

Processes of Learning and eLearning

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Abstract

Learning is a set of mental processes driven by a proactive interaction between individuals, and between individuals and their environment. Environment includes resources focused on learning (such as technology, teaching-learning tools and the expertise of others). Environment also encompasses formal and informal social settings such as the workplace and educational institutions. Past history and experience are key features of the individual's learning environment.

A pre-requisite of learning is a process of iteration as the individual registers sensory inputs and tests these against mental models. Such mental models facilitate an individual to make sense of their environment. Iteration over time allows the individual to fine tune the inputs. Experience counts for much. Ideally, sense-making is within socialised interactions with others. This dynamic process allows the creation of new knowledge, skills, abilities and competences. A model of learning which views learning as a linear (step-by-step) process of teaching input followed by learning response overlooks the essential dynamism of the process.

The object of this paper is to present some models of work-related learning.

We present examples of processes of learning and, in so doing, we explain not only how individuals learn but also how organizations and societies learn and develop in an analogous way. We examine the role of learning technologies in the context of these models and suggest guidelines for eLearning at work. We describe the advantages of distance learning and the use of the web and the role of specially designed eLearning system as support and facilitation.

INTRODUCTION

Learning is a set of mental processes driven by a proactive interaction between individuals, and between individuals and their environment (i.e. the world we live in). Our understanding and interpretations of the world we live in gives us a foundation and purpose for our learning. Included in this environment are our home and workplace settings and the people and events with whom we interact. Part of this environment includes setting and activities focused on learning, such as: schools, colleges, and training organizations.

For optimized learning, the environment in which we learn should be learning-focused. In terms of 'hardware' it can encompass formal learning settings such as

lecture halls, training rooms and classrooms. Environment might include learning-supporting resources (such as technology, teaching-learning tools, the expertise of professional educators). Environment also encompasses structured learning settings such as the workplace which contain both formalized and informal learning situations. These might include communities of like-minded people in, for example, mentor relationships, and situations involving learning-by-doing (such as on-the-job training) and apprenticeship schemes. In the workplace, as in other settings where learning takes place, an important attribute is a culture of learning. This includes factors that contribute to make learning a commonplace activity in which people engage as part of their everyday workplace routines.

Key features of a person's learning are the individual's past history and prior experience of learning. These influence individual mental learning processes as well as providing models of successful learning. Formalized education (such as periods of compulsory schooling) shape the individual's mental models of learning as well as providing paradigms for learning styles and techniques. Here, learning styles refer to an individual's ideal manner of learning; perhaps based on their prior learning experiences and on their instinctive abilities and awareness of what constitutes, for them, the route to learning success.

A pre-requisite of learning is a process of iteration as the individual registers sensory inputs from the environment and tests these inputs against existing mental models. In a process of iteration, such mental models help an individual to make sense of their environment. Iteration over time allows the individual to monitor and assess progress and fine tune the sensory inputs. Experience counts for much.

Learning takes place – often unconsciously – as a result of the amalgam

of these processes and these environmental conditions. Pro-activity with the environment is a prerequisite for learning (even if teaching is often conducted “in a vacuum” learning should not be). Making sense of the environment provides a learner with a powerful motivation to learn and also provides a convenient feedback loop for on-going learning to be monitored for progress and relevance. Socialized interactions with others help sense making and allow individuals to create new knowledge, skills and competences in response to their environment. Proactive interactions with other people in the environment provide feedback loops for monitoring learning and adapting it to the environment. Such processes are dynamic. A model of learning which views learning as a linear (step-by-step) process of teaching input followed by cognition overlooks the essential dynamism of the learning process.

DEFINING LEARNING

Learning is a complex phenomenon that has generated a wide systematic body of knowledge (Pear, 2001). Definitions of learning are myriad. Fiol and Lyles (1985) suggest that learning is “the development of insights, knowledge and associations between past actions, the effectiveness of those actions and future actions.” This suggests a continuum of thought from the past through the present and into the future. Huber (1991) notes the need for changes in potential behaviors: “an entity learns if, through its processing of information, the range of potential behaviors is changed.” Here, a learning response to sensory inputs results in the individual broadening the choices for future behaviors. Bood (1998) suggests that learning develops cognition and thus has the potential to enlarge and restructure the innate knowledge base. For Bood, “learning is a cognitive development during which the knowledge base of an

individual or organization grows and/or is restructured” (Bood, 1998: 218).

SINGLE-LOOP AND DOUBLE-LOOP LEARNING

Argyris and Schön (1978, 1996) suggest that an organization can learn in ways that solve problems. In other words, like its human members, an organization will develop over time. Single-loop learning is a learning style which helps an organization to solve problems already identified. Single-loop learning uses a feedback loop so that earlier actions can be corrected. The authors give an example of production engineers who change product specifications when a defective product is identified; or marketing managers who improve their marketing strategies in the light of declining sales. Single loop learning is defined as, “instrumental learning that **changes strategies of action or assumptions underlying strategies in ways that leave the values of a theory of action unchanged**” (Argyris and Schön, 1996: 20; our emphasis added).

Double-loop learning (an improvement of single loop learning) helps solve unidentified (future) problems. In an organization, double-loop learning is a hallmark that the organization has ‘learned how to learn.’ The double loop feedback mechanism not only focuses on “actions and assumptions” but is able to influence the underlying “theories-in-use” that drove those actions in the first instance. This means that learning mechanisms and routines are sufficiently developed such that fundamental thinking processes can be questioned and, if necessary, amended in the light of informed experience. Double-loop learning is “learning that **results in a change in the values of theory-in-use, as well as its strategies and assumptions**” Argyris and

Schön, 1996: 21 (our emphasis added). In an analogous way, one can discuss ways in which a society learns and develops in response to (and as a facet of) its evolving history.

THE PROCESS OF LEARNING

Figure 1 shows a model of the learning process. Proposed by Raelin (1997) this model comprises two parameters: Knowledge and Learning. Knowledge is explicit or tacit (see, for example, Polanyi, 1966; Nonaka, 1991; Leonard-Barton, 1995; Von Krogh et al, 1998; Baumard, 1999; Lam, 2000). These two aspects of knowledge frame knowledge creation. The other dimension in the Raelin (1997) model is the theoretical and practical components of learning. While these components can be symbiotic and mutually supportive, they can exist alone: some learners’ knowledge of theory outstrips their practical learning ability: some competent practitioners lack a comprehensive grasp of theory. The resulting two by two matrix has four panels:

- Conceptualization** (explicit knowledge processed through theory),
- Experimentation** (theoretical application of tacit knowledge)
- Experience** (practical application of tacit knowledge)
- Reflection** (practical application of explicit knowledge)

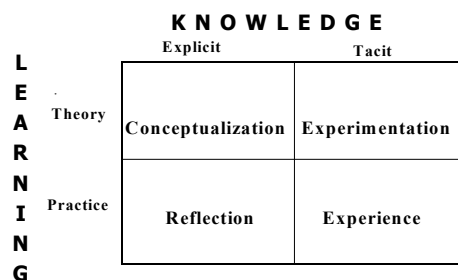


Figure 1: A Model of the Learning Process (Raelin, 1997)

DEVELOPING THE MODEL OF LEARNING

The Raelin (1997) model can be developed to show dynamic learning processes (Figure 2). In this modified model the parameters remain the same: Knowledge (explicit or tacit) and Learning (theory or practice). Applying elements of learning to the model illustrates what learners do in a learning cycle. Certain components of the learning accord with Kolb's (1984) learning cycle model. The resultant two by two matrix now has four additional components and two sets of directional arrows. The directional arrows show the development of learning into knowledge (the four straight arrows within the matrix panels) and the development of learning through practice (the four curved arrows outside the matrix panels). These additions to the standard model give four learning elements:

Mental models (conceptualization of explicit knowledge processed through theory),

Simulations (experimentation from theoretical application of tacit knowledge)

Practice (gaining experience from practical application of tacit knowledge)

Time to think (reflection from practical application of explicit knowledge)

Adding these learning processes develops the existing model in two ways: i). it gives an increased dynamism to the model and ii). it helps illustrate the dynamism of learning in the larger environment. In particular, the addition of the new components into the model shows a cycle of learning routines becoming increasingly robust until they provide inputs to learning. This accords with earlier work on learning

processes (see, for example, Schön, 1982, Kolb, 1984).

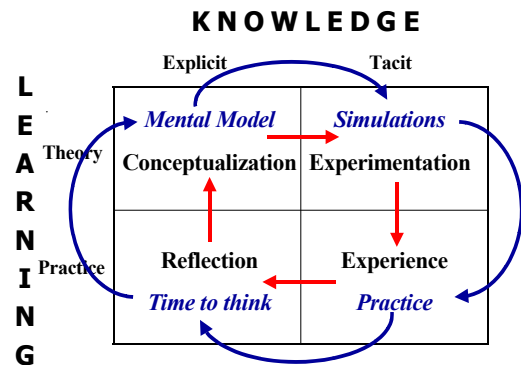


Figure 2: A Model of the Learning Process (modified from Raelin, 1997)

The four learning elements (what learners do) help further our understanding of the learning process. Individuals conceptualize by applying their learning theory to explicit knowledge (knowledge available in the public domain). Conceptualization helps the learner make sense of existing knowledge using their innate theories of learning (perhaps developed from earlier learning experiences). The resultant mental models (mental images of learning informed by currently available knowledge) become the preliminary steps in the process of creating new knowledge. The next step is an opportunity to experiment with (test out) the first step (mental models) in a controlled environment where experimentation can be conducted. One attribute of this environment is the possible use of simulations to provide sensory inputs to the learning in a way that is unthreatening. In this way any flawed learning outputs provide further inputs rather than outputs for 'real' use. In eLearning applications computers can provide randomized experimentation ad infinitum. In this stage, the learner gains experience from

the practical application of tacit knowledge (developed via the two earlier stages in the process). When the learner is ready the next learning stage, practice, can be tackled. Here the practice can be more ‘real’ for example in real time in real situations in the workplace; for example, while the production line is actually running; serving customers; in a live TV studio; at the controls of an aircraft. Again the learner can use learning from the previous stage to perfect workplace practice.

The final stage of the process (before iteration) involves time to think. Here the learner reflects back on the process and sequential outcomes. This involves reflection by the learner of the process and outcomes of applying practice to explicit knowledge. In this way the process is developed as a result of learning and also provides inputs into the process starting afresh.

MODELS OF LEARNING AT WORK

Learning has become a key issue (perhaps *the* key issue) in organizations, particularly the development of individual competences at work. In an organization, learning – especially the double-looped variety – is a conscious effort at work process transformation. Rowden (2001) notes that “in a learning organization attempts are made to provide frequent, on-going, opportunities for action-based learning.”

Learning at work brings extra dimensions to learning (Ellstrom, 2001; Paulsson et al, 2004). In addition to the learner and the learning process are the workplace environment and the organization at large. In combination these elements add new dimensions to the already intricate learning process. In the workplace a key issue is how to integrate learning with work tasks (Ellstrom, 2001). Learning at work may cause stress; especially when employees are expected to fit learning around their

current work tasks (Paulsson et al, 2004). To take these additional dimensions into account requires the definitions and models of learning to be refined. Models that help explain learning in a workplace include Raelin (1997); Nonaka and Takeuchi (1995); Crossan et al, 1995; Nonaka et al (1998); Takeuchi and Nonaka (2004).

Our definition of workplace learning is: *Observed changes in workplace behavior attributable to new cognitions and/or skills.* What makes this definition useful and important is that it applies to learning partly independently of whatever approach to learning is being used. It relates both to a classic positivistic (scientific) approach as well as a more holistic or phenomenological approach. It is also useful to describe a linear or an iterative way of learning. This is because the definition focuses on the outcome of workplace behavior. Changes (improvements) in workplace behavior are an obvious prerequisite for learning at work. However, it is not always an obvious requirement for other learning environments (e.g. learning at school) where other factors may impinge onto the learning situation.

Learning in an organization is between the individuals and the increasing larger communities (group or organization) in which they work. Nonaka (1999) notes that new knowledge is created dynamically at the interface of tacit and explicit knowledge. This is facilitated by the exchange of ideas between workplace colleagues so that tacit (personal) knowledge becomes more public and thus can be augmented and developed through the ideas of others. The SECI model (Nonaka *et al*, 2000) shows the development of knowledge from tacit-tacit (existential, face-to-face) through tacit-explicit (reflective, peer-to-peer) to explicit-explicit (systemic, collaborative). In this dynamic process, the individual brings new (tacit) knowledge and transforms this from knowledge held personally (‘indwelled’) to

knowledge shared with others to become publicly accessible.

OUR MODEL OF LEARNING AT WORK

Figure 3 shows our model of learning at work. The model has two environments: the workplace environment and the outside

world. The workplace environment is bounded by a dotted line representing its separation from the outside world. The line is dotted rather than continuous to indicate that this separation is more metaphorical than actual: rarely do employees discard the outside world when they enter their workplace.

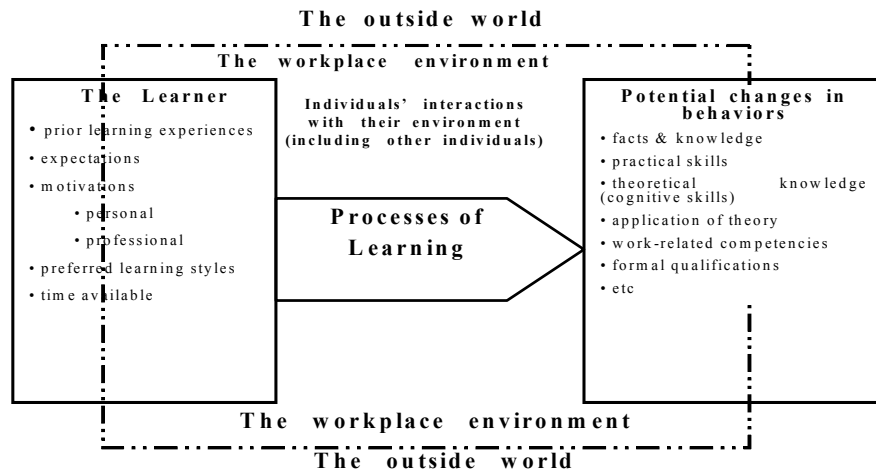


Figure 3: A Model of Workplace Learning

The model comprises four components: the Learner, the Workplace Environment, the Processes of Learning, and Potential Changes in Behaviors. Neither the Learner nor the Potential Changes in Behavior exist in a vacuum; both are informed by the wider world outside the workplace (hence they straddle the dotted line to indicate that the separation of the workplace from the outside world is only partial). In our model the Processes of Learning are within the workplace environment.

Although within the workplace, the learning interface is affected by the outside world through the inputs from learning design and the learner (which themselves relate to the outside world). In a model where learning at work is facilitated by an external e-education organization providing online learning services to the organization's

workforce, the learning interface would also straddle the workplace-outside world (and represented by the dotted line).

CREATING A POSITIVE LEARNING ENVIRONMENT IN THE WORKPLACE

In workplace setting where learning takes place, it is important to establish an environment that supports and encourages learning. Encouragement might stem from workplace communities whose key feature is to support learning in the workplace. Examples are: mentoring networks where more experienced employees counsel their junior colleagues or on-the-job training (OJT) activities where employees learn-by-doing. These may be formalized in apprenticeship schemes lasting for lengthy periods of time at the end of which the

apprentice is entitled to become a member of recognized professional body of skilled workers. More informally, employees might agree to meet socially to discuss new ways of working (perhaps in relation to a newly introduced product or process that needs to be learned). Most important is to create a recognizable culture where learning is seen as a natural component of workplace activity.

In workplace learning a critical success factor is the behavior of employer and employees towards each other. From the employer's perspective, establishing reward

and remuneration systems is a key component in recognizing and celebrating successful learning. From the perspective of the organization, the integration of learning with work tasks (such as new job design, innovative processes, strategic direction) is beneficial in creating motivation for learning. Focused motivations aid learning by providing a purpose for the learning. Learning with a purpose tends to be more successful than purposeless learning. Figure 4 shows the relationship of environmental factors to the learner and learning.

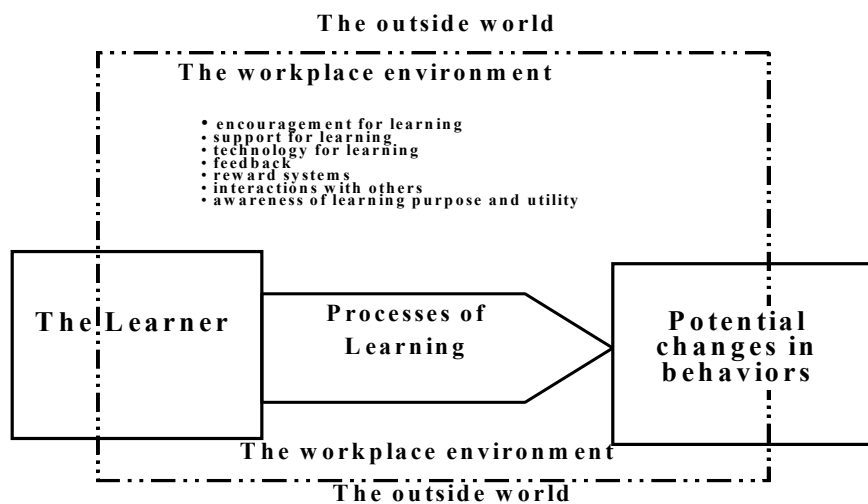


Figure 4: Environmental Factors Influence Learning

DESIGN OF LEARNING IN ORGANIZATIONS

Learning design relates to the issues that ensure that workplace learning is optimized for the circumstances of the organization. Important issues include: identification of learning needs, ensuring that these needs match organizational requirements, support and encouragement for the learning to take place, choice of technology to deliver the learning, feedback mechanisms on the effectiveness of the learning and reward

systems for acknowledging and celebrating learning success. An important factor in the environment is the learner's awareness of the purpose for the learning and the utility of this learning to the organization through improved workplace practices.

Issues which affect the learner include: prior learning experiences, expectations from the current learning, motivations (both personal and professional), preferred learning styles and time available to engage in the learning activity. Motivation (both extrinsic and intrinsic) plays an important

role. Extrinsic motivation includes encouragement for the learning through awards, bonuses and promotions. Intrinsic motivation encompasses personal ambition, pride and an interest in self-development. These different types of motivation can combine to produce a positive learning environment.

The learning interface is where the learning content and methodology is delivered to the learner. This includes resources that facilitate the learning, learning content, the intended process through which the learner gains access to the learning content, processes to monitor learning progress, some means of assessment, feedback mechanisms, and expected learning outcomes.

OPPORTUNITIES FROM TECHNOLOGY

The need to develop new competencies in the workforce presents significant challenges and opportunities for the organization and its employees. For any organization, the introduction of new technologies is a linchpin for both technological change and for organizational-wide process development and change (Tyre and Orlikowski, 1993; Hope and Hope, 1997). This is particularly so with the emergence of technologies that aid and abet an organization's activities; a phenomenon that some authors refer to as "a paradigm shift" (Tapscott and Caston, 1993). Introducing technologies into organizational processes requires organizations (and their members) to "change paradigms" about how they work and behave (Clarke and Clegg, 1998).

Rapid developments in IT create an urgent need for organizations to develop new skills, competencies and knowledge (Ivergård and Berns, 2000, Paulsson et al, 2004). The three elements of IT: as a driver of organizational transformation, the role of IT as an enabler to deliver that

transformation, and the needs of the organization for new skills and competencies. These strands inform our model of learning at work.

For many organizations, a critical issue is not in keeping up to date with the development of technology *per se*, but in developing competencies to enable the organization to gain full advantage of the technology. The full potential of technology will only be realized if the organization succeeds in adopting new business processes and working routines into the organization as new ways of doing things (McKenney, 1995; Clarke and Clegg, 1998). Thus it becomes critical for organizations to develop new competencies in employees who use the new technology in their work. This includes learning the skills needed to utilize new technologies in the workplace (Edmondson et al, 2003). Technology is thus a key driver for workplace learning as employees need to develop skills for managing and operating newly adopted technology (Pisano, 1994). Learning the skills to perform using the new technology is critical if the technology is to be used from optimum benefit. As a complement, the new technology in itself has to be adapted to the existing competence and knowledge infrastructure of the organization. The importance of this symbiotic relationship between technology and people in organizations is discussed by Ivergård, 2000.

THE ROLE OF LEARNING TECHNOLOGIES

Technology is normally not an aim in itself but provides a means to achieve other aims, e.g. improve efficiency of learning or to reduce cost of leaning. Inherent in leaning at work are many possibilities of integrating learning technologies as a part of the control system of industrial and administrative processes. As such, technology has been a key driver for learning at work (Pisano,

1994; Edmonson et al, 2003). Technology can provide motivation for learning if employees are rewarded for improved or increased output once they master the new technology for their work tasks. Artificial Intelligence (AI) has a new and potentially very fruitful area of application. However, it is obvious that eLearning and other forms of learning technologies can never – or at least very rarely – ‘stand alone’ for learning process. Rather, these technologies have to be combined with other methods to create a complete process of learning.

GUIDELINES FOR DESIGN FOR USABILITY OF ELEARNING

At the end of the 1990s the European Commission (EC) financed a large project about a human approach to eLearning. The aim of the project was to clarify the issues and resolve the problems surrounding the imbalance between the demand for, and supply of, skills and competences in the present fast-changing business and industrial environment. Such an imbalance is characterized by significant segments of the workforce becoming unemployed and then unemployable. This is clearly a highly undesirable state of affairs with disastrous consequences for a country’s economy. The work was carried out as a cooperation between the National Institute of Working

life and the Swedish Labour Market Administration and a number of papers partly based on this project is being published in a special issue of *Applied Ergonomics* (forthcoming, 2004).

To conclude the EC project, an international workshop was held in Östersund in northern Sweden – “Worklife 2000 Workshop about Balanced Information Technology in a Fast Changing Industrial Environment and Labour Market.” In the course of the workshop a proposal for a Policy Statement about E-learning for Europe was developed. Later this proposal was presented at an EU conference in Malmö in the south of Sweden and also published (Kirk and Ivergård, 2001). (Appendix 1 contains an abstract of the EU policy statement).

As a final Comment it was stated, “The EU, National Governments and business and industry must take a proactive role in remedying the imbalance between technology and people. People must come first, technology second. This enterprise will founder unless two conditions are met. First of all an environment must be created in which people take precedence over technology. Secondly, funding must be provided, particularly by the EU, so that technology which matches the needs, expectations and aspirations of its users is developed.”

APPENDIX 1

An abstract of the EU policy statement:

(i) However, technology continues and will continue to develop at an increasing speed, funded by business and governments. The EU is a facilitator of this process. Research and promotion of human and social factors, in the broadest sense, needs to be given greatly increased support so that the application needs of technology can not only be met, but anticipated. Otherwise human and social factors will always lag behind and technological systems will be as deficient as they now are, if not more so. Business, industry, national governments and the EU have to take a proactive role in facilitating the process of adapting technology and the new economy to the real needs and demands of society and individual people (irrespective of age, social and ethnic background, gender, race and disabilities). Lack of this adaptation of technology may produce a volatile response in the economy.

(ii) Rapid technological change, even with the best HF in terms of research, development and application, requires new competences if Europe is to maintain and to improve its competitiveness in business and industry on the world market. Old competences become rapidly out-of-date. The continual and continuous need for the updating of competences and skills in the EU labour market should involve the workforce in a corresponding continual and continuous process of learning. It will be a major and difficult challenge to match the fast change in demand for new competences and skills and to avoid the severe 'bottlenecks' and unemployment which skills shortages produce. New approaches are needed to facilitate effective and accelerated learning among those in the labour market whose skills are no longer relevant. E-learning is a

strong contender with great potential as it could easily be integrated in the technology of the new economy.

(iii) Development of e-learning and leadership are key factors for success in the era of the new economy. Studies have shown that many current applications of e-learning at work and among the unemployed are highly inefficient¹. However, many possibilities for the development and application of e-learning were presented at the workshop. The following recommendation were made:

1. Systematic methods for instructional design have to be applied in all areas of industry and business.

2. Cost-benefit studies have to be carried out to balance workload, stress, and ill-health, on the one hand, and good learning outcomes, and productivity, on the other.

3. E-learning has to attract and excite its users, and not to repel them.

4. From the users' point of view the emphasis of e-learning should be on its content and not on the mechanisms of delivery.

5. E-learning should only be used for tasks and in environments for which it is most suited.

6. The individuals' 'mind set' in learning must be consonant with the culture and vision of the businesses and the companies in which they work.

7. Empower the learner.

¹ Prof. Leela Damodaran of Husat, UK and Dr Paul Mulholland of OU, UK presented examples from industry (less than 10% efficiency in one example). Dr Toni Ivergard of PASS AB in Sweden presented examples from new developments of labour market training (the placement in job following labour market training increased from 20% to 70%).

8. Learning can only take place if there is time and space for reflection and the context is right².

9. E-learning has to fit many different styles of learning.

10. Basic capacities have to be developed in people – learning to learn, to think and to reflect, to communicate and to relate, and to be well and feel well³.

11. To optimise e-learning in smaller organisations, virtual networks of learning should be created between micro- and mini-sized companies.

12. Top management should internalise the concept of learning at work and actively promote the conditions for its successful implementation.

(iv) Despite the promise of e-learning it needs to be evaluated in different contexts to ensure that it really does enhance the learning process.

(v) It is a mistake to believe that e-learning by itself can deliver the goods. Inevitably some face-to-face human support is likely to be required.

² On the job learning increase the closeness to the real context.

³ Prof. Prasad Kaipa, of US and India, pointed to the importance of identifying important core and meta skills and knowledge that could act as building blocks. Combined with values, a foundation for alternative learning strategies could be created.

References

- Argyris, C. (1996) and Schön, D. A. *Organizational Learning II: Theory, Method and Practice*, Addison-Wesley Publishing
- Argyris, C. (1977) "Double Loop Learning in Organizations, *Harvard Business Review*, September-October Vol 55, No 5, pp 115-125
- Argyris, C. (1992) *On Organizational Learning*, Blackwell Business
- Baumard, P. (1999) *Tacit Knowledge in Organizations*, Sage Publications
- Berger, P. and Luckman, T. (1991) *The Social Construction of Reality: A Treatise in the Sociology of Knowledge*, Penguin Books.
- Bood, R.P. (1998) "Charting Organizational Learning: A Comparison of Multiple Mapping Techniques" (in *Managerial and Organizational Cognition: Theory, Methods and Research* Eden, C. and Spender, J. -C. (eds) Sage Publications
- Clarke, T., and Clegg, S. (1998) *Changing Paradigms: The transformation of management knowledge in the 21st century*. Harper Collins Business
- Crossan, M. M., Lane, H. W., White, R. E. & Djurfeldt, L. (1995) "Organizational Learning: Dimensions for a Theory", *The International Journal of Organizational Analysis*, Vol 3, No 4, 337-360
- Crossan, M. M., Lane, H. W. and White, R. E. (1999) "An Organizational Learning Framework: From Intuition to Institution", *Academy of Management Review*, 24, 3, 522-537
- Edmondson, A., Winslow, A. Bohmer, R., and Pisano, G. (2003) "Learning How and Learning What: Effects of Tacit and Codified Knowledge on Performance Improvement Following Technology Adoption", *Decision Sciences*, 34, 2, Spring, 197-223
- Ellstrom, Per-Erik, (2001) "Integrating Learning and Work: Problems and Prospects", *Human Resource Development Quarterly*, 12, 4, 421-436
- Fiol, C. M. and Lyles, M. A. (1985) "Organizational Learning", *Academy of Management Review*, 10 (4), pp 803-813
- Hope, J., and Hope, T (1997) *Competing in the Third Wave: The Ten Key Management Issues of the Information Age*, Harvard Business School Press
- Huber, G. (1991) "Organizational Learning: the contribution process and the literature" *Organizational Science*, 2 (1): 88-115
- Ivergard, T. and Berns, T. (2000), Special Issue: "Information Technology and Learning", *Behaviour & Information Technology*, 19, 3 May – June
- Ivergård, T. (2000), "An Ergonomics Approach for Work in the Next Millennium in an IT world", *Behaviour & Information Technology*, 19, 2 May – June.
- Kolb, D. A. (1984) *Experimental Learning: Experience as the Source of Learning and Development*, Prentice-Hall.
- Kirk, N.S. and Ivergard, T.B.K. (2001), Internal report (in Swedish), National Institute for Working Life, Ostersund.
- Lam, Alice (2000) "Tacit Knowledge, Organizational Learning and Societal Institutions: an integrated framework", *Organizational Studies*, May, 21, 3, 487-514
- Leonard, D., and Sensiper, S.(1998) "The Role of Tacit Knowledge in Group Innovation" *California Management Review*, Vol 40, No 3, Spring, 112-132
- Leonard-Barton, D. (1995) *Wellsprings of Knowledge*, Harvard Business School Press
- McKenney, J. (1995) *Waves of Change: Business Evolution through Information Technology*, Harvard Business School Press
- Nonaka (1991) "The Knowledge-Creating Company", *Harvard Business Review*, November-December, pp 96-104
- Nonaka, I. (1994) "A Dynamic Theory of Organizational Knowledge Creation",

- Organizational Science*, Vol 5, No 1 February pp 14-37
- Nonaka, I., and Takeuchi, H. (1995) *The Knowledge-Creating Company*, Oxford University Press
- Nonaka, I. (1999) The Dynamics of Knowledge Creation in Ruggles, D. and D. Holtshouse *The Knowledge Advantage* Capstone US Business Books
- Nonaka, I., Umemoto, K., and Sasaki, K. (1998) Three Tales of Knowledge-Creating Companies in Von Krogh, G., Roos, J. & Kleine, D. *Knowing in Firms*, Sage Publications
- Nonaka, I., and Nishiguchi, T. (2001) *Knowledge Emergence*, Oxford University Press
- Paulsson, K., Ivergard, T., and Hunt, B. N. (2004) "Learning at Work: Balancing Competence and Stress", forthcoming in Special Issue *Learning at Work* of *Applied Ergonomics*, Summer.
- Pear, J. J. (2001) *The Science of Learning*, Psychology Press, 2001.
- Pisano, G (1994) "Knowledge, Integration, and the Locus of Learning: An Empirical Analysis of Process Development", *Strategic Management Journal*, 15, Winter, 85-100
- Polanyi, M. (1966) *The Tacit Dimension* Peter Smith (reprinted 1983 by Doubleday & Co.) partly reproduced in Prusak, L. (1977) *Knowledge in Organizations* Butterworth-Heinemann pp135-146
- Raelin, J. A. (1997) A Model of Work-Based Learning, *Organizational Science*, 8, 6, 563-578.
- Rowden, R. W. (2001) "The Learning Organization and Strategic Change", *SAM Advanced Management Journal*, 66, 3, Summer
- Schön, D (1982) *The Reflective Practitioner: How Professionals Think in Action*, Basic Books Inc.
- Takeuchi, H., and Nonaka, I. (2004) *Hitotsubashi on Knowledge Management*, John Wiley and Sons (Asia) Pte.
- Tapscott, D., and Caston, A. (1993) *Paradigm Shift: The New Promise of IT*, McGraw-Hill
- Tyre, M. J., and Orlikowski, W. J. (1993) "Exploiting Opportunities for Technological Improvement in Organizations", *Sloan Management Review*, Fall, pp. 13-26
- Von Krogh, G., Roos, J., and Kleine, D. (1998) *Knowing in Firms* Sage Publications
- Von Krogh, G., Ichijo, K. and Nonaka, I (2000) *Enabling Knowledge Creation* Oxford University Press
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