THE LABOUR PROCESS: LEARNING, WORK & PRODUCTIVITY[1]

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Abstract

A concept is proposed of the nature, content and functioning of the labour process as the purposive application of personal cognitive abilities to solving problems. Work and learning are united in a dynamic symbiosis of thought and action. During the experience of productive activity and collaboration, each worker's cognitive abilities are endogenously reformulated, and the utilisation of those abilities during work progressively modifies the content of a job, improves each worker's performance, and increases productivity.

The chief implication for theory and research is that human capital is reconceived as a reserve of unique cognitive knowledge and abilities, which is continuously reconstituted during the labour process and cannot be fully observed. The foundation of effective productivity and socio-economic development is the unlimited human ability to modify, reorganise and extend cognition. This perspective contrasts with theories of exogenously formed human capital, and controverts the logic of calculations that assume causality between formal education (indicated by attainment) and personal productivity (indicated by wages). Our understanding of individual variability in the labour process and work-related learning would be enriched by more fine-grained individual case studies.

This concept of the labour process also challenges the pervasive assumption that the growth of productivity in a 'knowledge economy' is determined by the amount of investment in formal education and training. In the perspective proposed here, the alternative priority that requires serious consideration is to improve conditions for the sustained development and utilisation of human abilities in production by stabilising employment, improving job design, and recognising competence acquired by practical experience.

[1] Quotations from the SSHRC-funded Education-Job Requirements Matching (EJRM) Study case studies in progress were provided by Meredith Lordan, Sandria Officer, Marion Radsma, Johanna Weststar and Olivia Wilson.

I Perspective

World wide interest in work and learning is generating a large volume of disparate disconnected studies which can help improve our understanding of them as separate domains, but which lack an overall perspective. The research programme on Lifelong Learning and Work of the Centre for Studies in Education and Work (see www.wallnetwork.ca) is an opportunity to devise a conceptual framework for relating work and learning as a foundation for in-depth research and better-conceived policies.

The internal content of the labour process has been obscured in several ways. First, the labour process debate since Marx has stereotypically addressed issues of the labour theory of value, the ownership of labour capacity and how the benefits of work should be distributed between owners of labour and capital. Polemical debate diverts attention from the internal content of the labour process and its role as the ultimate source of both current production and the capacity for continued development of social and cultural institutions, customs and conventional practices, recorded knowledge, technology and fixed assets.

Second, with few exceptions[2], a sequential temporal relationship is assumed between learning and work: individual ability to work and total employment are assumed to depend on prior education. As a result, work and learning are separated in theories of work and education, administratively among governmental departments and within enterprises, functionally between schooling and employment, and in private and public policies for education and training.

Third, the predominance of macro and meso-social levels of analysis in occupational data and in research entails grossly simplifying assumptions about both work and learning. Quantitative studies of education and employment that stereotypically measure associations among grouped data treat dispersions about averages as standard 'errors' and so ignore the intrinsic interest of the entire ranges of behaviours in work and learning. The question 'Where have the workers gone? (Simpson 1989) has still to be answered by sociologists. Whilst most economists have accepted the concept of learning as a joint product with output (Rosen 1972), the nature and significance of individual behaviour in employment has still to be explained.

In research and policies alike, attention focuses heavily on issues external to the performance of work, such as the effects of hegemonic control on alienation and 'deskilling' (e.g. Braverman 1974), to the neglect of what actually happens after entering an employment contract. Internal labour market theories (Doeringer & Piore 1971) give more attention to hiring and promotion administration than to how work is done in each job.

Abstract discussions fail to recognise work and learning as two main characteristics of human nature and behaviour, common to all kinds of workers. To help close the gap in our

[2] Recurrent education is a temporal reorganisation of formal learning opportunities, which recognises that a right to formal education can be earned by working for the community.

understanding of how work and learning are interrelated within the labour process, a broad synthesis is constructed from familiar concepts in the philosophy of knowledge, individual and social psychology, psycholinguistic theory, empirical data about trends in labour costs and output, evidence from case studies of learning during work, and research in the neurological sciences.

II The nature & content of the labour process

Problem solving

The labour process is problem solving. A contract of employment is 'open' because what is to be done and how it is to be done cannot be fully specified by an employer. 'Katie' in information technology says her first task was:

> 'Just finding out what this job is. I had lots of questions because I was completely new to it. So you just kind of ask the guy in the office next door and he does some informal mentoring.' (EJRM study)

The external conditions under which a job will be done are unpredictable, especially in a market economy. The preferences of consumers and suppliers, markets, technological innovations and natural hazards, are all subject to change, either orderly or capricious. Assumptions have to be made about what competing producers will do. Because it is impossible to anticipate all contingencies and to specify in full what is to be done and how in the execution of a job, what a worker exchanges for pay is not a given output but labour power (Marx 1865; Garnier 1984), i.e. potential not actual performance. When a worker and an employer enter into a contract, neither can know what the outcome will be in terms of quantity or quality of production.

Given that lack of contractual specifiability, the essence of the labour process is problem solving in a state of partial ignorance and uncertainty. The term problem solving conveniently embraces a sequence of tasks: to identify problems, consider alternative possible solutions and the implications of each, to make decisions, to take action to implement them, and to monitor the results. The last stage relaunches the cycle. Work of any kind is purposive thinking for action towards a goal (Dewey 1910), which entails further thought when the results of action are perceived.

After entry into a contract, actual performance is governed by how employer and employee conceive and engage in problem solving. The employer seeks to maximise or optimise the effort of each employee by combinations of incentives, but cannot know what attributes each person brings to a job. Hiring by credential is an apparently low-cost procedure that assumes that a worker has technical knowledge and abilities, or the potential to acquire them, but uncertainty remains about how or how well a worker will perform, or will learn. Moreover, since job market turbulence can be high, and frequently alter the composition of a workforce, an employer is hard put to know the total set of human abilities available. Each employee determines at least some

part of what is done, and how, and sets the pace and quality of output, and applies a personal judgment that varies among workers, but cannot know how well an employer will manage production. Employers and employees alike make decisions; even those workers described as low skilled, or in low paid jobs, who often know more about the *minutiae* of production than managers. 'Ruth', a quality control supervisor in an automotive assembly plant, observes:

> '… the employees are the actual experts because they do their job day in and day out. They know what to expect and what could happen at any time.' (EJRM study)

They share the function of management. Neither knows fully what the other will do, nor the outcome.

Although these considerations apply at all levels of paid work, and to workers at all levels of formal educational attainment, the cognitive content of work is obscured by hegemonic employment structures in which hierarchies reflect social status rather than cognitive processes.

Within an organisational structure and a division of labour, paid work takes place in a set of relationships among colleagues, and between an employee and his or her employer, supervisor and peers. But the appropriate concepts to bring the whole person into research and policy in a manageable way are still lacking. Problem solving during work can be satisfactorily understood only by taking account of the personal attributes that are critical in human behaviour.

Work and learning in human nature

Work is action to satisfy human wants, which in the long run are insatiable, either by doing directly what one wants oneself, or indirectly by exchanging labour for pay. From satisfying primary needs for security, food, clothing and shelter, the self-interest that motivates work matures into aesthetic and cultural desires and enlightened self-interest to help others. As work entails problem solving at all stages, all forms of paid and unpaid work have a common characteristic. 'All life is problem solving' (Popper 1972). All actions entail thinking to perceive needs and desires, establish goals and decide when they have been realised. 'Ethan', an electrician maintaining automotive plant, describes his work:

> 'Troubleshooting - you get a call on a particular machine, go up there, talk to the tool setter, the operator, see if you can work these things out. It could be as simple as an operator error, or a dirty switch, something out of focus. It could be a number of really simple things or something extremely complicated that could take days to figure out with engineering support. The first thing that you do is find out what the problem is, they tell you what they think it is, I take that with a grain of salt, do my own little thing to try to figure it out and then think of solutions. If I need to go get parts, try this, try that. And then, if it works, we're off. Then it's the next job, then that repeats all the way down the day.' (EJRM study)

The perception of the results of action, and of progress towards realising an objective, means that each time a worker acts[3] experience is different and the perception of that changed experience modifies what is learned. Continuous action generates new and different experience and a continuous reformulation of understanding, whether the margins of learning are great or small.

Consequently, learning is an inherent attribute, intimately connected to action (Hampshire 1960). The capacity for learning is characteristic of human intergenerational evolution (Dorus et al. 2004). Each person perceives what is external to the mind, and makes an appropriate internal adjustment (Lamarck 1809). Darwin's proposition (1859) that what is true of physical organs is also true of mental instincts is the foundation of psychology. Learning capacity also develops intragenerationally. For example, empirical evidence demonstrates that glial cell activity stimulates the formation of new synapses (Fields & Stevens-Graham 2002), and that the experience of a particular type of sustained mental experience can result in morphological changes in part of the brain (Maguire et al. 2000).

Learning by experience is the generic form of learning, and is driven by an inherent predisposition to construct an organised representation of what is perceived. New and often incomplete data are reorganised by interpolation and extrapolation into a representation that has the quality of subjective coherence. The process of learning is provoked by curiosity when incongruities are perceived (Bruner 1966), and a learner seeks to place newly perceived data in relation to a previously formed conceptual representation. From that enduring background understanding, data can be retrieved selectively that are consistent with a particular need. This capacity for coherence, which is one of the least well-understood human attributes, is most evident in the interpretation of visual and auditory data, and in the application of the criteria of consistency and relevance when judging logical reasoning. Recent Canadian surveys of the incidence of informal learning[4] by level of formal educational attainment (Livingstone 2004a) can be interpreted as evidence that the abilities to learn are socially distributed more equally than formal credentials or hierarchical position appear to suggest.

The relationship between work and learning is a symbiosis between action and thought, in two different but related cognitive processes. The predominant form of learning is intuition, of which the learner is often unaware, and which supports habitual action in work and life in general. Intuition is a capacity for immediate apprehending a concept or a complex relationship.[5] Historically, our understanding of learning has developed from ideas of sensory perception (Locke 1690) and sensori-motor control. The human capacity to control muscular activity by electrical and chemical impulses operating in both directions is one common form of the iteration of thought and action. The principles discerned in sensory perception have been extended in the

[3] Decisions to act or to abstain from action are no different in principle (Hampshire 1960).
[4] Average hours of total informal learning and of job-related learning respectively.
[5] It is unnecessary here to enter the philosophical debate about whether this capacity is innate or a consolidation of experience.

concept of the *gestalt* (Wertheimer 1912) to abstract understanding, which can be complex. The significance of the concept of an image or mental representation is that new data acquired by experience is either assimilated into a pre-existing conceptual understanding or that understanding is reorganised to accommodate the data (Piaget 1969). The relationship between intuition and action can be instantaneous. The second form of learning is explicit instruction in formal settings and communication using codified language in serial exposition. Although we are more readily aware of explicit thinking, it is a form that presents many practical problems. The use of rigorous formal logic and scientific methods requires time, which is often constrained, particularly in productive activity. Most people resort to heuristic thinking, and there is some evidence of workers using heuristics to replace the algorithms learned in school, notably Scribner's classic case of packing milk for delivery (1986); but heuristic thinking creates errors and bias (Kahneman & Tversky 1982). Explicit thinking is necessary during work, but not sufficient.

The characteristics of learning by experience during work: summary of propositions

Cognitive processes.

Experience provides a continuous flow of data to be perceived and interpreted, so learning is a process of continuously changing understanding, not an accumulation of knowledge.

Any kind of experience is a source of learning since it is perceived, interpreted, and modifies previous understanding. 'Mike', a teacher with a handicap, chose his profession because he thinks students should be familiar with people with a disability and observe they can be successful (EJRM study in progress). Respondents to a 2005 survey[6] indicated that the kinds of learning that helped them do their paid jobs better were: informal learning other than courses 88%, housework 62%, and general interest learning 62%. Of those doing voluntary work, 88% thought that informal learning other than courses helped them do their voluntary work better. These findings refer to the effects of learning of which respondents were fully aware, and probably exclude the effects of collateral learning.

In the course of learning by experience, both cognitive knowledge and abilities are acquired. The degree of awareness of what is being learned varies from fully conscious awareness of explicit thought in formal instruction, through partial awareness, to a total absence of conscious awareness when collateral learning (Dewey 1916) takes place. The acquisition of abilities can easily pass unnoticed. 'Michael', a manual worker in automotive assembly, says:

> 'Every once in a while you get a surprise and it just amazes you, you know, how did you do that …' (EJRM study).

[6] Education-Jobs Matching Survey, CSEW, OISE/UT 2005, n = 1,709.

Through both intuition and explicit thinking, perceived data that is often incomplete is organised by interpolation and extrapolation into complex mental representations that have the quality of coherence. Examples of evidence of this predisposition to coherent representation are in recent research on visual perception (Shiffrar et al. 1995) and on aural processes (Karmarker and. Buonomano, 2003).

Humans possess cognitive control of the acquisition of knowledge and abilities. Intuitive thinking and habitual action in selected domains and on selected matters can be altered by deliberate decision; whilst sustained thinking explicitly using theoretical principles can become intuitive and habitual. There is no reason to suppose that the balance between intuition and deliberate reasoning is constant, since experience varies and there is no absolute constraint on freedom of choice.

As learning is a continuous modification of knowledge, what is known is necessarily incomplete or incorrect, and action is correspondingly imperfect. But the perception of error is a source of learning that progressively modifies knowledge and can be used to adjust action.

The stock of cognitive knowledge and abilities

The continuous reformulation of understanding during learning creates a reserve of cognitive knowledge and abilities, which is vast (Polanyi 1958) and is incessantly modified.

This reserve of knowledge and abilities[7] cannot be fully known since much of it is formed by collateral learning. The respective influences of direct and collateral learning on the formation of this reserve are also unknown. 'George', an archivist's assistant, comments:

> '... some of the stuff is, like, useless information, but then you never know when it comes into play' (EJRM study).

They are likely to be a function of individual experience, and of how cognitive control is exercised.

As learning is imperfect, the stock of knowledge and abilities acquired is correspondingly less than perfect but continuously improved. Since individual experience and perception are unique, workers are idiosyncratic and acquire heterogeneous cognitive knowledge and abilities. Consequently groups of workers form distinctive stocks of shared working knowledge and abilities. For these reasons, neither the labour force, nor everyone with a given level of educational or credential, can be assumed to be homogenous.

[7] Polanyi's term 'tacit knowledge' should be extended to include abilities.

The utilisation of cognitive knowledge and abilities in work

From each person's cognitive reserve, knowledge and or abilities are retrieved selectively. A sub-set can be retrieved that is relevant to the performance of a given task, and is more or less coherent. A worker is not necessarily aware of the process of retrieval or of what is retrieved. Examples are the ability to discriminate among types of sound, or types of knowledge. A young operator in a steel rolling mill says:

> 'Reading the tolerances in molten steel is *all* eyeball because we burn wood against it, it makes an impression, and each mark on the impression dictates what you need to do. That was the hardest part about the job, learning how to read that wood … But that's the learning process figuring out what the steel is doing, or what grade, or what your tolerances are, and how it reacts with different types of wood … The guy who trained me told me that *sound* would save my life there one day. … I hear things now that I shouldn't hear… That Mill, when it changes speed, I know. I know where it changed speed, if the bar is loose somewhere I can hear it, if it breaks out somewhere – the sound plays that much of a role.'[8]

Knowledge and abilities not relevant to a current task remain available, but are not utilised until another type of problem is encountered, and might never be utilised. Labour power is a reserve that is always underutilised, in the sense that the whole is not called into use at one moment.

The result of that selective retrieval of the cognitive knowledge and abilities relevant to a given problem, and their combination into a coherent representation and coordinated performance, constitutes competence. Competence is dynamic, not static, since the use of the abilities selected constitutes a change of experience that modifies them. Competence, or 'skill',[9] is this ability to select and combine a set of cognitive attributes into the performance of a task (Polanyi 1958), and can neither be represented by a single attribute such as literacy, numeracy or some component of them, nor by such attributes as assiduity or dexterity (Pankhurst 2005). The problems encountered in work can have more than one solution, and at times are even insoluble. What is learned by this kind of experience is complementary to and significantly different from the simulated problems of formal instruction. Heuristic thinking might be conceptually inferior to scientific rigor, but is a *sine qua non* in forming competence.

The use of what is learned creates economies of time. Complex operations which deliberately separate thought and action temporally are planned to economise time overall. Empirical comparisons of how experts and novices perform (e.g. Glaser 1985; Sternberg 2000)

[8] Livingstone interview with rolling mill operator, local steel mill, Toronto area, May 2004.

[9] Polanyi used the term 'skill', but this word lacks agreed definition, and is used ambiguously to refer either to a particular attribute or to a level of education.

demonstrate that recourse to theory, compared with crude pragmatism, takes longer in the earlier stages of problem solving, but results in a better solution in less overall time. Similarly, intuition created by collateral learning and integrated into a hidden reserve of abilities is the foundation of habitual, apparently automatic action. Moreover, recourse to theoretical principles becomes habitual.

The ability to control cognition is the foundation of competence and personal productivity. A large *corpus* of estimates of cost-output functions (e.g. Solow 1997) demonstrates progressive economies of labour at more or less steady rates (Appendix 1). Whilst these studies pose awkward epistemological problems, they are presumed to be evidence that learning is endogenous in productive activity (Arrow 1962; Rosen 1972), and are significant in demonstrating that formal education is not the sole source of productivity. Instead, the foundations of productivity growth lie in the ways that workers continuously learn by becoming familiar with their work tasks and with each other, and apply what they have learned.

III Some implications for research & policy

The persistent dilemma of reconciling macro-social and micro-social variables in research and policy is largely due to the variability in human behaviour, which makes generalisation difficult. The central importance of what individual and groups of workers do and how they learn in the course of production has yet to be brought into research and policies. Some progress towards generalisation from micro-social observations can be constructed as a symbiosis of the two variables: thought and action, which respects the principle of parsimony. Thought and action are the obverse and reverse of the same phenomenon. Both are constituents of paid and unpaid work, of work and learning, of intuition and habit, and of behaviour by all kinds of worker at all levels of work. Whilst this discussion has not ventured into all aspects of personality, including such attributes as emotion, it is likely that the symbiosis of thought and action have a potential to be extended to them, and accommodate variability in behaviour, including error, emotions, attitudes and dysfunctional behaviours.

A focus of attention on the symbiosis of thought and action restores interest in the nature and content of the labour process and its essential role in production and socio-economic development. The potential for unlimited cognitive development, which makes learning endogenous in human behaviour, is the foundation of continuous improvement in personal performance and aggregate productivity. Differences among idiosyncratic individual workers are a matter of empirical observation, not a fundamental issue. Time is the prime constraint on the efficiency of problem solving during work.

Research

In research it is time to move on from abstract and static concepts of human capital and productivity. The chief implication for theory and research is that human capital is reconceived as a reserve of unique cognitive knowledge and abilities, which is continuously reformulated

endogenously during the labour process and cannot be fully observed. The foundation of productivity is the unlimited human ability to modify, reorganise and extend cognition, both consciously and intuitively. That contrasts with theories of human capital formed exogenously by instruction. It also controverts the assumption of causality between formal education and productivity, and the validity and relevance to production of quantitative calculations of the relationship between vicarious indicators of education, such as level of formal attainment or duration of study, and proxy variables of personal productivity, such as wages. Static measures of years, level, or credential are not relevant to learning, and a poor guide to a potential to learn. Such calculations pass in silence over the variability in data and occlude our understanding of individual variations in cognitive knowledge and abilities and their progress. Our understanding of the labour process would be enriched by more fine-grained case studies of how cognitive processes are progressively formed and used by individual workers and groups in performing their jobs.

Challenges to policy

The simplistic political rhetoric (Industry Canada 2001; Human Resources Development Canada 2002) of the growth of productivity and of a 'knowledge-based economy' determined by the amount of investment in formal education and training is misleading (Livingstone 2004b). A more humane and effective way to achieve a sustained growth of productivity is to improve the utilisation of human capital by changes of emphasis in public policy and enterprise management. The aim to bring work and workers to the centre of policy can be a more direct way to raise productivity than the current macroeconomic focus on education and monetary policies. Whilst expenditure on formal education is *eminently justifiable as a human right* and could be distributed more equitably, it is a 'blunt instrument' for raising productivity and growth, and ignores the formation and utilisation of cognition during the labour process. The objective of monetary policies to contain inflation is also a blunt instrument that affects employment rates indirectly. Human capital built up by experience is wasted when employment is reduced and such capital is strained when employment is allowed to recover. Periods of unemployment are a gross underutilisation of current resources and a diminution of opportunities for human capital to grow. A shift of economic objectives to stabilise employment and continuity of experience would be a move towards more effective long term policy for productivity. Better opportunities to acquire knowledge and abilities by sustained job experience would also be provided in countries like Canada and the United States by legislative reforms to regulate weekly hours of paid work.

Improving the design of jobs to make better use of the unlimited ability for cognitive development that underpins productivity is a challenge to management policies that goes well beyond traditional techniques, such as time and motion studies, and job rotation. Workers often know more about the *minutiae* of production than their managers and supervisors. The task is to recognise that many ostensibly low level workers, with practical experience but no formal credential, already participate unobserved in the function of management, and find effective ways to mobilise their experience and make better use of their acquired judgment (Livingstone

and Sawchuk 2004). The challenge is still to establish parity of esteem and pay between the abilities demonstrated by competence and those sanctioned by formal credential. Prior Learning Acquisition and Recognition (PLAR), which is used predominantly for admission to further education, could be extended to testing and accrediting practical competence demonstrated in performance at work (see www.wallnetwork.ca**)**. To that end, it is necessary to have more empirical research about how abilities are formed during the labour process.

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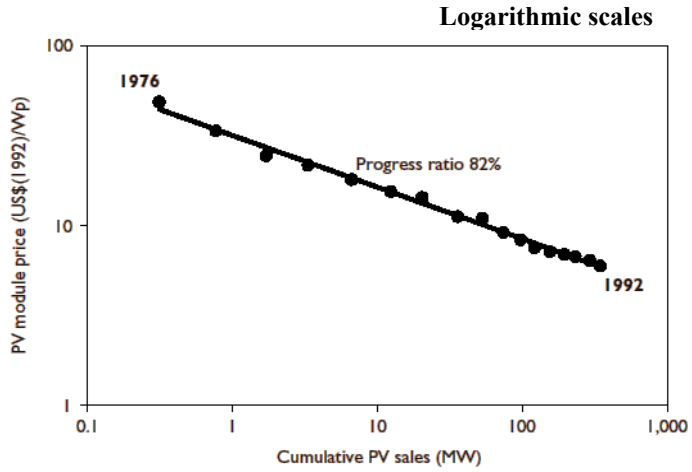
Appendix 1

Cost/output functions

A vast literature of estimates of the relationship between labour costs and output suggests that labour costs decline at a more or less steady logarithmic rate as production increases. The example, Figure 1, can be read to indicate that every time cumulated output is doubled labour costs tend to decline by 18%. These estimates have become commonly known as 'learning' or 'experience' curves. Whilst many show a steady average rate of decline, others are more complex, and like the example all exhibit some variability about a trend.

Figure 1

Experience Curve for Photovoltaic Modules, 1976 t0 1992



Source: OECD/IEA (2000)