, 22, 31
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From the cognitive psychology literature some key attributes of expertise have been identified - as have some conditions for development of those attributes

Indexing - *rich and multi-fold indexing of knowledge* (Collins, Brown & Newman, 1989; Ericsson & Simon, 1984; Greeno, 1989a)

examples

2. provision of cues and clues in the indexation of knowledge (Eylon & Lin, 1988)
3. visual cues from artefacts, objects and physical arrangements (Brown, Collins & Duguid, 1989)
18. clues provided by fellow workers (de Kleer & Brown, 1984)
22. problem-solving ability from domain-learning (Anderson, 1993)
23. schemata developed through accessing knowledge during problem-solving (Glaser, 1990) as a product of means-end search (Sweller, 1989)
26. transfer facilitated by rich interconnections experienced during knowledge acquisition (Royer, 1979)

Deployment of knowledge structures - (*schemata*) *organisational structures facilitating complex thinking processes* (Anderson, 1993; Glaser, 1990; Wagner & Sternberg, 1986)

examples

16. structuring of cognition distributed across social and physical environment (Brown, Collins & Duguid, 1989)
19. joint problem-solving (scaffolding) avoids decomposing (disaggregating) the target task (Glaser, 1990) -thereby developing purposeful schemata
21. expert making explicit which of a series of alternatives is most appropriate (Schoenfeld, 1985)
22. problem-solving ability from domain-learning (Anderson, 1993)
23. schemata developed through accessing knowledge during problem-solving (Glaser, 1990) as a product of means-end search (Sweller, 1989)
24. problems classified by rich experience, over time, with problem-solving within a domain (Sweller, 1989; 1990a; Chi, Glaser & Rees, 1982)
27. knowledge chunked in cause-effect sequences related to problem-solving (Glaser & Bassok, 1989)
29. orchestrated contribution of knowledge types through authentic activities (Gott, 1989)

Problem-solving

examples

17. everyday problem-solving strengthens thinking procedures (Groen & Patel, 1988; Glaser, 1990)
19. joint problem-solving (scaffolding) avoids decomposing (dissagregating) the target task (Glaser, 1990) -thereby developing purposeful schemata through transparency between process and product (Collins, Brown & Newman, 1989).
22. problem-solving ability from domain-learning (Anderson, 1993)
28. learning occurs through problem-solving (Glaser & Bassok, 1989)
29. orchestrated contribution of knowledge types through authentic activities (Gott, 1989)

Procedures - *ability to secure goals (knowledge how)* Anderson, 1982

examples

1. exposing learners to alternative views challenge and clarify initial understanding (Glaser, 1990)
6. development of an interpretative rule-based system of domain knowledge (Groen & Patel; 1988)
7. opportunities for the selection & monitoring of strategies (Eylon & Lin, 1988; Glaser & Bassok, 1989; Brown & Palinscar, 1989)
9. developing an extensive repertoire of procedures (Sweller, 1989)
12. modelling of procedures (Collins, Brown & Newman, 1989)
15. approximation of procedures (Collins, Brown & Newman, 1989)
19. joint problem-solving (scaffolding) avoids decomposing (dissagregating) the target task (Glaser, 1990) -thereby developing purposeful schemata
20. pressing learners into higher order activities (Stevenson & McKavanagh, 1994), making learners responsible for decision-making (Glaser, 1990)
21. expert making explicit which of a series of alternatives is most appropriate (Schoenfeld, 1985)
22. problem-solving ability from domain-learning (Anderson, 1993)
25. compilation of knowledge (Anderson, 1982; Stevenson, 1986a) through everyday

experiences (Anderson, 1993; Glaser, 1990)

29.orchestrated contribution of knowledge types through authentic activities (Gott, 1989)

30.knowledge debugged through extensive learning experiences (Ericsson & Simon, 1984)

32.procedural knowledge developed through situated learning (Prawat, 1993)

Propositions - *conceptual understanding (knowing that)* (Anderson, 1982)

examples

1.exposing learners to alternative views challenge and clarify initial understanding (Glaser, 1990)

4. development of propositions through the patterning of events & activities (Scribner, 1985)

5.generating mental models (Collins, Brown & Newman, 1989; Gott, 1989)

8. deepening understanding by access to the conditions in which knowledge is experienced (Anderson, 1993)

10. acquiring implicit understanding about work activities & structures

13. scaffolding for conceptual knowledge for self-monitoring (Collins, Brown & Newman, 1989)

14. development & deepening of propositions (Gott, 1989)

19.joint problem-solving (scaffolding) avoids decomposing (dissagregating) the target task (Glaser, 1990) -thereby developing purposeful schemata

22. problem-solving ability from domain-learning (Anderson, 1993)

31. accommodations with environments provide frames of reference to consider new experiences (Posner, 1982)

5 Concluding Discussion.

The framework above has been used to provide some reconciliation between two literatures which are often viewed as being so distinct in their orientation that they are not reconcilable. The table also illustrates ways in which social circumstances shape the acquisition of types of knowledge and assists with their deployment in certain cognitive activities. This then provides a basis for considering the means and consequences of developing knowledge and cognitive activities. At a specific level this table provides a basis for evaluating learning experiences situated in the workplace. More broadly it provides a framework for considering learning arrangements in settings which are described as either formal or informal. The constructivist view of learning emphasises 'what happens' - how individuals construct knowledge. This particular framework advances a view about how that process can be made more viable and strengthened by a consideration of the contributions offered by both literatures.

To address the concern expressed by Pravat (1993) and also raised by subjects in investigation into workplace learning, that situated learning privileges the development of procedures, the following is advanced. It is possible to suggest from the above table that if a series of conditions are not available for the development of propositional knowledge then this prediction might be true. Conversely, the table outlines a set of conditions which could be used to engage learners to maximise the development of propositional knowledge. From the descriptions of strategies and approaches mentioned below it is possible to predict that some forms of accessing knowledge are more likely to engender deep conceptual knowledge, although usually with guidance. A further and more comprehensive review of the literature is required to examine the sorts of experiences that are more likely to generate deeper conceptual knowledge and robust and transferable procedures.

To conclude, from the synthesis of the two bodies of literature provided in this paper it is possible to propose that the consequences of engaging in socially determined practice are likely to have consequences in terms of cognitive development and change. This also allows for claims made within the socio-cultural literature to be appraised. Key claims within the socio-cultural literature, such as that activity structures cognition (Rogoff & Lave, 1984), and the appropriation of knowledge being social in terms of its origins and transmission are advanced in this discussion and table, but require further validation. Moreover, because socio-cultural theorists have a key interest in social and culturally derived knowledge, they may not give due acknowledgment to the individual and idiosyncratic nature of knowledge construction which is evident within the constructivist view pursued within this paper.

References

- Anderson, J.R. (1993). Problem solving and learning. *American Psychologist*, 48 (1) January 35-44.
- Anderson, J. R. (1982). Acquisition of Cognitive Skill. *Psychological Review*, 89 (4), 369-406.
- Alexander, P.A. & Judy, J.E. (1988). The interaction of Domain Specific and Strategic Knowledge in Academic Performance. *Review of Educational Research*, 58 (4) 375-404.
- Belenky, M.F., Clinchy, B.M., Goldberger, N.R., & Tarule, J.M. (1986). *Women's way of knowing*. New York: Basic Books.
- Billett, S.R. (1992). Authenticating learning - learning in the workplace. A Paper Presented at the 1992 AARE & NZARE Joint Conference "Educational Research: Discipline and Diversity" Deakin University, Geelong, Victoria, 22-26 November 1992.
- Billett, S.R. (1993a). *Evaluating modes of skill acquisition*. Centre for Skill Formation Research and Development. Griffith University: Brisbane, Australia.
- Billett, S.R. (1993b). Authenticity and a Culture of Practice. *Australian and New Zealand Journal of Vocational Education and Research*, 2 (1) 1-29
- Billett, S. (1994, in press). Situated Learning - a workplace experience. *Australian Journal of Adult and Community Education*, 34 (2).
- Brown, J.S., Collins, A., & Duguid P. (1989). Situated Cognition and the Culture of Learning. *Educational Researcher*, V.18,(1), 32-34.
- Chi, M.T.H., Glaser, R., & Rees, E. (1982). Problem-solving ability. In R.J. Sternberg (ed) *Advances in the psychology of human intelligence (Vol 1)* 7-76. Hillsdale N.J. Erlbaum.
- Collins, A., Brown J. S., & Newman, S. E. (1989). Cognitive Apprenticeship: Teaching the Crafts of Reading, Writing and Mathematics. In L.B. Resnick (ed) *Knowledge, Learning and Instruction, Essays in honour of Robert Glaser*. 453-494. Hillsdale, N.J: Erlbaum & Associates.
- de Kleer, J., & Brown, J. S. (1984). A qualitative physics based on confluence. *Artificial Intelligence Journal*, 24, 1-3.
- di Sessa, A.A. (1982). Unlearning Aristolean physics: a study of knowledge-based learning. *Cognitive Science*,(6) 37-75.
- Dweck, C.S & Elliott, E.S. (1983). Achievement motivation. In E.M. Hetherington (eds) *Handbook of child psychology* (4) 643-691.
- Ericsson, K. A. & Simon, H. A. (1984). *Protocol Analysis -verbal reports as data*. Cambridge, Mass. The MIT Press
- Evans, G. ed. (1991). *Learning and Teaching Cognitive Skills*. Victoria, Australia: The

Australian Council for Educational Research.

Eylon, B., & Linn, M. C. (1988). Learning and instruction: An examination of four research perspectives in science education. *Review of Educational Research*, 58, 251-301.

Gelman, R. & Greeno J.G. (1989). On The Nature of Competence: Principles for Understanding in a Domain. in Lauren B. Resnick (ed) *Knowing, Learning and Instruction: Essays in Honor of Robert Glaser*. Hillsdale, NJ: Lawrence Erlbaum Associates.

Glaser, R. (1989). Expertise and learning: How do we think about instructional processes that we have discovered knowledge structures? In D. Klahr & K. Kotovsky (ed) *Complex Information Processing: The impact of Herbert A. Simon*. Hillsdale, N.J: Erlbaum & Associates.

Glaser, R. (1990). Re-emergence of Learning Theory within Instructional Research. *American Psychologist*, 45(1) 29-39.

Glaser, R., & Bassok, M. (1989). Learning Theory and the Study of Instruction. *Annual Review of Psychology*, 40, 631-66.

Goodnow, J.J (1990). The socialisation of cognition: what's involved?. *Cultural Psychology*. (ed) Stigler, J.W., Shweder, R.A., & Herdt, G. 259-86. Cambridge: Cambridge University Press.

Goodnow, J.J. (1993, in press). Paper in preparation for Interactive minds conference - Berlin

Gott, S. (1989). Apprenticeship Instruction for Real-World Tasks: The Coordination of Procedures, Mental Models, and Strategies. in Rothkopf, E. Z. (ed) *Review of Research in Education*, Washington, DC: American Educational Research Association.

Greeno, J.G (1989). A Perspective on Thinking. *American Psychologist*, 44 (2) 134-141.

Lave, J. (1977). Tailor-made experiments and evaluating the intellectual consequences of Apprenticeship Training. *Quarterly Newsletter of Institute for Comparative Human Development*, 1, 1-3.

Lave, J. (1990). The culture of acquisition and the practice of understanding. *Cultural Psychology*. (ed) Stigler, J.W., Shweder, R.A., & Herdt, G. 259-86. Cambridge: Cambridge University Press.

Lave, J. (1993). The practice of learning. in S. Chaiklin & J. Lave (ed) *Understanding practice: perspectives on activity and context*. Cambridge, UK: Cambridge University Press 3-32.

Lave, J. & Wenger, E. (1991). *Situated learning - legitimate peripheral participation*. Cambridge: Cambridge University Press.

Leonteyev, A.N. (1981). Problems of the development of the mind. Moscow: Progress Publishers.

Newell, A. & Simon, H.A. (1972) *Human Problem Solving*. Englewood Cliffs N.J:Prentice Hall.

- Newman, D., Griffin, P. & Cole, M. (1989). *The Construction Zone: Working for cognitive change in schools*. Cambridge: Cambridge University Press.
- Palinscar, A. S. & Brown, A. L. (1984). Reciprocal Teaching of Comprehension - Fostering and Comprehension - Monitoring Activities. *Cognition and Instruction*, 1(2), 117-175.
- Pea, R.D. (1987). Socializing the knowledge transfer problem. *International Journal of Educational Research*, 11(6), 639-663.
- Perkins, D.N. & Salomon, G. (1989). Are Cognitive Skills Context Bound? *Educational Researcher*, January - February.
- Posner, G. (1982). A Cognitive Science Conception of Curriculum and Instruction. *Journal of Curriculum Studies*, 14(4), 343-351.
- Prawat, R.S (1989). Promoting Access to Knowledge, Strategy, and Dispositions in Students: A Research Synthesis. *Review of Educational Research*, 59 (1) 1-41, Spring
- Prawat, R.S. (1993). The value of Ideas: Problems versus possibilities in learning. *Educational Researcher*, 22(6) 5-16.
- Raizen, S. A. (1991). *Learning and Work: the research base*. OECD.
- Rogoff, B., & Lave, J. (Eds) (1984). *Everyday Cognition: Its development in social context*. Cambridge, Mass: Harvard University Press.
- Rogoff, B. (1990). *Apprenticeship in thinking - Cognitive Development in Social Context*. New York: Oxford University Press.
- Rogoff, B. (1993, in print). Observing Sociocultural Activity on Three Planes: Participatory Appropriation, Guided Participation, Apprenticeship. in A. Alvarez, P.del Rio, & J.W. Wertsch (eds) *Sociocultural Studies of Mind*. Cambridge University Press.
- Royer, J. M. (1979). Theories of the Transfer of Learning, *Educational Psychologist*, 14, 53-69.
- Schoenfeld, A.H. (1985). *Mathematics problem-solving*. New York: Academic Press.
- Scribner, S. (1984). Studying Working Intelligence. In B. Rogoff & J. Lave (ed) *Everyday Cognition: Its development in social context*. Cambridge, Mass: Harvard University Press.
- Scribner, S. (1985a). Knowledge at Work. *Anthropology and Education Quarterly*, 16, 199-206.
- Scribner, S. (1985b) Vygostky's use of history. in J.V. Wertsch (ed). *Culture, Communication and Cognition: Vygotskian Perspectives*. Cambridge: Cambridge University Press. 119-145
- Shuell, T. J. (1990). 'Phases of meaningful learning'. *Review of Educational Research*, 60 (4) 531-547.
- Stevenson, J. C. (1986a). Adaptability: theoretical considerations. *Journal of Structured*

learning, 9 107-117.

Stevenson, J. C. (1991). Cognitive Structures for the teaching of adaptability in vocational education. In Evans G (ed) *Learning and Teaching Cognitive Skills*. Victoria, Australia: ACER.

Stevenson, J.C, McKavanagh, C. & Evans, G. (1994). Measuring the press for skill development. in J. Stevenson (ed) *Cognition at work: the development of vocational expertise*. Adelaide, South Australia: National Centre for Vocational Education Research. 198 - 216.

Sweller, J. (1990a). Cognitive Processes and Instructional Procedures. *Australian Journal of Education*, 34 (2) 1990, 125-130.

Sweller, J. (1989). Should Problem Solving be used as a learning Device in Mathematics. *Journal of Research into Mathematics Education*, 20 (3) 321-28 May 1989

von Glasersfeld, E. (1987). Learning as a Constructive Activity. in Claude Janvier (ed) *Problems of Representation in the Teaching and Learning of Mathematics*. Hillsdale, NJ: Lawrence Erlbaum

Vygotsky, L. S. (1978). *Mind in Society - the development of higher psychological processes*. Harvard University Press.

Vygotsky, L.S. (1987). *Thought and Language*. (ed A. Kouzulin). Massachusetts: The MIT Press.

Wagner, R. K., & Sternberg, R. J. (1986). Tacit Knowledge and intelligence in the everyday world. in Sternberg, R. J., & Wagner, R. K. (1986). *Practical Intelligence - nature and origins of competence in the everyday world*, Cambridge: Cambridge University Press.