

Griffith Research Online

<https://research-repository.griffith.edu.au>

Situated Learning: Bridging Sociocultural and Cognitive Theorising

Author

Billett, Stephen

Published

1996

Journal Title

Learning and Instruction

DOI

[https://doi.org/10.1016/0959-4752\(96\)00006-0](https://doi.org/10.1016/0959-4752(96)00006-0)

Copyright Statement

Copyright 1996 Elsevier. This is the author-manuscript version of this paper. Reproduced in accordance with the copyright policy of the publisher. Please refer to the journal's website for access to the definitive, published version.

Downloaded from

<http://hdl.handle.net/10072/11061>

Situated learning: bridging sociocultural and cognitive theorising

Stephen Billett

School of Vocational, Community and Technology Education
Faculty of Education
Griffith University
NATHAN 4111
Australia

Fax (07) 3875 6868
Email s.billett@edn.gu.edu.au

There is currently a widening interest in learning in the type of situation where the learnt knowledge is to be deployed - situated learning. However, the understanding about this approach to learning and its outcomes remain incomplete. It remains unclear how situations influence the co-construction of knowledge. This paper seeks to commence addressing this question through an analysis of the nature and possible cognitive consequences of situated learning. To engage in this analysis it is necessary to offer an initial reconciliation of aspects of cognitive and socio-cultural theorising. This reconciliation provides basis to advance an account of how situations influence the co-construction of knowledge. It is held that individuals participation in goal-directed activities is integral to a mutually transforming process of learning. Moreover, the situation and circumstances constitute a basis for understanding these activities and therefore cognition. Areas of compatibility between the two perspectives are first identified followed by a view of how social circumstances influence the reciprocal construction of knowledge using a review of the literature. Finally, an account of the likely cognitive consequences of situated learning and their sources is advanced.

1. Introduction

The last six years have witnessed a widening interest in situated learning. This is learning through goal-directed activity situated in circumstances which are authentic, in terms of the intended application of the learnt knowledge. The source of this interest appears to reside in concerns about the paucity of the transfer of knowledge appropriated within educational institutions to situations and circumstances outside of those institutions. Therefore, learning is now seen as being more closely linked to the circumstances of its acquisition than previously acknowledged. Moreover, it is proposed that learnt knowledge may not readily transfer to circumstances that are different or remote from those which were its source. These propositions suggest that although all learning is situated, the nature of the situation and circumstances in which knowledge is appropriated is influential in determining the likely prospect of subsequent redeployment to other situations and settings. For example, if learning is undertaken in educational institutional settings, transfer between these type of settings is most likely. The same would stand for knowledge appropriated in workplace settings. However, knowledge may less readily transfer from educational institutions to workplaces or across different types of work or educational settings. Consequently, views about learning are being re-appraised to consider how the circumstances of the acquisition of knowledge influence cognition and, as a consequence, the transfer of knowledge to other situations. The widening interest in situated learning is largely attributable to Collins, Brown and Newman (1989) and Brown, Collins and Duguid (1989). Their work calls for a greater consideration of the contributions which sociology and anthropology make to understanding how individuals think and act. Consequently, the contributions of Lave (1990; 1993), Rogoff (1990, 1995) and Scribner (1984, 1985a, 1985b), from the socio-cultural constructivist perspective are now being widely acknowledged within cognitive views.

Despite this interest, and accumulating work by researchers, there remains an inadequate understanding of the consequences of situated learning. For example, what contributions can particular circumstances make to cognitive development? Also, what are the consequences of learning situated in the circumstances of its deployment in goal-directed activity? Pravat (1993), for example, has claimed that situated learning favours the development of procedural knowledge (knowledge `that') over that of propositional or

conceptual knowledge (knowledge 'how'). Indeed, recent empirical work (Billett, 1992, 1993, 1994), which investigated the learning of vocational skills in workplaces, although providing some evidence of the efficacy of this mode of learning failed to provide a comprehensive account of the consequences of this mode of learning. Moreover, in two studies (Billett, 1993, 1994) concerns about the development of propositional knowledge was reported. So at this time, the understanding about the cognitive consequences of situated learning remain opaque largely because the relationship between social circumstances and cognition remains unclear.

To develop further understanding about how the relationship between the construction of knowledge and the circumstances of its acquisition, this paper draws on the cognitive and socio-cultural constructivist perspectives. In doing this, it seeks an initial reconciliation between these perspectives which themselves 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 appropriation of knowledge. This paper attempts three goals. Firstly, areas of complementarity between these perspectives are identified, in order to understand further the relationship between thinking and acting, and social circumstances. Next, a basis by which to consider these relationships through goal-directed activity is advanced. This complementarity is then extended to provide a framework which proposes how the interaction between social sources of knowledge and cognition can be understood. The paper concludes by advocating a greater reconciliation between these two views of thinking and acting in order to advance the understanding of everyday human performance.

2 RECONCILIATION BETWEEN THE PERSPECTIVES

In order to advance an initial reconciliation between external contributions and internal attributes it is necessary to establish links between the cognitive and socio-cultural constructive perspectives. However, this reconciliation needs to be undertaken in a way that is sympathetic to each perspective. Cole (1985) cautions against associations between these literatures, without advancing an adequate framework which is

sympathetic to the social and cultural perspective of practice. Lave (1993) also cautions against the adequacy of conducting such an analysis using only cognitive tools. Consequently, firstly, it is necessary to identify the basis for complementarity between these two literatures. A review of the cognitive literature reveals evidence of the sourcing of cognitive structures and cognitive activities within social practice with the socio-cultural literature providing a rich account of the sources of this knowledge (Billett, 1995).

Both sets of literature refer to representations of knowledge. In cognitive psychology, representations of knowledge in memory refer to cognitive structures consisting of conceptual and procedural knowledge (Anderson, 1982), including schemata and heuristics. These cognitive structures underpin thinking and acting, and are viewed as being individually constructed. Representations of knowledge in memory within the socio-cultural literature refer to dispositions being culturally shaped (Goodnow, 1990). In this perspective, representations are viewed as being patterned by social and cultural circumstance (Davydov, 1995), and these circumstances can be quite specific. Cognitive structures, which are taken to be the internal product of memory are, as is argued below, constructed and developed in particular social circumstances. Such a proposition challenges the isolation of cognitive representations from social sources. Moreover, a common characteristic of both views is the emphasis on interpretations of tasks against a background of past experience and intellectual resources (Greeno, 1989; Newell & Simon, 1972; Prawat, 1989) or ontogenetic development (Rogoff, 1990; Scribner, 1985b). The costs and benefits of engagement in activities include individuals' purposes and interests (Pea, 1987; Perkins, Jay & Tishman, 1993a, 1993b; Prawat, 1989; Tobias, 1994), the roles of which have not been fully elaborated within cognitive psychology, are also commonly acknowledged in both sets of literature.

Cognitive psychology provides an account of the construction of individuals' representations of knowledge in memory. Representations are forms of conceptual and procedural knowledge, referred to as cognitive structures, which are acquired, organised in memory and utilised in addressing both routine and non-routine cognitive activities. The significance of cognitive structures resides in their deployment in cognitive activity, such as problem-solving, transfer and learning. Learning, from the sociocultural

perspective is viewed as the appropriation of socially derived forms of knowledge. Appropriation is not merely the internalisation of externally derived stimuli, but instead consists of a transformational and reciprocal constructive process (Rogoff, 1995). This perspective provides a view of knowledge which emphasises the mutuality between persons acting and the social and cultural circumstances in which they act. Valsiner (1994) refers to this as coconstruction. Yet while these views might seem disparate they offer some basis for considering relationships. Both refer to the manipulation or transformation of knowledge and whereas one focuses on the internal process the other details the negotiated nature of the reciprocal transformation with social partners and sources.

These linkages indicate a basis to investigate further the relationship between cognitive structures and social circumstances. In order to examine these relationships it is important to identify areas where one set of literature complements the other to the extent that this analysis identifies the cognitive consequences of social circumstances. Given the differences in the views about thinking and acting held in these literature, a relationship founded on complementarity is advanced as a basis for an initial reconciliation.

3 COMPLEMENTARITY BETWEEN THE LITERATURES

In the following section, six areas of complementarity between the two sets of literature are advanced. These are: (i) expertise is domain-specific; (ii) knowledge is constructed through problem-solving; (iii) compilation is negotiated in social circumstances; (iv) transfer is a socially and culturally constructed; (v) individuals' efforts are relational to social practice; and (vi) socially determined dispositional factors are relational to cognitive structures and activities. Although it is acknowledged that these areas are not neutral, as they represent some key concepts from cognitive theories, they provide a basis for building the bridges between the two sets of theories. In doing so the goal of developing a framework which is sympathetic to both sets of theories, which Lave (1993) and Cole (1985) argue for, is upheld. These areas of complementarity are now discussed.

3.1 Expertise is domain-specific

Differences between novices and experts and pathways towards expertise are referred to in both the cognitive and socio-cultural literatures. Cognitive psychology posits a pathway to expertise through the acquisition of procedural and conceptual knowledge (cognitive structures), organised and richly indexed to facilitate complex thinking activities, such as adaptability, transfer and non-routine problem-solving (Evans, 1991; Gott, 1989; Royer, 1979; Stevenson, 1986a, 1991). Increasingly, within this discipline, the nature of expertise is viewed as being domain-specific or situational (Alexander & Judy, 1988; Glaser, 1990; Perkins & Salomon, 1989; Sweller, 1989). Therefore, rather than complex performance being associated with the universal application of cognitive structures, a more specific view, involving situationally dependent understanding and procedures, is now being advanced within cognitive psychology.

A socio-cultural pathway to expertise is associated with immersion in a particular social situation over time, and acquiring not only skilful knowledge, but also the facility to engage successfully in the discourse, norms and practices of the particular community of practice (Fuhrer, 1993; Goodnow, 1990; Lave, 1990; Lave & Wenger, 1991). These qualities have commonality with those advanced by cognitive psychology, in terms of acquiring forms of knowledge which permit successful performance within a specific set of circumstances. The goals within the goal-directed process of problem-solving are socially sourced, as are procedures used to secure those goals. While both perspectives

refer to the application of salient concepts to secure outcomes, the socio-cultural view emphasises social aspects of competence within its view of expertise. Together, these views emphasise that expertise will be realised only in social circumstances that are able to provide problems, their solutions and the means by which particular solutions are able to be judged. These conditions could not exist without the range of situational social factors which enable the application and appraisal of cognitive structures and activities. Communities of practice are constituted by a range of social factors. A community of practice is defined as a set of relations among persons, activity and world, over time and in relationship with other tangential and overlapping communities of practice (Lave & Wenger, 1991:98). However, disembodied social practice, such as that which is remote from the circumstances of the knowledge's deployment, may fail to provide the array of social circumstances, thereby inhibiting the construction of transferable knowledge.

This situated conceptualisation of expertise, which is evident in both literatures, includes demonstrating a capability in the social aspects of goal-directed activities (Goodnow, 1990; Lave & Wenger, 1991). In such a view of expertise, novices do not necessarily lack capability. They may, however, lack that knowledge which is accessible from experience within a particular domain of knowledge (Glaser, 1990; Sternberg, 1989; Wagner & Sternberg, 1986) or situation which permits the conceptualisation and categorisation of problems, and deployment of cognitive structures to secure goals.

Therefore, domains of knowledge are not formal fields of study, as they are often conceptualised (Alexander & Judy, 1988), but are rather a set of rule-based concepts and procedures which are patterned by the social factors within a particular community of practice. Becoming expert is thereby premised on access to the particular social practice and what that practice privileges (Goodnow, 1990; Lave, 1990). Social circumstances in this way provide a foundation for a rule-based domain of knowledge associated with an activity system (Engestrom, 1993; Leonteyev, 1981) which is delineated by the norms and practices (the culture of practice) of the community. Moreover, the community's culture also provide a basis for making judgements about expertise. Yet, domains of knowledge are unlikely to be constructed by individuals as faithful copies of a field of study or academic discipline. Instead, domains of knowledge are constructed through engagement in activities which provide a basis for individuals' interpretative and

reciprocal construction of that domain of activities (von Glasersfeld, 1987; Greeno, 1989; Lave, 1990; Posner, 1982).

So, in sum, both perspectives provide a view of expertise acknowledging particular social circumstances. Whereas the cognitive psychology literature emphasises the internal processes which respond to these circumstances, the socio-cultural literature delineates the requirements for expertise within social practice. In this way, the cognitive and socio-cultural views have complementary aspects.

3.2 Knowledge is constructed through problem-solving

Within cognitive psychology, problem-solving is viewed as the manipulation of problematic situations, comprising the appraisal of the problem, creation of a problem space (Newell & Simon, 1972), selection of goals, and the deployment and monitoring of cognitive structures to secure those goals. Moreover, problem-solving is seen as being synonymous with learning, within cognitive psychology (e.g. Anderson, 1993; Shuell, 1990). Problem-solving is viewed similarly in the socio-cultural literature, through selecting approaches and solutions which are viable within the social circumstances of its application (Lave & Wenger, 1991). This view complements the cognitive perspective to account for social and cultural factors, where the cognitive values details and elaborates processes of achieving viability.

Processes such as negotiating an impasse (Van Lehn, 1988) and seeking viability in the interpretation and transformation of knowledge (von Glasersfeld, 1987) are also advanced as a means of appropriating new and reinforcing existing knowledge by other constructivists. Rogoff (1990) links activity with problem-solving when she argues that it involves interpersonal and practical deliberations in goal-directed activity, thereby establishing links between appropriation and internal structures. Moreover, Engestrom (1993) and Lave (1993) both refer to the 'problem space', with the latter proposing that such spaces are occupied by people. Consequently, the concept of problem space can include social and cognitive contingencies.

Problem-solving, within cognitive psychology, is seen as being both routine and non-routine. By referring to routineness, rather than complexity, this emphasises the

interpretative, situation and person dependent nature of problem solving, instead of assumptions about complexity. Routine problem-solving in everyday activities, set within a particular community of practice, embeds thinking and acting in the context in which the knowledge is sourced (Ceci & Liker, 1986; Perkins & Salomon, 1989). Therefore, routine problem-solving, over time, incrementally constructs and reinforces knowledge. In non-routine problem-solving, existing knowledge is retrieved and manipulated to resolve problems that have not been encountered before. Through this process, new knowledge is appropriated through solving the problem. The problem space and new knowledge, created to address non-routine-problems, are the products of individuals' interpretive construction, based on circumstances of the coconstruction of knowledge and individuals' previous history (von Glasersfeld, 1987; Posner, 1982). It is engagement in the goal-directed activity of problem-solving which, over time, results in the appropriation and organisation of functional knowledge.

In both literatures problem-solving is viewed as being closely associated with acquiring knowledge - learning or appropriating new knowledge. The links between problem solving and socially determined goal-directed activity provide another basis for complementarity between the literatures. Furthermore, these links emphasise the embeddedness of the construction of knowledge in social circumstances where knowledge is appropriated and subsequently deployed in ongoing reciprocal interactions.

3.3 Compilation is negotiated in social circumstances

The compilation of knowledge remains one of the more detailed accounts of knowledge development within cognitive psychology. It is claimed that, as procedural knowledge becomes well-practised, compilation occurs with movement from declarative (stateable) to autonomous stages of Anderson's (1982) theory of skill acquisition. Composition, one of the processes of compilation, is premised on the collapsing of a series of specific procedures (Anderson, 1982; Glaser, 1990; Stevenson, 1986a) to produce automated procedures that do not require conscious recall in memory in order to be deployed. Proceduralisation, the other process of compilation, consists of the transformation of declarative knowledge into procedures (Anderson, 1982). Yet, the specific procedures resulting from these processes, it is held, are patterned by the social circumstances in which they are accessed. Moreover, as compilation demands practice, over time, in circumstances where individuals can progress with increasingly mature approximations

of the task, such social circumstances, are a necessary component in the mutually transforming process of appropriation. In this way, the requirements and characteristics of particular social circumstances contribute to individuals' automated (highly practised and instantaneously applied) procedures (Ericsson & Simon, 1984; Sweller, 1989), albeit fashioned through reciprocal construction.

It is advanced that, through the mutually transforming process of the individual engaging in a particular social practice, socially constituted knowledge becomes tacit and not consciously retrieved into working memory once compiled (Gelman & Greeno, 1989). In this way, the requirements and characteristics of particular social circumstances are compiled to become the instantaneously applied procedures that are used to fulfil routine activities. Consequently, the proceduralisation of knowledge is advanced as being sourced from social circumstances.

3.4 Transfer is socially and culturally construction

Propositions about the specificity of knowledge and expertise, within cognitive psychology, have consequences for the adaptation and transfer of knowledge. For knowledge to be robust, it should be applicable in novel circumstances. Both sets of literature refer to abstracting knowledge from particular contexts (Lave, 1988, 1993; Perkins & Salomon, 1989) or domains of knowledge (Royer, 1979) and applying it in novel circumstances. Although these abstractions can be applied across domains of knowledge, the more distant (far) the application, the less specific the transfer is likely to be (Royer, 1979), and consequently the less satisfactory the generalisation and transfer.

A useful way of conceptualising this view of transfer is through consideration of application to social practice. Whereas it is possible that more durable procedures and concepts can be transferred across social practice (far transfer) and therefore between communities of practice, near transfer is a more likely outcome. Durable properties of knowledge are appropriated in specific situations thereby becoming applicable and transferable to other situations through a process of problem solving-like abstraction (Lave, 1988). This view of transfer challenges the universal applicability of knowledge, which has a residual legacy in current views about how instruction is to be conducted (Prawat, 1992). The socio-cultural basis of knowledge construction argues for an initial

embeddedness of knowledge in one social practice and its abstraction for use in other circumstances - with the differences in the interpretative appropriation of circumstances determining what is far transfer, thus requiring greater abstraction. A key feature of this view is the mutuality of the construction process in which the setting is an integral component of problem and is itself transformed through this engagement (Billett, 1995). This conceptualisation may help explain why far transfer seldom occurs. It also may explain the paucity of transfer from formal education settings to other situations. As greater abstraction from particular communities of practice is required, re-application of abstracted understanding is needed. This re-application occurs only if similarities in the community of practice can be identified, seen as appropriate and regarded as worth expending effort upon. The mutuality of knowledge construction from the socio-cultural perspective challenges beliefs about transfer being based on objectively identifiable factors.

Given that problem-solving and transfer are held to be similar cognitive activities, it follows from earlier discussions that transfer is not solely the product of the internal mechanisms of memory. Rather, transfer is dependent upon individuals' facility to respond to particular conditions under which the knowledge-to-be-transferred is constructed, including the organisation and indexation of that knowledge (Brown et al., 1989; Pea, 1987). Transfer, therefore, is co-constructed by situation and circumstances (Lave, 1988; Scribner, 1985b), the interpretation of those circumstances by individuals (Posner, 1982; von Glasersfeld, 1987), the ability to abstract meaning from situationally determined knowledge (community of practice) and the perceived appropriateness of its deployment in other circumstances. Consequently, transfer is a reciprocal process influenced by community and cultural sources, which suggests a further area of complementarity between the cognitive and socio-cultural constructivist literatures.

3.5 Individuals' efforts are related to social practice.

Engagement in complex thinking activities, such as non-routine problem-solving, is effortful. The management of the cognitive load in complex activities (Sweller, 1990) is influenced by what individuals deem is worth giving effortful attention to (Goodnow, 1990). These decisions are likely to be determined by the socially co-constructed dispositions of the learner (Posner, 1982; Pea, 1987) and values promoted in the

community of practice in which the problems are experienced (Goodnow, 1990; Lave, 1990). In addition, the activities which individuals prefer to participate in (Tobias, 1994), or are encouraged to appropriate knowledge about, are likely to influence what knowledge is constructed (Goodnow & Warton, 1991), and also what is given either superficial or effortful attention (Goodnow, 1990). Consequently, effortful engagement needs to be conceptualised in terms of individuals' dispositions and what is privileged in social practice (Lave & Wenger, 1991), not just expectations that certain stimuli will result in universal and predictable outcomes. This is a further area of complementarity between the two sets of literature as there are internal implications for these external influences.

3.6 Socially determined dispositional factors are relational to cognitive structures and activities

Dispositions are inherent in the co-construction, organisation and deployment of cognitive structures (Fuhrer, 1993; Grusec & Goodnow, 1994; Hoffman, 1986; Perkins et al., 1993a). Dispositions arise from both personal histories (Belenky, Clinchy, Goldberger & Tarule, 1986) and cultural sources (Dweck & Elliott, 1983; Goodnow, 1990). Existing views about cognitive structures, even when accounting for strategic forms of knowledge, do not adequately address issues of disposition (Perkins et al., 1993a), values, affect (Nunnally, 1976) and interest (Tobias, 1994). Yet these attributes are salient to the appropriation, organisation and deployment of knowledge. The significance of dispositional contributions to cognitive structures is that they direct the effortful process of learning through problem-solving. In turn, these dispositions are influenced by a range of social sources including cultural values, social relations, culture of practice and individuals' ontogenetic development. Both literatures lend themselves to complementary treatment of dispositions and their social origins.

In elaborating these relationships, the social contributions to learning become clearer. Moreover, they place learning in the domain of everyday activity, within different communities of practice rather than being something privileged to settings that are nominated as educational institutions. It is everyday social activities which Vygotsky (1978) refers to as being the socially prevalent form of interpersonal interaction, which

result in higher psychological functions. Moreover, these six areas of complementarity provide some initial bridging between cognitive and sociocultural theorising.

4 COGNITIVE CONSEQUENCES OF SITUATED LEARNING

It is advanced above that it is through the reciprocal and transformative process of appropriation in particular circumstances where the co-construction of knowledge is most apparent. Yet, to advance further the theoretical synthesis, it is necessary to propose how knowledge is co-constructed in particular situations. Specifically, it is argued below that problem-solving provides the means for construction of knowledge. The relationship between cognitive structures and the social setting during problem-solving is held as being the process by which knowledge is appropriated through interaction with social sources (see Figure 1).

FIGURE 1 ABOUT HERE

The theoretical principle that underpins this proposition is that goal-directed activity promotes the psychological functions of the learner (Leonteyev, 1981; Martin & Scribner, 1991; Scribner & Beach, 1993). Put another way, as individuals engage in goal-directed activities, they access, manipulate and transform cognitive structures which are socially sourced resulting in the construction and organisation of knowledge. So, central to this appropriation are routine and non-routine problem-solving activities in everyday practice, because both problems and their solutions are socially determined (Brown et al., 1989). Part of the problem-solving task is the defining and negotiation which occurs within a particular social situation which makes it problematic to separate individuals' performance of tasks from the social process of defining and negotiating the task and its goals (Bredo, 1994). Rather, they need to be viewed as being mutually defining. Yet, the mutual transformation between socially determined factors and the interpretative formation of the problem space is premised on individuals' histories. It follows that different experiences lead to different outcomes (Gauvain, 1993), but more importantly, different sources of social practice transforms cognition in different ways, and particular circumstances are likely to privilege forms of knowledge in different ways. Moreover, generalisable or durable forms of knowledge, which may promote transfer, are accessible from particular circumstances (Lave, 1993; Wertsch, 1993).

In Figure 1 it is advanced that individuals' prior knowledge is the product of their personal histories or ontogeny, comprising the organisation of concepts and procedures

underpinned by dispositions. Prior knowledge includes higher order procedures which guide and monitor cognitive activity (Evans, 1991; Stevenson, 1991). During both routine and non-routine problem-solving, individuals have to resolve an impasse (Van Lehn, 1988). The social circumstances are shaped by socially derived knowledge, aspects of which are privileged by the particular community of practice and shaped by the circumstances of their application. Individuals' responses to the problem are also likely to be influenced by their standing in the community of practice (peripheral or full) which may determine the scope of their solution options. The community of practice equates to the situations in which learning occurs. The response to and resolution of the problem engage the solvers in the utilisation of their existing cognitive structures, which will be reinforced by routine problem-solving or will be required to be transformed if the problem is non-routine.

Learning is therefore viewed as the mutual transformation of existing knowledge (Lave, 1993), which may include durable concepts and procedures. This transformation is achieved through the deployment of higher order procedural knowledge (in concert with conceptual understanding), acting to overcome the problem presented by the reciprocal interaction between the individuals' prior knowledge and social circumstances. In these ways, these executive forms of knowledge transform individuals' prior knowledge through problem-solving. In addition, as knowledge is appropriated in particular circumstances, there is the possibility for transfer to other settings. Everyday experience demonstrates that knowledge is transferable to situations different from those in which it was appropriated. The degree of transfer is likely to be premised upon the degree by which the transfer is interpreted by individuals to be 'near' or 'far' (Royer, 1979) and whether the individual's cognitive structures provide the capability for transfer.

In the following sections, conclusions are advanced from both literatures about the relationships between representations of knowledge and social sources. These conclusions provide a speculative view of the cognitive consequences of situated learning. Firstly, some supportive examples of social structuring of knowledge from the cognitive literature are summarised. These examples are then aligned with social sources (Table 1). These examples are not intended to represent an exhaustive account of conclusions from the cognitive literature; rather, they are provided as illustrative

examples from the literature reviewed. The examples are categorised into: (a) means of appropriation; and (b) products of appropriation of knowledge structures. The former relates to the participation in goal directed activity in social settings and the latter to the outcomes of that process. Means of appropriation refers to *Indexing*, *Developing cognitive structures* and *Problem-solving*. Products of appropriation, i.e. Knowledge, comprises the cognitive structures of *Procedures* and *Propositions* underpinned by dispositions. Indexation refers to the procedure of linking social circumstances to the organisation of knowledge, which has implications for subsequent deployment of that knowledge. The literature is presented using these headings with evidence and bibliographical source. The numbers are used later in Table 1 to relate these cognitive processes and activities to social goals. Some examples are cross-classified as they relate to multiple purposes.

4.1 Examples from the cognitive literature

Means of appropriation

Indexing - *rich and multi-fold indexing of knowledge* (Collins et al., 1989; Ericsson & Simon, 1984; Greeno, 1989)

Supportive examples

2. Provision of cues and clues in the indexation of knowledge from the physical environment (Eylon & Linn, 1988)
3. Visual cues from artefacts, objects and physical arrangements (Brown et al., 1989)
18. Provision of clues by fellow workers (de Kleer & Brown, 1984)
21. Experts making explicit which of a series of alternatives is most appropriate (Schoenfeld, 1985)
26. Transfer facilitated by rich interconnections experienced during knowledge acquisition (Royer, 1979)

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

Supportive examples

4. Development of propositions through the patterning of events and activities (Scribner, 1985a; 1985b)
5. Generating mental models through engagement in everyday activities (Collins et al., 1989; Gott, 1989)
8. Deepening understanding by access to the conditions in which knowledge is experienced (Anderson, 1993)
9. Debugging knowledge through extensive learning experiences (Ericsson & Simon, 1984)
10. Acquiring implicit understanding about work activities and structures
11. Procedural knowledge developed through situated learning (Prawat, 1993)
14. Development and deepening of propositions through everyday activities (Gott, 1989)
15. Approximation of procedures (Collins et al., 1989)
16. Structuring of cognition distributed across social and physical environment (Brown et al., 1989)

19. Joint problem-solving (scaffolding) avoids decomposing (disaggregating) the target task (Glaser, 1990) - thereby developing purposeful schemata
21. Experts making explicit which of a series of alternatives is most appropriate (Schoenfeld, 1985)
22. Problem-solving ability from domain-related activity (Anderson, 1993)
23. Orchestrating contributions of knowledge types through authentic activities (Gott, 1989)
24. Classification of problems by rich experience, over time, with problem-solving within a domain (Sweller, 1989; 1990; Chi, Glaser & Rees, 1982)
25. Compilation of knowledge (Anderson, 1982; Stevenson, 1986a) through everyday experiences (Anderson, 1993; Glaser, 1990)

Problem-solving - deployment of cognitive structures to overcome impasses, secure learning and achieve cognitive development (Anderson, 1993; Van Lehn, 1988)

Supportive examples

17. Strengthening thinking through everyday problem-solving procedures (Groen & Patel, 1988; Glaser, 1990)
19. Joint problem-solving (scaffolding) avoids decomposing (disaggregating) the target task (Glaser, 1990) - thereby developing purposeful schemata through transparency between process and product (Collins et al., 1989).
22. Problem-solving ability from domain-related activity (Anderson, 1993)
23. Orchestrating contributions of knowledge types through authentic activities (Gott, 1989)

Products of Appropriation: Knowledge structures

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

Supportive examples

1. Exposing learners to alternative views challenge and clarifying initial understanding (Glaser, 1990)
7. Opportunities for the selection and monitoring of strategies (Eylon & Linn, 1988; Glaser & Bassok, 1989; Brown & Palinscar, 1989)
9. Debugging knowledge through extensive learning experiences (Ericsson & Simon, 1984)
11. Procedural knowledge developed through situated learning (Prawat, 1993)
12. Modelling of procedures (Collins et al., 1989)
15. Approximation of procedures (Collins et al., 1989)
19. Joint problem-solving (scaffolding) avoids decomposing (disaggregating) 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-related activities (Anderson, 1993)
23. Orchestrating contributions of knowledge types through authentic activities (Gott, 1989)
25. Compilation of knowledge (Anderson, 1982; Stevenson, 1986a) through everyday experiences (Anderson, 1993; Glaser, 1990)

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

Supportive examples

1. Exposing learners to alternative views challenge and clarifying initial understanding (Glaser, 1990)
4. Development of propositions through the patterning of events and activities (Scribner, 1985a; b)

5. Generating mental models through engagement in everyday activities (Collins et al., 1989; Gott, 1989)
6. Accommodation with environments provide frames of reference to consider new experiences (Posner, 1982)
8. Deepening understanding by access to the conditions in which knowledge is experienced (Anderson, 1993)
10. Acquiring implicit understanding about work activities and structures
13. Scaffolding for conceptual knowledge for self-monitoring (Collins et al., 1989)
14. Development and deepening of propositions through everyday activities (Gott, 1989)
19. Joint problem-solving (scaffolding) avoids decomposing (disaggregating) the target task (Glaser, 1990) - thereby developing purposeful schemata

From this listing it can be seen that the cognitive literature contains multifold examples of the contributions of social circumstances to the appropriation of knowledge, yet fails to provide an account of the consequences of different kinds of sources.

4.2 Constructing knowledge: An initial reconciliation of views

Having located supportive examples within the cognitive literature of the social contributions to cognition it is necessary to delineate further the different sources of knowledge. These social sources can be delineated into proximal guidance, distal guidance (authentic and everyday activities in a community of practice) and individuals interpretation from their personal histories. The descriptions of the sources of knowledge are predicated on those synthesised through the literature and on those identified in earlier studies of learning situated in the workplace (Billett, 1992, 1993, 1994). Proximal guidance in a community of practice refers to both direct interpersonal guidance and non-direct forms of proximal guidance, such as observation and listening. Proximal guidance includes novices performing tasks under expert guidance, which leads to novices appropriating relevant contextual knowledge and some of the expert understanding of problems and situations (Wertsch & Stone, 1985). Distal or more distant sources are also found in authentic community activities - the everyday activities of the situation, as well as the clues and cues provided by the physical setting, and more distal influences through participation in socio-historical and socio-cultural determined practice (Scribner, 1985b).

On the vertical axis in Table 1, the social sources of knowledge within a community of practice, identified from the cognitive literature, are listed under the headings of distal and proximal forms of social guidance and the personal histories of individuals, all of which are involved in the appropriation of knowledge. These different dimensions of social practice are viewed as being relational and interdependent. On the horizontal axis

are listed the means of appropriation (indexing, deployment of structured knowledge and problem-solving) and products of appropriation (propositional and procedural knowledge). These two axes can be conceptualised as being causes (social sources) and consequences (cognition), although this distinction does not adequately account for the reciprocal (mutual) relations between the two perspectives.

From the sources illustrated in Table 1, it is possible to predict that different forms of social practice are likely to have different consequences for the appropriation and structuring of knowledge. The depiction suggests relations between the cognitive and socio-cultural literatures that may be further examined in order to improve learning and guide further inquiry. Thus, the table permits insights into how engagement in situated learning provides access to forms of knowledge and the development of expertise. Moreover, it provides a framework to evaluate learning arrangements by indicating the means by which different forms of knowledge are likely to be appropriated.

Table 1 - Linking sources of knowledge with appropriation and consequences

SOURCES	MEANS OF APPROPRIATION			PRODUCTS OF APPROPRIATION: FORMS OF KNOWLEDGE	
Proximal guidance	Indexing of structured knowledge	Developing cognitive structures (schemata)	Problem-solving	Procedures	Propositions
Social setting - other workers, hints reminders and explanations (social guidance (Vygotsky, 1987))	2, 18, 21, 26	4, 5, 8, 10, 11, 14, 15, 16, 19, 21, 24, 25	19, 23	1, 7, 11, 12, 15, 19, 21, 25	1, 4, 5, 6, 8, 10, 13, 14, 19
Observing and listening - proximal guidance non-direct	2, 3, 21, 26	4, 5, 8, 10, 11, 14, 15, 16, 19, 25	19, 23	1, 7, 11, 12, 15, 19, 21, 25	1, 4, 5, 6, 8, 10
Distal guidance					
Authentic problems - learning curriculum (Lave, 1990; Lave & Wenger, 1991)	2, 3, 26	4, 5, 8, 9, 10, 11, 14, 15, 16, 22, 23, 25, 27	22, 23	7, 9, 11, 12, 15, 20, 22, 25, 23	1, 4, 5, 8, 10, 14, 22, 24
Everyday activities (Activity system - Engestrom, 1993; Leonteyev, 1980) culture of practice (Brown et al., 1989)	2, 3, 26	4, 5, 8, 9, 10, 11, 14, 15, 16, 23, 24, 25	17, 22, 23	7, 9, 11, 12, 20, 25	1, 4, 6, 8, 10, 13, 14, 24
The physical setting - the workplace (distal guidance) - (Scribner, 1984, 1985a; 1985b)	2, 3, 26	4, 5, 8, 9, 10, 11, 14, 15, 16, 25	29	6, 11, 25	4, 6, 8, 10, 24
Individual interpretation and construction of knowledge					
Personal histories and epistemologies (Greeno, 1989; Pea, 1987; Posner, 1982)	23, 26	4, 5, 8, 9, 10, 11, 14, 15, 23, 24, 25	17, 19, 22, 23	1, 7, 9, 11, 15, 20, 22, 23, 25	1, 4, 5, 6, 8, 10, 14, 19

For example, consider the concerns expressed by Prawat (1993), and also those raised by subjects in investigations into workplace learning (Billett, 1993, 1994), that situated learning favours the development of procedures. Table 1 suggests a set of conditions for maximising the development of propositional knowledge, through proximal and distal guidance. These conditions include exposing learners to different views, clarifying initial understandings, through the development of models as a part of everyday activity which will pattern propositional knowledge in certain ways, and provide to consider new experiences and engagement in joint problem-solving. Thus it is possible to advance, from Table 1, that if this series of conditions is not available for the development of propositional knowledge, then this may not occur. Equally, the table provides guidance as to which forms of propositional and procedural knowledge which are likely to promote the development of transferable knowledge.

However, while these contributions are useful, the key purpose of the table is to illustrate the complementary role between the two constructivist perspectives thereby providing a basis for an initial bridging. This illustration of complementarity emphasises that, collectively, cognitive and socio-cultural contributions have the potential to offer a richer understanding about how knowledge is constructed than is currently available.

5 CONCLUSION

What has been advanced in this paper is that to understand situated learning necessitates a bridging of the contributions of sociocultural and cognitive theories. It is proposed that learning cannot be understood without considering the social contribution to the mutually transforming process of appropriation. Areas of complementarity between the cognitive and socio-cultural constructivist perspectives, taken together, enrich these two perspectives thereby providing a basis for understanding thinking and acting which on their own they could not achieve. Together, these combined contributions have the capacity to transform views about learning, the transfer of knowledge and expertise. The model of learning provided above has demonstrated how examples from the cognitive and sociocultural perspectives inform the situated nature of learning. Dimensions of social sourcing from the socio-cultural perspective add further insights into the different ways in which social circumstances engage and transform knowledge. The resultant framework provides an

account of the complementarity of these two constructivist views, and provides a means by which arrangements for learning can be deliberated upon and evaluated. The framework also indicates how different forms of social guidance (proximal and distal) contribute to learning. Moreover, it suggests that, through mutual transformation or co-construction, social circumstances influence the construction of knowledge in different ways. Circumstances are an active and mutually transforming element in the construction of knowledge. It also suggests that transfer has a social as well as a cognitive dimension. These propositions raise further questions about how we should about and make arrangements for learning and consider transfer. These analyses also emphasise the need to more fully pursue reconciliation between cognitive and sociocultural theorising. It is held for these questions to be addressed it is necessary to advance a more detailed reconciliation between the two perspectives in order to advance that understanding. Moreover, empirical evidence is now required to inform how different social sources coconstruct knowledge as postulated above.

Acknowledgments - I would like to acknowledge the assistance given in the development of this article by professor John Stevenson and the constructive suggestions of the two anonymous reviewers

References

- 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.
- Anderson, J. R. (1993). Problem solving and learning. *American Psychologist*, 48 (1), 35-44.
- Anderson, J. R. (1982). Acquisition of Cognitive Skill. *Psychological Review*, 89 (4), 369-406.
- 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. (1995). *Structuring knowledge through authentic activities*. Unpublished doctoral thesis. Griffith University, Brisbane.
- Billett, S. (1994). Situated Learning - a workplace experience. *Australian Journal of Adult and Community Education*, 34 (2), 112-130.
- Billett, S. R. (1993). Authenticity and a Culture of Practice. *Australian and New Zealand Journal of Vocational Education and Research*, Vol 2 (1), 1-29.
- Billett, S. R. (1992, November). 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.
- Bredo, E. (1994). Reconstructing Educational Psychology: Situated cognition and Deweyian pragmatism. *Educational Psychologist*, 29 (1), 23-35.
- Brown, A. L., & Palinscar, A. M. (1989). Guided, cooperative learning and individual knowledge acquisition. In L. B. Resnick (Ed.), *Knowledge, learning and instruction, Essays in honour of Robert Glaser* (pp. 393-451). Hillsdale, N.J: Erlbaum & Associates.
- Brown, J.S., Collins, A., & Duguid P. (1989). Situated Cognition and the Culture of Learning. *Educational Researcher*, 18 (1), 32-34.
- Ceci, S. J., & Liker, J. K. (1986). A day at the races: A study of I.Q. expertise and cognitive complexity. *Journal of Experimental Psychology: General*, 115, 225-266.
- Chi, M. T. H., Glaser, R., & Rees, E. (1982). Problem-solving ability. In R. J. Sternberg (Ed.), *Advances in the psychology of human intelligence 1* (pp. 7-76). Hillsdale N.J. Erlbaum.
- Cole, M. (1985). The zone of proximal development where culture and cognition create each other. In J. V. Wertsch (Ed.), *Culture, communication and cognition: Vygotskian perspectives*. (pp. 146-161). Cambridge: Cambridge University Press.
- Collins, A., Brown J. S., & Newman, S. E. (1989). Cognitive Apprenticeship: Teaching the Crafts of Reading, Writing and Mathematics. In L. B. Resnick (Ed.), *Knowing, Learning and Instruction, Essays in honour of Robert Glaser* (pp.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.
- Davydov, V. V. (1995). The influence of L.S. Vygotsky on education theory, research, and practice. *Educational Researcher*, 24 (3), 12-21.
- Dweck, C. S., & Elliott, E. S. (1983). Achievement motivation. In E. M. Hetherington (Ed.), *Handbook of child psychology*, 4, 643-691.
- Engestrom, Y. (1993). Development studies of work as a testbench of activity theory: The case of primary care medical practice. In S. Chaiklin & J. Lave (Eds.), *Understanding Practice: perspectives on activity and context*. (pp. 64-103). Cambridge, U.K.:Cambridge University Press.
- Ericsson, K. A., & Simon, H. A. (1984). *Protocol Analysis - verbal reports as data*. Cambridge, Mass. MIT Press.
- Evans, G. (1991). Lesson cognitive demands and student processing in upper secondary mathematics. In G. Evans (Ed.), *Learning and teaching cognitive skills*, ACER: Melbourne, Australia.
- 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.
- Fuhrer, U. (1993). Behaviour settings analysis of situated learning: the case of newcomers. In S. Chaiklin & J. Lave (Eds.), *Understanding practice: Perspectives on activity and context* (pp. 179-211). Cambridge, UK: Cambridge University Press.
- Gauvain, M. (1993). The development of spatial thinking in everyday activity. *Development Review*, 13 (1), 92-121.

- Gelman, R., & Greeno J. G. (1989). On The Nature of Competence: Principles for Understanding in a Domain. In L. B. Resnick (Ed.), *Knowing, Learning and Instruction: Essays in Honor of Robert Glaser* (pp. 125-186). Hillsdale, NJ: Lawrence 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*. In J. W. Stigler., R.A. Shweder., & G. Herdt (Eds.), (pp. 259-86). Cambridge: Cambridge University Press.
- Goodnow, J. J., & Warton, P. M. (1991). The social bases of social cognition: Interactions about work and their implications. *Merrill-Palmer Quarterly*, 37 (1), 27-58.
- 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*, 15, 97-169
- Groen, G. J., & Patel, P. (1988). The relationship between comprehension and reasoning in medical expertise. In M. T. H. Chi, R. Glaser & R. Farr (Eds), *The Nature of Expertise* (pp. 287-310) Hillsdale, NJ: Erlbaum.
- Greeno, J. G. (1989). A Perspective on Thinking. *American Psychologist*, 44 (2), 134-141.
- Grusec, J. E., & Goodnow, J. J. (1994). Impact of parental discipline methods on the child's internalisation of values: A reconceptualisation of current points of view. *Developmental Psychology*, 30 (2), 4-19.
- Hoffman, M. L. (1986). Affect, motivation and cognition. In R. M. Sorrentino & E. T. Higgins (Eds.), *Handbook of motivation and Cognition: Foundations of Social Behaviour* (pp. 236-274). New York: Guilford Press.
- Lave, J. (1993). The practice of learning. in S. Chaiklin & J. Lave (Ed.), *Understanding practice: perspectives on activity and context* (pp. 3-32). Cambridge, UK: Cambridge University Press.
- Lave, J. (1990). The culture of acquisition and the practice of understanding. In J. W. Stigler, R.A. Shweder., & G. Herdt (Eds.), *Cultural Psychology* (pp. 259-86). Cambridge: Cambridge University Press.
- Lave, J. (1988). *Cognition in practice: Mind, mathematics and culture in everyday life*. Cambridge: Cambridge University Press.
- 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.
- Martin, L. M. W., & Scribner, S. (1991). Laboratory for cognitive studies of work: A case study of the intellectual implications of a new technology. *Teachers College Record*, 92 (4), 582-602.
- Newell, A., & Simon, H. A. (1972). *Human Problem Solving*. Englewood Cliffs N.J:Prentice Hall.
- Nunnally, J. (1976). *Psychometric theory*. New York: McGraw-Hill.
- 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*, 18 (1), 16-25.
- Perkins, D., Jay, E., & Tishman, S. (1993a). Beyond abilities: A dispositional theory of thinking. *Merrill-Palmer Quarterly*, 39 (1), 1-21.
- Perkins, D., Jay, E., & Tishman, S. (1993b). New conceptions of thinking: From ontology to education. *Educational Psychologist*, 28 (1), 67-85.
- 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.
- Prawat, R. S. (1992). Teachers' beliefs about teaching and learning: A constructivist perspective. *American Journal of Education*, 100, 355-395.
- Prawat, R. S. (1993). The value of ideas: Problems versus possibilities in learning. *Educational Researcher*, 22 (6), 5-16.
- Rogoff, B. (1990). *Apprenticeship in thinking - Cognitive Development in Social Context*. New York: Oxford University Press.
- Rogoff, B. (1995). Observing sociocultural activities on three planes: participatory appropriation, guided appropriation and apprenticeship. In J. V. Wertsch, P. Del Rio & A. Alvarez (Eds.), *Sociocultural studies of the mind* (pp. 139-164). Cambridge: 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 (Eds.), *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). Vygotsky's use of history. In J. V. Wertsch (Ed.), *Culture, Communication and Cognition: Vygotskian Perspectives* (pp. 119-145). Cambridge: Cambridge University Press.
- Scribner, S., & Beach, K. (1993). An activity theory approach to memory. *Applied Cognitive Psychology*, 7, 185-190.
- Shuell, T. J. (1990). 'Phases of meaningful learning'. *Review of Educational Research*, 60 (4), 531-547.
- Sternberg, R. J. (1989). Domain-generalty versus domain-specificity: The life and impending death of a false dichotomy. *Merrill-Palmer Quarterly*, 35 (1), 115-130.
- 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* (pp. 198-216). Adelaide, South Australia: National Centre for Vocational Education Research.
- Sweller, J. (1990). Cognitive Processes and Instructional Procedures. *Australian Journal of Education*, 34 (2), 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.
- Tobias, S. (1994). Interest, prior knowledge, and learning. *Review of Educational Research*, 64 (1), 37-54.
- Valsiner, J. (1994). Bi-directional cultural transmission and constructive sociogenesis. In W.de Graaf & R. Maier (Eds.), *Sociogenesis re-examined* (pp. 101-134). New York: Springer.
- Van Lehn, V (1988). Towards a theory of impasse-driven learning. In H. Mandl & A Lesgold (Eds). *Learning issues for intelligent tutoring systems* (pp. 31-32). New York: Springer-Verlag.
- von Glasersfeld, E. (1987). Learning as a Constructive Activity. In C 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.
- Wagner, R. K., & Sternberg, R. J. (1986). Tacit Knowledge and intelligence in the everyday world. In R. J. Sternberg, & R. K. Wagner (Eds.), *Practical Intelligence - nature and origins of competence in the everyday world* (pp. 51-83), Cambridge: Cambridge University Press.
- Wertsch, J. V. (1993). *Voices of the mind: A socio-cultural approach to mediated action*. Cambridge, Mass: Harvard University Press.
- Wertsch, J. V. & Addison-Stone, C. (1985). The concept of internalisation in Vygotsky's account of the genesis of higher mental functions. In J. V. Wertsch (Ed.), *Culture, communication and cognition: Vygotskian perspectives* (pp. 162-179). Cambridge: CUP.

Figure 1
Appropriating Knowledge

