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A Model of Work-Based Learning

Joseph A. Raelin
The Wallace E. Carroll School of Management, Boston College, Chestnut Hill, Massachusetts 02167

This paper addresses an interesting research question: how a comprehensive model of integrated learning and work can be conceptualized. The study attempts to combine explicit and tacit forms of knowledge with theory and practice modes of learning. The individual level and the collective level are bound together by a dynamic knowledge development. The paper offers an outlook and orientation for future studies on a theory of work-based learning.

Ikujiro Nonaka

Abstract

A comprehensive model of work-based learning is illustrated combining explicit and tacit forms of knowing and theory and practice modes of learning at both individual and collective levels. The model is designed to bring together epistemic contributions which are typically studied in isolation. The learning types produced from the model represent processes the intersection of which can contribute to the development of a comprehensive theory for integrating learning and work.

At the individual level, work-based learning might start with *conceptualization* which provides practitioners with a means to challenge the assumptions underlying their practice. In *experimentation,* they engage their conceptual knowledge in such a way that it becomes contextualized or grounded. However, within the world of practice, in applying theoretical criteria or advanced analytical techniques, one confronts technical, cultural, moral, and personal idiosyncrasies which defy categorization. Hence, *experience* is required to reinforce the tacit knowledge acquired in experimentation. In fact, learning acquired through experience, often referred to as implicit learning, is the foundation for tacit knowledge and can be used to solve problems as well as make reasonable decisions about novel situations. Nevertheless, *reflection* is required to bring the inherent tacit knowledge of experience to the surface. It thus contributes to the reconstruction of meaning.

At the collective level, conceptualization again makes a contribution in informing spontaneous inquiry but is now embedded within the more formal methods of *applied science.* Scientists seek to describe and explain social reality through the manipulation of theoretical propositions using the rules of hypothetico-deductive logic. The theories of applied science are often not helpful to practitioners, however, unless they are incorporated into practice. This is the purview of *action learning* wherein real-time experience, especially problems occurring within one's own work setting, constitutes the primary subject matter. As practitioners come together by being involved with one another in action, they may become a *community of practice* wherein they learn to construct shared understanding amidst confusing and conflicting data. Hence, community of practice returns knowledge back into its context such that groups learn to observe and experiment with their own collective tacit processes in action. *Action science* is called upon to bring the individuals' and group's mental models, often untested and unexamined, into consciousness. It is a form of "reflection-in-action" which attempts to discover how what one did contributed to an unexpected or expected outcome, taking into account the interplay between theory and practice.

Applications of the model can spur conceptual and practical developments that might lead to a comprehensive theory of work-based learning. The discussion takes up such issues as transition links between learning types, their segmentation by function or process, and implications for epistemology. A sample program, incorporating many of the learning types in the model, is demonstrated. The paper argues that all eight types of learning need to be brought into consideration if learners are to achieve proficiency and become critical while learning at work.

(*Theory and Practice*; *Epistemology*; *Organizational Learning*; *Action Learning*; *Action Science*; *Community of Practice*; *Organizational Cognition*)

Introduction

Continuing epistemological development in our age of the knowledge worker has led to the conclusion that the knowledge necessary to perform useful work cannot be a body of information to be learned, and learned once. Rather work-based learning is acquired in the midst of

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action and is dedicated to the task at hand (Dretske 1981). Further it sees knowledge as a collective activity wherein learning becomes everyone's responsibility. Finally its users demonstrate a learning-to-learn aptitude in order to stay abreast with changes in the field and to invent new tools with the assistance of others to solve new problems (Drucker 1994, Nonaka 1994).

We are only now beginning to understand the full dynamics of work-based learning. The erstwhile Cartesian split between the world and our knowledge of it has been questioned sufficiently that we can truly appreciate that learning is always occurring. Yet, work-based learning is much more than the familiar "experiential" learning which consists of adding a layer of experience onto conceptual knowledge. In work-based learning, theory, for instance, may be acquired in concert with practice. Theory may also be introduced *after* rather than before experience in order to question the assumptions of practice. Although there is now a rich source of knowledge to help us understand how work-based learning occurs and may be facilitated, we need a model which might integrate the many traditions underlying its construction.

In developing such a model, we need to incorporate two dimensions fundamental to the process of work-based learning: theory and practice modes of learning and explicit and tacit forms of knowledge. Since theory can be viewed as a frame in which to challenge the assumptions of practice, it makes most sense as a mode of learning when combined with action. Indeed, the connection between the teacher's intentions and the students' understanding is best achieved through action. Practice, meanwhile, is the process by which individuals acquire and practice artistry (Schön 1983).

J.-C. Spender (1994) argues that the Carnegie School, William Simon in particular, was responsible for separating the logical process of decision making from that which was being processed so teachers could focus on theory, that is, teach rational processes, without taking into consideration the context. Only once in practice would students have to make the link between the previously learned theory and their current practice. On their own, they might also discover the reasoning behind their practice. Thus, knowledge assumed a connotation of abstraction and permanence.

But we know that knowledge undergoes construction and transformation, that it is as much a dynamic as a static concept (Lave 1993). In fact, the relatively new word, "knowing," has emerged to represent this dynamic process of knowledge. Sims and McAulay (1995) suggest that learning, too, is preferably a verb or process rather than a noun or product. They go as far as to suggest that learning lasts only when it is still alive or in transition. By the time it has been caught or measured, it is dead. Activity theorists and adherents, such as Brown and Duguid (1991), Lave and Wenger (1991), Engestrom (1987), Starr (1992), and Blackler (1993) emphasize the collective, situational, and tentative nature of knowing. Workers learn as much by collective action and skill as by rational thought. Abstract knowledge cannot help but be affected by circumstances, and frames of situations are at best inconclusive until verified by their effectiveness in action. Work-based learning, then, must blend theory and action. Theory makes sense only through practice, but practice makes sense only through reflection as enhanced by theory.

Besides theory and practice, the other dimension to be considered in building a model of work-based learning is Polanyi's (1966) distinction between the explicit and tacit. Explicit knowledge is the familiar codified form that is transmittable in formal, systematic language. Tacit knowledge is the component of knowledge that is normally not reportable since it is deeply rooted in action and involvement in a specific context. It thus reflects the active participation of the knower in the situation at hand. It has two parts: the technical form that applies to specific settings and the cognitive form, constituting mental models which help people perceive and define their world.

Even though tacit knowledge may not be expressed or codified, it may be teachable. For example, a competent trainer might provide an observable model of tacit skill for the trainee to follow and imitate. The tacit skill would thus be apprehensible and observable in use, even though not articulated or put into words (Wright 1994).

Conventional learning methodologies tend to be theory-based classroom experiences relying on explicit knowledge. Unfortunately, they suffer the risk of leaving inexperienced students with the impression that subsequent field problems can be nestled into neat technical packages. But, as Robert Reilly (1982) asks, can these students once in practice think independently, function without sufficient data or extrapolate beyond given data, change their approach in mid-stream, negotiate, and continually reflect and inquire. In a compelling example, he depicts the shock of a fresh M.B.A.-trained manager who finds out that a product line divestment decision has less to do with marginal cost analysis than with personal affinity to the line on the part of the CEO who began his career with the brand.

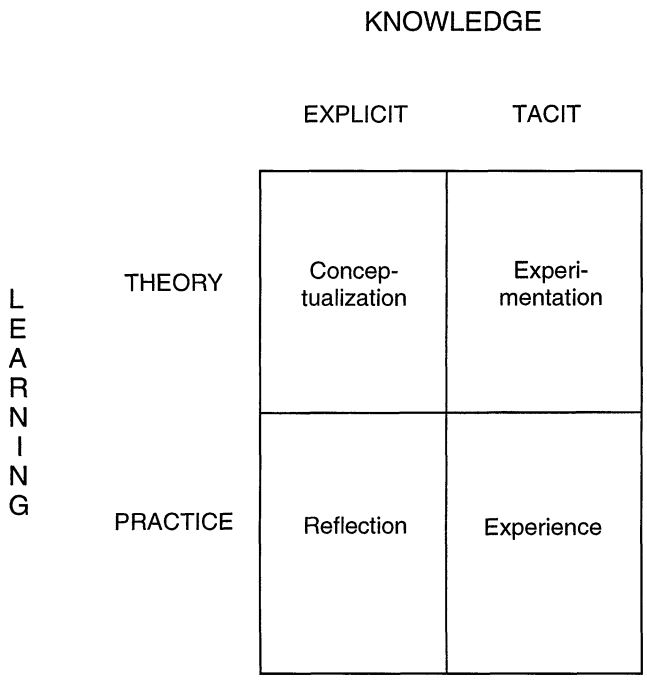
The purpose of this paper is to develop a model of work-based learning which can bring together an otherwise disparate set of epistemic contributions by examining the intersections between the two dimensions previously described, modes of learning and forms of knowledge, and a third dimension of level of activity. One

learns through work at an individual level as the intersection between the learning modes and knowledge forms challenges frames of action. However, learning in the workplace requires an extension of learning out to the collective level defined as one's co-workers be they within or even outside the present work unit. In this way, the paper extends the dialogue between tacit and explicit knowledge and reinforces the spiral between levels of activity, both introduced in Nonaka's seminal work (1994) as a means of reinforcing how knowledge conversion and transformation can integrate learning and work.

Work-Based Learning as an Individual Property

We initiate the model at the individual level by displaying in Figure 1 four learning types resulting from a matrix of the two learning modes and knowledge forms. Astute readers will immediately see a similarity between the labels used here and those depicted in David Kolb's well-known learning style inventory (Kolb et al. 1995). In fact, the processes operating in the work-based learning model and Kolb's learning from experience are compatible. However, since Kolb first produced his inventory, much more research has been done in tacit knowledge, especially by the discipline of cognitive psychology, leading to a deeper understanding of the learning process while working. Furthermore, Kolb's framework was ultimately designed as a way of gaining insight into one's style of learning which in turn could provide an indication of career interest (Kolb and Plovnick 1977). The learning types produced in the first matrix of the model of work-based learning do not so much characterize styles as processes which individuals may deploy to learn effectively, efficiently, and critically within work. Although like Kolb, I contend that individuals are predisposed to a learning type, all four should be used to engender the most learning in the shortest amount of time. Hence, effectiveness of work-based learning results from the comprehensiveness of facets to which the learner is exposed. It is not sufficient to learn only through theoretical exposition nor is it sufficient to engage in tacit practices without making one's mental models accessible. Meanwhile, efficiency of work-based learning results from selective attention to each of the four learning types. For example, experience solidifies the learning made tacit in experimentation but may lead to mastery more quickly when subjected to reflection. As we move from reflection back into conceptualization, we hope to achieve criticalness, defined as the ability and dedication to question our underlying assumptions within the learning process. The purpose of the four sections to follow is to demonstrate how each of the four learning types contributes to a solid foundation for work-based learning on the part of individuals.

Figure 1 **A Model of Work-Based Learning at the Individual Level**



Conceptualization

Let us review for a moment the contribution of basic theory to management practice. Not only does theory, as we already pointed out, challenge the assumptions underlying practice, but, according to Thorpe (1988), as a way of illuminating and describing action, it provides practitioners with a common language and wide powers of analysis. They learn to perceive even standard problems in a new light. Furthermore, by introducing practitioners to new principles, conceptualization gives them a means to tackle new and different problems in different contexts. It might even reveal problems heretofore undiscovered or left fallow for lack of recognizable solutions. Theory allows practitioners to explicitly reflect upon and actively experiment with their practice interventions. Hence, it is virtually necessary in work-based learning if students are to adopt the capacity to deal with change and with the future; indeed, if they are to imagine.

Conceptualization is often criticized as not being sufficiently real-world, meaning not capable of being translated into practice. However, as Maclagan (1995) has shown, it is possible that individuals use theories to help

them with their reasoning but purposely keep them implicit in communication with others. In fact, since theoretical language may not be accepted in some cultural settings (consider the tolerance toward using ethical jargon), individuals may choose to translate otherwise obscure concepts into everyday language. It is also possible that theoretical exposure prior to practice may affect decision making and behavior although tacit or hidden from consciousness (Agor 1986). As noted, conceptualization can also provide a basis for subsequent reflection on and reappraisal of actions.

Experimentation

In his day Dewey (1916) warned educators that mere "doing" or activity was not enough to produce learning; rather, doing should become a trying, an experiment with the world to find out what it is like. Students need the opportunity to try out their conceptual knowledge so that it becomes contextual or grounded, in a word, that it becomes "do-able." In fact, reliance on conceptualization alone may even limit our problem-solving since most new or real problems are not yet sufficiently coherent to be organized into theory (Polanyi 1966).

Once they enter the field, students normally encounter a dissonance between their theory and practice. Argyris and Schön (1974) refer to this inconsistency as a difference between one's "espoused theory" and one's "theory-in-use." The espoused theory is the theory with which one enters a situation; hence it might well be the conceptual knowledge that a student brings to bear on the situation. Once in action, however, we tend to modify or vary from our espoused theories even unconsciously as we employ our theories-in-use. It is important that students have the opportunity to engage in experiments to bring these two theories into alignment. This would be the purpose of experimentation, which often takes the form of case studies, role-plays, in-basket exercises, simulations, and the like.

Consider the plight of a nursing student who enters her clinical experience with visions of attending to the needs of the whole person only to find that the pressing demands of the unit combined with her sheer exhaustion allows her to attend merely to the urgent, physical needs of her patients. A case study or simulation revealing the demands on an emergency ward nurse might help ground the student's conceptual foundations. Experiments serve to make our espoused theories tacit, applicable to the situation at hand, and more understandable to ourselves.

Experience

Learning often occurs through experience. Learners first need to undergo a particular experience and then, upon reflecting upon that experience, extrapolate learning from it (Long 1990). Learning of this nature is important to new practitioners for once they enter the world of practice, no matter how hard they try to apply theoretical criteria or use advanced analytic techniques, they confront technical, cultural, moral, and personal idiosyncrasies which defy categorization.

Experience reinforces the tacit knowledge acquired in experimentation. It can also be thought of as nonconscious intellectual activity. Practitioners who rely on nonconscious acquisition of information can often not only process more quickly than their more "thoughtful" counterparts but can handle more sophisticated data, such as multidimensional and interactive relations between variables (Lewicki et al. 1992). We all know of athletes who always seem to be at the right place on the field, rink, or court, who are amazingly intelligent in practice but almost totally hamstrung when it comes to articulating their performance. This kind of knowledge is not necessarily mediated by conscious knowledge. There is no abstract theory guiding performance in these cases. We act because we are familiar. Subsequently, we can form an impression, a theory perhaps, of our expert activity.

The nonconscious part of experience is also thought often to be better left unanalyzed within the performance. For example, the musician within the orchestra tends to focus on the work of the whole and its interpretation rather than the mechanics of his/her playing. Indeed, concentrating attention on one's fingers might even paralyze one's playing. It is after the experience that one might attempt to bring the inherent tacit knowledge to the surface. In so doing, we might not only improve but even permanently alter our understanding of the situation and, as a result, our actual performance (Polanyi 1966, Reber 1976). The critical issue in learning from experience seems to be not whether but *when* to introduce explicit instructions and reflection into the field to yield optimal performance (Howard and Ballas 1980, Lewicki 1986).

Learning acquired through experience is often referred to by cognitive psychologists as implicit learning, meaning the acquisition of complex knowledge that takes place without the learner's awareness that he or she is learning (Hayes and Broadbent 1988, Green and Shanks 1993). Implicit learning is thought to be the foundation for tacit knowledge and can be used to solve problems as well as make reasonable decisions about novel stimulus circumstances (Reber 1989). Knowledge acquired during implicit learning is not amenable to verbal report whereas explicit learning, which proceeds with the subject's awareness of what is being learned, is verbally reportable. It is conceivable that implicit learning serves as the base for conscious operations. It is perhaps at its most accessible point when we think of our actions as intuitive

(Reber 1989). This is when we have a sense of the correct action or response but are incapable of explaining why we behaved the way we did. The subsequent step of reflection allows us to bring our intuitive actions to the surface.

Reflection

Reflection constitutes the ability to uncover and make explicit to oneself what one has planned, observed, or achieved in practice. Hence, it is concerned with the reconstruction of meaning. In particular, it privileges the process of inquiry leading to an understanding of experiences that may have been overlooked in practice.

Most practitioners are unfortunately unable to develop a cohesive theory and explanation of their work, though they may be very skilled (Viljoen et al. 1990). Hence, as noted in the prior discussion of implicit learning and intuition, they have difficulty explaining their interventions to themselves or to others. Reflective practitioners, on the other hand, become sensitive to why they performed in a certain way, the values that were being manifested, the discrepancies that existed between what was said and what was done, and the way in which forces below the surface may have shaped actions and outcomes. Rather than follow prescribed methods, they question whether new approaches could have led to better solutions. Reflective practitioners are thus critical thinkers who have the intellectual discipline to avoid confusing viewpoint and reality. They probe whether a socially approved decision is ethically justified and whether a suggested action is ultimately consistent with the very values that they espouse (Argyris and Schön 1978, Marsick 1988, Paul 1992, Raelin 1993).

Reflection is thought by cognitive psychologists to contribute as much to learning as experience itself to the extent learners are active observers. In fact, people often learn behavior from observing others before performing the behavior themselves (Bandura 1986). According to social learning theory (*SLT*), individuals tend to anticipate actions and their associated consequences. Hence, before trying out new or altered behaviors, they first pay attention to others and develop mental models or cognitive maps to guide their trials (Bandura 1977).

Reflection is also thought to exist along a "reflective spectrum," rather than constitute a one-time experience (Day 1993). Griffiths and Tann (1991) identified a time-sequenced five-level model of reflective practice:

1. Rapid reaction (instinctive, immediate);
2. Repair (habitual, pause for thought, fast, on the spot);
3. Review (time-out to reassess, over hours or days);
4. Research (systematic, sharply focused, over weeks or months);
5. Reformulation (abstract, rigorous, clearly formulated, over months or years).

Patricia King and Karen Kitchener (1994) have developed a seven-stage reflective judgment model which is developmentally sequenced based upon increasingly complex ways of understanding and resolving ill-structured problems. Individuals progress through the stages on the basis of a number of epistemic assumptions: the extent to which they investigate the facts of a situation, the strategies they use to obtain information, their degree of acceptance of divergent interpretations, and the degree of uncertainty they feel about whether a problem has been solved. By the last stage, for example, reflective judgment entails acknowledging that one's understanding of the world is not a given but must be actively constructed and interpreted. Knowledge is understood in relationship to the context in which it was generated. Criteria, such as conceptual soundness, coherence, or parsimony are also available to judge some knowledge claims as more plausible than others.

Mezirow (1991) distinguishes three forms of reflection. Content reflection is based upon what we perceive, think, feel, or act upon. Initially grounded in Dewey's notion of "critical inquiry" (1933), itself based upon an implicit hypothetical-deductive model, reflection on content involves a review of the way we have consciously applied ideas in strategizing and implementing each phase of solving a problem. Process reflection, on the other hand, is an examination of how we go about problem solving with a view toward the procedures and assumptions in use. Process reflection also takes account of how we think about a given situation. Premise reflection goes to a final step of questioning the very presuppositions attending to the problem to begin with. In premise reflection, we question the very questions we have been asking in order to challenge our fundamental beliefs.

According to developmental psychologists, such as Broughton (1977), premise reflection or "theoretical self-consciousness" is only available to adults. It is only in adulthood that one becomes capable of recognizing paradigmatic assumptions in our thinking. However, adults need to engage, to evoke their reflective consciousness in order to learn at this level. Mezirow (1981) calls this learning transformative: learning which can take us into new meanings. Transformative learning can help us review and alter any misconstrued meanings arising out of uncritical half-truths found in conventional wisdom or in power relationships. Since higher-level reflection may not occur naturally, educational opportunities need to be provided within the workplace to provoke critical reflection on current meaning perspectives. As Kegan (1982) has noted, however, such a practice can be threatening unless

accompanied by an environment which intellectually and emotionally supports individuals in their epistemic development.

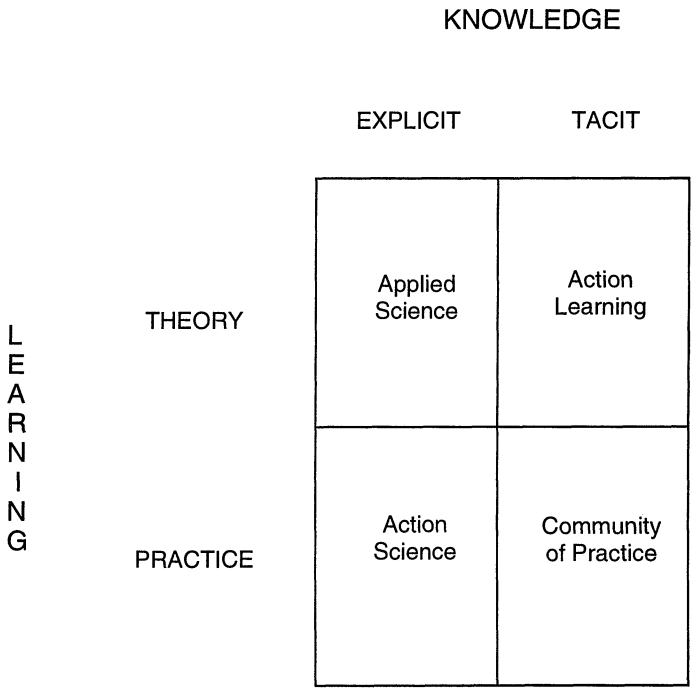
Work-Based Learning as a Collective Property

Having explored work-based learning at the individual level, we can now turn to the processes of learning within work in the company of others. In Figure 2, four different types are displayed at the collective level resulting from a matrix of the same dimensions of learning modes and knowledge forms. These types have each been studied before, but typically in isolation. As we shall see, each tends to be derived from a distinct epistemological tradition. We propose again to integrate them at least insofar as the model of work-based learning requires each in order to produce effective, efficient, and critical learning. In the succeeding four sections, the next four learning types are discussed to culminate the model of work-based learning as it pertains to learning with others.

Applied Science

Although experiments under the carefully controlled conditions of the scientific method can proceed in the domain of learning and work, most academics in the field tend to dedicate their science to instrumental or applied problems. However, as good scientists, they tend not to waver in their commitment to the scientific method. Accordingly, they seek to describe and explain social reality through the manipulation of theoretical propositions using the rules of formal hypothetico-deductive logic (Lee 1991). These rules, often referred to as the modernist methods of positivist science (Bernstein 1976, Hanfling 1981, Rosenau 1992), permit scientists to gain insight into an objective knowledge or reality that exists outside of human thought.

Figure 2 **A Model of Work-Based Learning at the Collective Level**



In an attempt to find areas of objective knowledge still left undiscovered, scientists further explicitly detach themselves from the situations which might reveal elements of this knowledge, they selectively test out preordained patterns of conceptual relationships, and then draw conclusions which might generalize to other similar situations. The knowledge subject to this intensity of inquiry has such features as: (1) it becomes truer or more valid as it undergoes the rigorous methods of theory testing, (2) it becomes expressed as a series of logical relationships defined often using mathematical language, and (3) it invites reformulation as its precepts and procedures are subjected to public scrutiny (Hoshmand and Polkinghorne 1992).

Scientific knowledge using positivist methods has been proposed as being superior to that produced from values, feelings, or even experience because of its adherence to scrupulously objective and unbiased methods (Popper 1959). Consequently, theory, which affords testable propositions, is deemed best separated from practice. Teaching is also separated from learning as it is seen as a transfer of information from teacher to student. Learning occurs when that information is received, stored, and recapitulated. Unfortunately, the segmentation between theory and practice and teaching and learning has been exacerbated through the further divisionalization of subject matter to the extent that exchanges across disciplines rarely occur. Cross-disciplinary connections are more likely to occur in practice than in academia.

Nevertheless, applications of science, especially social science, can contribute a great deal to collective knowing (Sutton 1989). Active theory can inform spontaneous inquiry. What can be most helpful to practitioners is not a pure scientific method which attempts to objectify all organizational phenomena but an applied science which takes into consideration the cultural, political, and moral dilemmas within our social systems (Toulmin 1990, Wilmott 1993). We need to correct and qualify what we learn in one discipline by what we learn not only in other disciplines but from everyday life as well (Paul 1992).

Applied science can make an important contribution to

practice by offering theories of action which are systematically tested using the rigorous conditions of hypothetico-deductive logic. At the same time, practitioners have to be allowed to contribute to theory and comment on gaps between formal research and processes in the field. In this way theory can be united with the practice world consistent with the philosophy of praxis (Vazquez 1977). The history of science and human thought clearly makes room for the contribution of human activity. Conversely, praxis benefits from theory construction and verification (Hoshmand and Polkinghorne 1992). Work-based learning will benefit most from an applied science which deliberately introduces its methods into the practice field and which solicits the contributions of practitioners.

Action Learning

In order to apply theory to the workplace, educators need to view the real-world as an appropriate location for learning (Korey and Bogorya 1985). Since practitioners are stakeholders in the problems which they attempt to solve, real problems can become the focus of study. Note that these problems ought to be real, not simulated. Extant curricular devices which attempt to introduce a spirit of tacit knowing into traditional lectures—be they case analyses, action research through consultancy, field research and observation, or multimedia methods—though useful, are not sufficient to help students convert theory into tacit knowledge or to learn how to challenge and reflect on their own theoretical assumptions. Students need to take real positions, make moral judgments, and defend them under pressure. Dealing exclusively with simulated events risks defusing or abstracting their live conflicts. Cooperation typically is obtained where it otherwise may be impossible, and emotionally-laden and status problems get neatly analyzed into solutions. As Brown and Duguid (1991) have aptly put it, a critical issue in work-based learning is becoming a practitioner, not learning about practice.

Practitioners thus need the opportunity to merge theoretical principles with an understanding of the social construction of the organizations in which they work. Most principles about organizations, for example, cannot anticipate the particular circumstances unique to each organization. Further, practitioners often learn best by sharing their theories and experiences with each other. Another way to put this is that organizational members need to enter each others' area of operation in order to provide new perspectives and stimulate inquiry regarding practice experiences (Nonaka 1994).

In action learning, real-time experience, especially problems occurring within one's own work setting, constitutes a good part of the subject matter of the lesson. Opportunities are also provided for substantial debriefing of the real-time experience so that the student may inquire how others reacted to his/her handling of the situation. Any actions taken are also subject to inquiry about the effectiveness of these actions, including a review of how one's theories were applied into practice. Hence, action learning relies upon feedback which by focusing on the student's values and behavior ensures that any actions are seen not as neutral stances but as positions with points of view and anticipated consequences.

Action learning commonly refers to specific programmatic features of a learning course in addition to its contribution as a philosophy of learning (Revans 1983, Margerison 1988, Raelin and LeBien 1993). The course might begin with the presentation of a theoretical modular unit on a given topic or functional area. Following the presentation of this conventional component, students are asked to apply the theory to a real live project which is sanctioned by organizational sponsors and which has potential value not only to the participant but to the organizational unit to which the project is attached.

Throughout the course, the students continue to work on the projects with assistance from other participants as well as from qualified tutors or facilitators who help them make sense of their project experiences in light of relevant theory. This feedback feature is facilitated by the formation of learning teams or "action learning sets" which typically are composed of five to seven practitioners. During the learning team sessions, the students discuss not only the practical dilemmas arising from actions in their work settings, but the applications or misapplications of theories and concepts to these actions. Further, the group develops a social culture in its own right which presents participants with lessons regarding group dynamics. Team members also provide encouragement to one another.

As might be expected, not all organizational problems are solved in action learning interventions. Hence, the experience tends to confront participants with the constraints of organizational realities, leading oftentimes to their discovery of alternative and creative means to accomplish their objectives.

Community of Practice

Communities of practice evolve as people united in a common enterprise develop a shared history as well as particular values, beliefs, ways of talking, and ways of doing things (Drath and Palus 1994). They come together, not so much on the basis of formal memberships or job descriptions, as by being involved with one another in action (Lave and Wenger 1991). They learn to construct shared understanding amidst confusing and conflicting

data (Brown and Duguid 1991). They begin to rely upon one another for mutual assistance. In time, their efforts as an informal community become tacit; indeed, at this point, we tend to refer to the work as effortless. Nonaka's (1994) metaphor of the wave aptly captures this spirit. Once the collective work becomes tacit, it's like a wave that passes through people's bodies and culminates when everyone synchronizes themselves with the wave.

The expertness of the community of practice as a learning community should not be overlooked. As an element of work-based learning, it often supersedes the formal scientific documentation that can be found in training manuals or designs which are "downskilled" to the operating levels. Learning becomes "enacted," that is, constructed on the spot as new information comes on-line (Daft and Weick 1984). Documentation often assumes that the problems it is designed to debug are relatively predictable. Unfortunately, manuals and the like are mere abstractions which often fall short in comprehending the complexity of actual field practices (Brown and Duguid 1991). Typically, it is necessary for field workers through their informal interactions or stories, representing repositories of accumulated wisdom, to bring coherence to an otherwise random set of conditions.

Consider the case of photocopier technicians (Orr 1990) who often must work around training manuals as they confront idiosyncratic workplace problems. Designers obviously cannot predict the social context in which the machines are used, so they must rely upon the technicians to understand the user environment. In many instances, problems arise because of operator use or misuse not predicted by the designers. So, the knowledge that is acquired here is social, as if the repairmen are participants in a group mind. Nelson and Winter (1982) point out that organizations build up "routines" that transcend the sum of individual actions and capabilities. Problem solving becomes more of a social activity than an analytically detached process. It also becomes a natural exercise. Scribner (1986) described workers in a commercial dairy, showing how the packers, for example, were able to configure mixed orders using calculations based upon changing base numbers depending on the item and its pack size. Their calculations, which were error-free, seemed virtually effortless.

The social and tacit infrastructure of workers is not always productive or even collective. Hence, remedying ineffective team behavior where differences become polarized, for example, requires more than individual reflection. Instead, groups have to learn to observe and experiment with their own collective tacit processes in action. Bohm (1985) suggests that breakdowns in team effectiveness be handled through a dialogic process in which participants learn or re-learn to reason together. Orr (1990, pp. 186–187) found that war stories represented a natural and effective means to build collective memory which, in turn, would preserve and circulate needed information to be deployed in the field.

The notion of community of practice returns knowledge back into its context. As a model of work-based learning, it suggests that learning is built out of the materials of the local situation and that it is often collective. Hence, students cannot be segregated from the communities in which they are to work. Apprenticeships, for example, cannot be complete if training is conducted in merely simulated work conditions. Apprentices must have the opportunity to observe and even participate in collective practices and thus learn how to make interpretations of the assumptions guiding the experts' behavior (Wertsch 1985, Blackler 1993). The knowledge used in a context is often practical as opposed to theoretical, and is also often expert in its simplicity. In other words, it is typically directed toward the task at hand, and the task, in turn, is inextricable from its environment. In her study of the dairy, Scribner (1986) reported that drivers maintained a nearly perfect on-the-job accuracy rate on pricing problems, but when given standard arithmetic tests, they made many errors on decimal multiplication problems nearly identical in format to their pricing problems.

Meanwhile, journeymen or regular members of a community of practice need to literally practice together in order to develop their mutual expertise. We would not expect an orchestra to perform without rehearsal, so why should a workteam be expected to perform without practice? Hence, time needs to be taken to experiment and reflect on one's practice in a safe environment. At times, the action may even have to be slowed down or dissected in parts in order to build on the otherwise intersubjective tacitness of the entire performance (Kofman and Senge 1993).

Whether through dissection or through programming—with or without computers—collective learning can be accelerated. Compared to nonconscious performance, programmed collective learning can expand the consideration of new conditions and perspectives. It introduces practitioners to a language that is capable of uncovering personal conventions of practice that without programming would not otherwise add to collective memory.

Programmed learning in a community of practice bridges to the next learning type—action science—when implicit behavior is made explicit using cognitive and artificial intelligence technologies. The method known as cognitive task analysis has begun to analyze the knowledge and performance requirements for jobs that involve complex cognitive skills (Ryder and Redding 1993). For

example, progress has been made in designing training to help novices accelerate their acquisition of automatic job skills which tend to be associated with the unconscious actions of experts (Fisk and Gallini 1989).

In the area of network technology, collective experience can be captured for on-line examination as is the case with the *CAMS* (computer aided maintenance system) system used by General Motors. Given the complexity of repair due to the increasing diversity and customization characterizing the automobile industry, it has almost become impossible to rely upon written repair manuals to assist mechanics in performing their job. What CAMS does is reproduce the collective memory of mechanics who have derived useful routines or heuristics in solving planned but also unforeseen breakdowns in vehicle performance. The mechanics, whether novice or expert, can use each others' experiences when trying to fix new problems associated with new components on new vehicles. In a similar vein, *GE* has established an Answer Center which has programmed 1.5 million potential questions and complaints into a computerized database system (Nonaka and Takeuchi 1995).

Action Science

How do we make our mental models explicit? Mental models are the images, assumptions, and stories which we carry in our minds of ourselves and of others. In action science, we seek ways to bring these mental models, which are often untested and unexamined and, consequently, often erroneous, into consciousness in such a way that new models are formed which serve us better (Burgoyne 1994, Senge et al. 1994). Vygotsky (1962) argued that consciousness is the dynamic outcome of an ongoing interaction between the social and the nonconscious. What consciousness does is bring out the intuitive use of tools and skills for subsequent use. So, for Vygotsky, knowledge is the lever of action. Similarly, Habermas (1984) sees reason as the basis for *argumentation,* or the process of dialogue in which implicit validity claims or unquestioned assumptions are made explicit and contested.

What characterizes action science as a form of work-based learning is the deliberate questioning of existing perspectives and interpretations, referred to by Argyris and Schön (1978) as "double-loop" learning. In questioning even the governing values of one's organization, learners consider not just what has been explained through normal communication channels but they also consider what needs to be explained. This allows them to keep alive, in the midst of action, a multiplicity of views of the situation (Hoshmand and Polkinghorne 1992), including their own enactments. Thus, rather than purposely take the subject out of explanations of reality, they learn to incorporate it.

We need, consequently, to develop cognitive models which help us make sense of our own practice (Kuhn et al. 1988). Donald Schön (1983) coined the term, "reflection-in-action," to characterize the rethinking process which attempts to discover how what one did contributed to an unexpected or expected outcome, taking into account factors unique to the interplay between the individual practitioner and his/her local operating context as well as the interplay between theory and practice.

In order to engage in a reflection-in-action, learners might start by offering a frame of the situation at hand. Then, they might inquire as to how others see it. As the group reflects upon these frames, they begin to surface and test underlying assumptions about their respective reasoning processes. They would also learn pattern recognition and reframing. For example, if a pattern conventionally used to respond to a given situation no longer fits because of changes in the situation, they would learn how to reframe the situation on-line and perhaps alter the ineffectual pattern (Schön 1983, Dreyfus and Dreyfus 1986).

Framing and subsequent communication in action science may depend upon areas of knowledge and human interest which, in turn, shape the type of discourse to be held (Habermas 1971). Technical knowledge involves predictions about observable events, physical or social. This type of knowledge may result in empirical or theoretical discourse in which claims to truth may be validated by empirical tests. Empirical discourse relies upon hypothetico-deductive logic developed in applied science.

The second type of knowledge is what Habermas refers to as "practical," which entails social norms, ideals, values, and moral decisions. Practical or rational discourse, in the absence of empirical tests, may call upon tradition and authority, but preferably uses consensus based upon a dialogue over contested meanings. Naturally, there are times when the presuppositions of opposing groups become irreconcilable. Without rational discourse, however, decisions may be expropriated by political or religious leaders (Mezirow 1991). Parties to a rational discourse need consequently to work particularly hard to avoid irrational action. Learning through metaphors—understanding one kind of thing in terms of another—may be a useful method (Lakoff and Johnson 1980, p. 5) to help resolve contradictions or inconsistencies between concepts and contexts or to allow expression of particularly indeterminate practices (Bateson 1972). Ultimately, practical discourse must allow dialectical movement between preconception and confirmation or between meaning and experience (Wolff 1975). The logic incorporated

is metaphorical-abductive rather than hypothetical-deductive, as is the case in empirical discourse. In abduction, we make active and constant metaphoric association between what is known based upon current interpretation and new experience. Hence, practical discourse searches for meaning rather than attempt to delineate causality.

Habermas' third type of knowledge, emancipatory, is gained through critical self-reflection of our taken-for-granted assumptions and feelings. Reflective discourse is used in this instance to determine whether the premises for our interpretation or understanding are themselves valid. Bateson's (1972) concept of third-order learning represents this level of discourse. In first-order learning, we move from using preexisting habitual responses (zero-order learning) to learning about them. In second-order learning, we learn about contexts sufficiently to challenge the standard meanings underlying our habitual responses. Thus, using second-order learning, we find ourselves capable of transferring our learning from one context to the other. Burgoyne and Hodgson (1983) also found second-order learning to occur most frequently at a tacit level of experience. By third-order learning, we become aware that our whole way of perceiving the world has been based on questionable premises. It is learning about the "context of contexts" such that our entire assumptive frame of reference can be challenged. Indeed, it is conceivable that without third-order learning, the potential for transfer of learning characterized by second-order learning may be limited as practitioner actions become habitual and unwittingly inflexible (Freire 1970, Burgoyne and Hodgson 1983). For example, in the midst of action, we may begin to rely on preconceived criteria for appropriate action. Unfortunately, this tendency limits our innovation in working through irregularities in certain contexts. Using third-order learning, one holds a virtual reflective conversation with one's situation. In this way, we can remake a part of our practice world and attempt to reveal the tacit processes that underlie our practice.

A critical difference between practical and reflective discourse to which Habermas has not devoted much attention (Burrell 1994) is the distinction between perceiving and feeling experience. The latter refers to the explicit referencing of emotional reactions which are often denied or dismissed, be they defensive reactions, embarrassment, or general anxiety (Vince and Martin 1993). Action science allows social relationships to form in a group but, unlike conventional work environments, also encourages the surfacing in the safe presence of trusting peers emotional and political reactions that might block effective interactions.

Action science essentially creates an on-line learning environment which permits and encourages learners to engage in emancipatory discourse, thus testing their mental models, especially their inferences and assumptions about others and their own behavior. Coworkers come to understand the embedded cultural myths which underlie their felt needs and wants expressed in their relations with others. Mezirow (1981) has demonstrated how projective instructional materials along with Socratic dialogue might be used in small group settings to elicit and challenge psycho-cultural assumptions behind habituated ways of perceiving, thinking, feeling, and behaving. Graphic representation techniques, such as "concept mapping," can also be used to help learners either individually or in groups reflect critically on concepts and their interrelationships and, in addition, search for alternative ways of interpreting these same or allied concepts (Trochim 1989). These approaches extend the lesson of action learning which, at the level of practical discourse, is more concerned with meaning-making, that is, helping students enhance their sensitivity to the ways others perceive or react to them. Whereas action learning seeks to contextualize learning, action science decontextualizes practice so that learners can become more critical of their behavior, explore the premises of their beliefs, and consider how relevant knowledge is constructed and managed.

Action science can also be used to surface the technical as well as cultural practices in a work group. Nonaka and Takeuchi (1995) illustrate how Matsushita's early efforts in launching its phenomenally successful home breadmaker were based on the careful study by engineers of the meticulous movements in kneading on the part of master bakers.

Discussion

We have developed a model of work-based learning which illustrates the interplay between the forms of knowledge and the modes of learning at both individual and collective levels. This approach recognizes that practitioners in order to be proficient need to bridge the gap between explicit and tacit knowledge and between theory and practice. Work-based learning subscribes to a form of knowing that is context-dependent. Practitioners use theories to frame their understanding of the context but simultaneously incorporate an awareness of the social processes in which organizational activity is embedded.

In the discussion to follow, I present first the implications for the model of work-based learning in terms of theory. I start by revising the model to represent its dynamic nature, propose how it can be conceptualized as an integrative approach, and suggest avenues for further research. I then depict how the model can be used in practice as a program for learner development. Although the

model can be applied in any number of diverse learning settings, I will draw an example from my own area of interest, executive education.

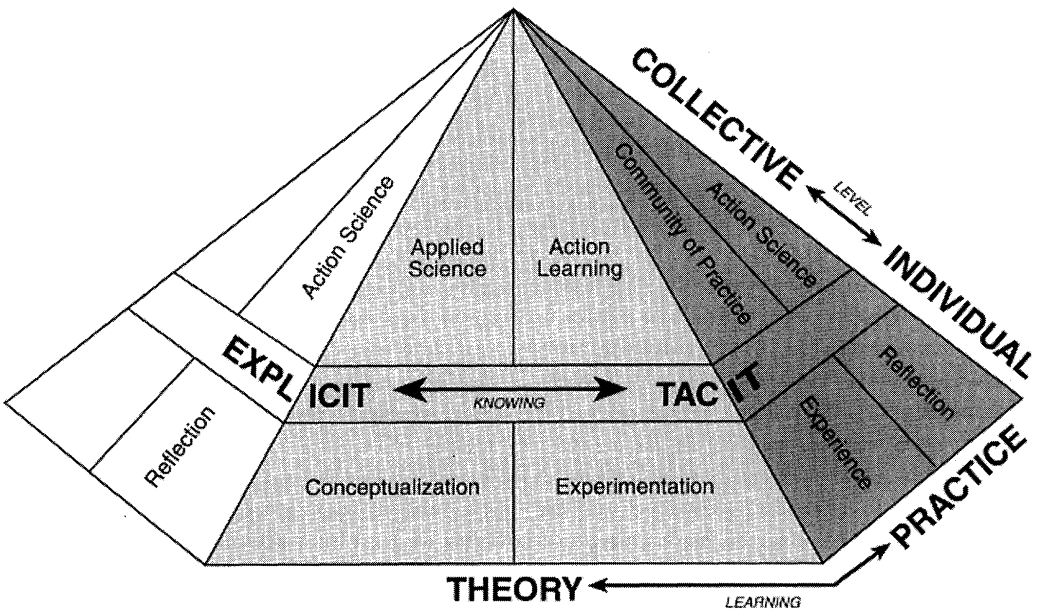
Work-Based Learning in Theory

Figure 3 combines the prior two figures into a comprehensive model of work-based learning. Readers will note that it is no longer depicted in the classic matrix style. The comprehensive model now occupies a three-dimensional space showing transitional movement across all three dimensions. Consequently, whether learning by oneself or collectively with others, each of the eight types of learning needs to be brought into consideration if learners are to achieve proficiency and criticalness of their learning. Further, as learners in practice do not step into a discrete space to perform experience or reflection, our model cannot rigidly classify these behaviors. Rather, the model of work-based learning must represent the integration of these styles in a similar way as Pye (1995) characterizes the interplay between dialogue and doing. For example, our theories are based not only on empirical knowledge, but on what DeFord (1993) refers to as "beliefs-in-action." For critical learning to occur, for instance for learners to bring their cultural assumptions into consciousness, these theories must be tested. Hence, conceptualized knowledge ultimately requires the test of tacit experimentation. The pure tacit experience, representing beliefs-in-action, requires the test of reflection.

Although there is a logic to the choice of neighbors among the types, there is no precise rotation that is recommended. Further, the model, as depicted by the symmetrical arrows, accounts for regression to prior types. For examples, experiments of theory are often tentative or successive requiring frequent reversion to theory, especially during early stages of development. There are also links represented between the levels. For example, reflections lead to theory testing which can contribute to science. Furthermore, isolated reflection tends ultimately to incorporate the surrounding social context. Individual learning can proceed independently for awhile but it may be illusory to think of oneself as autonomous (Brookfield 1993). Most of us work with others and so we need to inquire as to how they see us in action and how they interpret workplace phenomena.

The collective level is not meant to describe merely group-level phenomena. Although reflections from practice may be shared with an intimate community, the very process of sharing may ultimately spiral out to other communities. Communities of practice, for example, often include customers and suppliers in order to promote understanding of tacit behaviors. Hence, although this model has a modest focus on learning through work, it can contribute to the more encompassing processes of organizational learning, organizational transformation, and organizational knowledge creation. For example, Nonaka's theory of organizational knowledge creation (1994) demonstrates how the dynamic interaction between tacit and explicit knowledge and a spiral process

Figure 3 A Comprehensive Model of Work-Based Learning



through expanding communities of interaction that cross even organizational boundaries contribute to new knowledge evidenced in a company's products, services, and systems.

Our revised model also adjusts the knowledge dimension. The static concept of knowledge with its connotation of rationalism, abstraction, and permanency has been replaced with the more fluid process of knowing. Knowing entertains the constant shifting between explicit and tacit and between concept and context and hence more accurately denotes the construction and transformation of knowledge as it is used. The difficulty of knowing at the individual level, which requires confronting the gap between receiving information and making meaning from it, is heightened at the collective level wherein colleagues attempt to share and arrive at a consensus on their respective interpretations.

It should be apparent that each of the styles of Figure 3 performs an important function but that various intersections are required to achieve comprehensive learning. A perfectly tacit community of practice may exist in a given work setting seemingly requiring minimal intervention. In fact, efforts to intervene may not only be rejected but may actually interrupt the work flow. However, communities of this nature cannot function forever as closed systems. What happens when new inputs are added to the system? Is it possible that new processes, especially from advanced technologies, might even accelerate learning and performance? Most critically, what if the community needs to grow and accept new members? How can these novices be brought quickly up to speed so that they can emulate the unconscious mastery of the experts?

Communities may also give the appearance of perfection in action, belying in some cases underlying hostility that might eventually disrupt the team. Is it possible in these instances to change the common social interaction into an emancipatory discourse, associated with action science, which might begin to challenge the premises of operation without permanently spoiling the smooth work flow?

Although we present the model as a comprehensive framework, it is unclear where or how quickly integration ought to occur. In fact, the learning types might be differentiable according to functions or processes within an organization. For example, it may not be necessary, indeed it might even be dysfunctional, to create a community of practice within a research group which is often dependent upon individual expertise. However, within the function of technical service, it becomes more critical that knowledge workers function more as a high-performing team that benefits from the intersubjective knowledge shared within a community of practice. Perhaps learning types might also differentiate according to life cycle or developmental stage at various levels of operation, for example, within individuals, groups, or the organization as a whole.

It would be useful to determine how the model might be applied within diverse settings. It seems natural as a basis for organizing adult education offerings, for example, since adults generally prefer to be responsible for their own learning, to deal with real-life situations, and to apply what they have conceptualized. Likewise, it could form the basis for school-to-work transition experiences for youth since these efforts by nature are designed to integrate school-based and work-based learning and shift the emphasis from preparation *for* work to preparation *through* work.

The model of work-based learning thus awaits further development to determine its utility within epistemology. For the moment, the model serves to bring together a number of otherwise disparate learning processes, each of which has its own justification as a basis for learning within work. By integrating these processes, we gather insight into the dynamic interplay of forces which can impede or facilitate learning in the workplace.

Work-Based Learning in Practice

The dominant method of developing employees in North America is through training. In the case of management training, billions of dollars are spent annually in the U.S. mostly on classroom instruction. The focus of this effort is on the delivery of a broad range of conceptual knowledge and skills in the various fields and functional disciplines of management. Besides classroom instruction, the other predominant mode of developing managers in through experience. In particular, it is thought that mastery of an interdisciplinary, interfunctional field like management is best achieved by exposure to diverse challenges in corporate life normally through the judicious mapping of assignments.

Unfortunately, classroom and real-world development experiences are typically provided independently as if there were no need to merge theory with practice. As we have seen, work-based learning deliberately merges theory with practice and acknowledges the intersection of explicit and tacit forms of knowing. A prototypical learning program combining some of the learning types of the model of work-based learning is demonstrated below based upon the experiences of the author in executive education. Space considerations cannot allow a comprehensive account; rather, the depiction is meant to give the reader a flavor for the model in practice.

The model of work-based learning has no set sequence

since learning modalities are dependent on any number of conditions, such as the readiness level of the learners, the strengths and preferences of the facilitator(s), or the past practices of the sponsoring unit or organization. As a rule of thumb, however, if the learners are uninitiated, it is more threatening to expose them to their tacit assumptions than have them articulate their explicit beliefs. This is especially the case if the assumptions under review might expose learners to their psychological defenses or to their emotional or personal reactions to others. Hence, programs might start by having managers critically analyze a set of theoretical treatises in the area of study, perhaps it might be different perspectives of leadership. Discussions might initially be kept at the theoretical level within the study group but participants might be encouraged to individually experiment in their own work setting with some of the ideas brought up. Meanwhile, discussions can gradually shift from the purely conceptual level to introspection regarding the use of the ideas in practice. Participants might even be encouraged to bring in experiences from their own jobs to verify or challenge some of the theories under review. During these components, participants should be encouraged to persistently observe themselves and others in practice and try to become sensitive to why they perform in certain ways. In particular, they should try to reflect upon what tacit theories are actually used in practice, how these theories match against the new theories introduced in the program, and whether people actually behave consistently with whatever theories they espouse.

It may be difficult for some participants to engage in the reflective components just described without the assistance of a partner and/or a mentor. These "helper" roles can be critical in encouraging participants to try out new workplace behaviors and learn from their experiences. A program called "LeaderLab," sponsored by the Center for Creative Leadership deploys three helper roles: a process advisor, represented by a staff professional who meets with the participants in person and by phone during the three-month experience; in-course change partners who work with one another to experiment with and reflect upon classroom experiences; and back-home change partners who help the participants transfer off-site lessons into the work site (Burnside and Guthrie 1992). Another complementary tool to help participants reflect more on their individual development is the journal. Journal writing provides an opportunity for participants to break their habitual ways of thinking and doing through reflective withdrawal and reentry (Lukinsky 1990).

Program development can advance to another level of activity when participants are asked to intentionally practice some of the new ideas introduced. One way to foster this type of learning is to create projects in the sponsoring organization which might represent either problems in current operations or opportunities for functional improvement. The identification of projects can be handled using conventional applied research methods. A learning consortium group made up of six major companies in a large New England city uses focus groups to prioritize the most critical areas for managerial and corporate development. With the projects in place, groups can begin to work on them while meeting in action learning teams as a means of debriefing their real-time experiences. Actions taken in the projects can now be subject to inquiry about their effectiveness including a review of how participants' theories were applied into practice.

Project groups need not assemble organizational strangers to work on problems outside their work area. Intact teams can participate in development programs to help them become more of a community of practice. Communities of practice recognize that their very effectiveness rests on their ability to learn from one another. Participants in such groups not only learn to observe and experiment with their own collective tacit processes in action, but, while doing so, seek to improve their own performance. There are many so-called "team-building" methods available to help intact groups work toward higher levels of insight and performance. Teaching participants how to become process observers of their own interactions can accelerate development by exposing team members to each others' potential contributions as well as to the team's overall needs. Another method to help participants work toward a community of practice is through the process of dialogue which helps team members think as well as act together (Bohm 1985).

If the learning community is willing, members can continue to engage their collective consciousness through the process which we have called action science. More than the other tools, it calls for the deliberate questioning of existing perspectives and interpretations and thus seeks to make explicit the constituent elements of our assumptive worlds. The practices of action science can vary in threat from scenario analysis, wherein participants explore the actions of hypothetical characters, to critical incidents wherein they have the opportunity to face the assumptions framing their own practice through an analysis of events in their lives that are remembered for their emotional significance (Brookfield 1992). For example, participants may be asked to describe an event as a manager that made them feel a real "high" of satisfaction and fulfillment and one that made them feel a real "low" of dissatisfaction and disappointment. Repertory grids and metaphor analysis can also be used to help participants

bring to the surface their otherwise tacit personal constructs (Kelly 1955, Deshler 1985).

As readers might conclude, there are many options and practices that can be used with individuals and groups in work-based learning. Perhaps the hidden variable throughout this account is the role of the facilitator. The model requires the coordination and skilled practice of a competent facilitator if it is to be actualized. However, the directness and substance of any intervention can vary on the basis of the needs of the group as well as the facilitator's preferences, skills, and comfort level. For example, some facilitators might see their role as merely acting like a "mirror" to illustrate conditions in the learning team in such a way that participants learn by themselves and from each other. In other cases, facilitators might see the need to present some technical knowledge which is essential to problem framing, propose various inquiry modes, or even model reflection-in-action. Participants might even be introduced to the theory behind the various learning styles depicted in the model of work-based learning. While fluid, the model's transition links between styles and levels must be approached in practice with both care and skill. Hence, facilitators need to be frank with participants about their intervention approach and, if possible, attempt to anticipate and inform participants when transitions are advised.

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