

EDUCATION, EMPLOYMENT AND ECONOMIC PERFORMANCE - PART II

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Abstract

Part I reviewed the weaknesses of public education and training policies and programmes for dealing with problems of the economy and the labour market. This Part discusses some of the findings of research about how workers learn. Learning-by-doing during production links education, employment and production methods and is one source of economic progress. The challenge to education and labour market policies is to harness the ability of human beings to think independently, to recognise and resolve problems, and not to instruct workers in specific ways of doing their jobs.

THE PROCESS OF PRODUCTION

Costs

The results of a growing research literature indicate the presence of something in the course of production which has nothing to do with investment or the scale of production. The learning curve proposed in 1936 indicated how the cost of constructing airframes fell as more were made (Wright, 1936). It had been observed that there was a steady proportionate reduction in costs each time that total production doubled. For example, suppose that a firm builds 100 airframes at an average cost of \$100,000. If it goes on to make another 100 frames their average cost would turn out to be, say, 5% lower, i.e. \$95,000. If it then goes on to make another 200 frames their cost would fall by another 5% to \$90,250.

The idea was used during World War II as a practical rule of thumb for planning budgets and labour requirements in aircraft manufacture (Alchian, 1963) and has subsequently been used in production planning in many other industries. It has been extensively tested for more than 50 years in very many studies of different industries and products, e.g. in ship design and construction, railroads and rail transport, oil refining, building construction, textiles, chemicals, aircraft maintenance, power generation, tele-communications.

The 'Horndal' effect described by Ohlin is a reflection of this phenomenon. It had been observed that in the Swedish iron-works at Horndal output per person per hour rose by 2.2 % a year between 1946 and 1957 even though there was no new investment. Part of this increase was attributable to capital intensity and the remainder was a 'pure productivity increase' (Ohlin, 1962).

Whereas Denison (1964) had postulated formal educational attainment as the "hidden factor" in economic growth Kenneth Arrow suggested the hypothesis that productive activity gives rise to problems that have to be solved and that solving them leads to the best solutions, so

knowledge accumulates in a process of learning-by-doing. His reformulation of the findings about progressive cost reductions suggested that learning happens during the process of production and is a factor in technological progress (Arrow, 1962).

Work

Many studies suggest that workers at all levels learn-by-doing from the perception and the interpretation of their work activity. For example, operatives discover techniques for saving time or doing things in better ways; managers discover how to improve financing, purchasing and sales; and engineers improve designs and maintenance procedures. One consequence is that the first entrant to an industry has the opportunity to begin to accumulate a competitive advantage and can progressively improve its market position.

There are several explanations of how learning-by-doing can arise during work. Some French economists have argued that it is because there is a margin of uncertainty in all jobs (e.g. Le Bas and Mercier, 1984). This can lead to error and learning begins when this error is observed. It can trigger a process of thinking what caused it, how to resolve it, taking action to improve things, observing the results, and then if necessary repeating the cycle.

Other research into work suggests that all jobs are a mix of prescription and discretion. Fox argued that all jobs involve decision-making (Fox, 1974). In the hierarchy of jobs the more professional or technical a job the more it is abstract, described in terms of objectives, and the less certain it is how to do it. A worker at this level makes many decisions, and the role of the supervisor is to advise. In contrast, low level jobs are often narrowly defined with the intention to limit mistakes and shirking, the worker makes few decisions and is closely supervised. Thus each worker has some freedom of decision which usually increases with the level of responsibility. Employers who think work can be controlled are often unaware how much discretion workers have in practice (Jacques, 1956).

Work by Glaser on expertise gives a few more insights into the nature of learning-by-doing at all levels of difficulty (Glaser, 1985). He compares how experts and novices go about solving problems. Whereas novices tend to approach a problem pragmatically experts allocate a higher proportion of their time to conceptual thinking and planning and less time to action, take less time overall to solve a problem and reach better solutions. The main reason why experts perform better is because they identify an appropriate theoretical framework which they use to plan how to proceed and as a criterion to monitor progress. Thus they learn something new from each task in a series of tasks and progressively improve their understanding. The acquisition of expertise is high level learning-by-doing about decision-making.

When the knowledge that is discovered through learning-by-doing during production is embodied in the design of capital equipment, routines and patents the structure of the production process becomes ever more "roundabout" and generates continuous changes in the role of human effort in production. Workers become an important source of new practical knowledge but have a diminished role as a store of knowledge.

Learning during work

The process by which doing begets learning has become easier to understand with the emergence of cognitive psychology which has mainly been developed since about the 1970s. The importance of cognitive psychology was slow to be recognised. The ideas of behavioural psychology were deeply entrenched. Early work by Werner and Wertheimer on cognitive psychology in Germany in the 1930s had little effect at the time because much of what happened in Germany in those years was treated with circumspection notwithstanding that these developments in psychology were at variance with propaganda based on behaviourist psychology.

According to this branch of psychology experience is interpreted in the mind of each person according to an individual conceptual framework which is progressively refined (Cartier, 1994). This learning may be conscious and the resulting knowledge explicit (e.g. in many professions) or it may be unconscious and lead to implicit understanding (e.g. in many occupations where manual dexterity is important).

Learning-by-doing is significant because the drive to learn is intrinsic (Bruner, 1966), and cannot be separated from the desire to act. This is a theme which many philosophers and educators have struggled to express, including Descartes (1636); Rousseau (1672), John Locke (1690) and many others including Pestalozzi, Piaget and Gandhi. The drive to learn arises because human beings are innately curious. The drive becomes stronger if people do something well because that helps them become interested in what they are doing and it can be reinforced by learning and working with others.

One of the strongest motivations to learn is to place a person in a problem situation. It changes experience and captures human curiosity and the will to understand. Over the entrance to the Mercedes-Benz apprenticeship school in Germany, one of the great vocational training centres in the world, are the words "Iron educates". The reason why an inert piece of metal, incapable of speech, can do some of the things to which a good teacher aspires is that an apprentice learns by thinking about the problem presented by being given a piece of iron and told to find out how to shape it.

This intrinsic motivation to learn underpins the mobility in the labour market noted in Part I and enables workers to improve the ways they do their jobs. When learning is directed by extrinsic motivation it becomes specific to the current task; but when learning is intrinsic it becomes more generic and more transferable.

Learning-by-doing is especially evident in those kinds of work which develop and use advanced technology. The advancement of science is often a process of learning from practical experience. In the French language, a single word *l'expérience* is used to mean both experience and experiment. In practice, technology often leads scientific knowledge by revealing problems or data which lead towards deeper theoretical understanding. History has many examples of technological progress leading scientific inquiry.

The cognitive ability a worker possesses is not to be confused with the common notion of 'skill' as manual dexterity alone. It is the full set of abilities which enable a worker to deal with

contingencies. It includes affective behavioural attributes as well as subject matter knowledge. One crucial affective quality is a person's ability deliberately to modify his or her own cognitive abilities by explicit study and by practice. The experience of dealing with a problem has two consequences. It shows how to solve that kind of problem. In addition, the experience of solving it strengthens the ability and confidence to solve others, i.e. to learn how to learn, and to discriminate in the use of knowledge for purposive action. The second lesson is at least as important as the first.

Learning-by-doing can happen anywhere and at any time. George Bernard Shaw joked that the only time his education was interrupted was when he was in school. As long ago as 1915 the great educational philosopher John Dewey observed that to tribal people it would seem preposterous to seek out a place where nothing but learning was going on in order that one might learn (Dewey, 1915).

Although Arrow (1962) argued that learning-by-doing can generate advances in knowledge the process is imperfect. The will and the ability to learn and to act accordingly is limited. John Locke held that whilst people have a natural facility to reason, pride is an obstacle to careful thinking (1690). Habermas, the exponent of critical philosophy, asserts that what we have to explain is not why people learn, but why they do not (1976). Bower and Hilgard have summarized the evidence about the resistance to learning. If a person starts with a strong belief in an idea it may not be changed even by overwhelming evidence. There is often a bias towards seeking to confirm an existing idea rather than to examine it properly so that some people come away from massively disconfirming evidence with their faith even stronger than before (Bower and Hilgard, 1981). During learning on the job a worker may not necessarily learn what is technically best but how to manipulate a situation in his or her own interests. It is the constraint of having to reason about production problems in a competitive environment which can tilt the balance of learning towards technical improvement.

Productive activity can give rise to learning-by-doing and to knowledge with wider applications than to specific circumscribed tasks. It is a process which depends on a symbiotic link between two vital traits which define human life, doing and thinking. It is a continuous dynamic process which has the potential progressively to improve human understanding, the quality of work and the performance of the economy.

Education and knowledge

In Mediaeval times knowledge could be transferred from one generation to another by instruction, including apprenticeship. When formal public institutional education began in the 19th Century the same model was adopted because new knowledge was being rapidly consolidated into formally defined subject disciplines, but it was still possible for much of that knowledge to be stored in the minds of people. Now knowledge has been transformed. It is too complex and interrelated to be confined in the traditional concept of subject disciplines which are distinct from each other. It is too vast to be held in the human mind and has to be embodied in equipment, or stored in routines, programmes, technology, patents and trade marks. The effect is

that the acquisition of knowledge has been separated from its use. The growth of the law of intellectual property demonstrates the detachment of knowledge from the user.

The more general and demanding task for modern society is to manage knowledge and use it for politically agreed social ends. It calls for radical changes in thinking about education and work. The cost of attention to specific job preparation in school is to divert attention from the central role of education to help develop the whole person and to think independently. We have to help workers become better sources of knowledge, and not strain them to store it.

Vocational education

One of the main features which distinguishes *homo sapiens* from other hominids is the ability to make tools, whether fire, stone axes, ships or robots, which has the effect of multiplying human physical power. Similarly, the ability to devise advanced tools such as language, mathematics, scientific theories or computer programmes multiplies human intellectual power. Curiously, we have downgraded much vocational education to low level instruction and degraded those who study it. Education is better linked to the operation and management of an advanced economy by endowing people with the ability to use thought in purposive action than by trying to confer specific functional knowledge.

The concept of vocational education as conferring the ability to perform a specific job or task, implies that a worker has to be instructed how to perform it. The fallacy at its heart is to separate learning from subject matter and knowledge from its use. It ignores the learner as a living being who forms ideas by interpreting experience. Dewey commented that training for routine action which is automatic may increase skill to do a particular thing, but it limits rather than widens. Since the environment changes and our way of acting has to be modified, an isolated uniform way of acting becomes disastrous at some critical moment. The vaunted 'skill' turns out gross ineptitude (Dewey, 1916).

The weakness of thinking that vocational education is training for a skill is in describing superficially what a worker appears to do in a specific task or type of job, rather than developing the general cognitive ability composed of a background understanding of materials, process, product, customers, etc. and the ability to use it in a discriminating way. This internal process by which a worker recognises, often so rapidly that it appears intuitive, the characteristics of a situation or problem and adjusts and applies this understanding to the task in hand is identical to the concept of expertise and differs only in degree and esteem. Recognising this is the first step to revaluing manual work.

Employment and education

Keeping children in school and out of the workplace has been a major social achievement. It has become the standard model for schooling to precede employment and the model has been extended to a belief that education confers access to employment by endowing people with the substantive and personal qualities needed to work.

This sequence can be inverted. Employment can and often does precede education, and there are many initiatives which put doing before thinking. Three of them can be cited.

Adults in the labour force

One example is recurrent or continuing education which is often presented as a means of retraining adults to keep up with the changing technological demands of the economy. This can be turned round. Public policies can allow people with a history of employment but who had no opportunities for education when they were young to be given access to adult education if it is recognised that they have made a contribution to society through their work. In Sweden, for example, anyone who has worked for 5 years (whether paid work or work in the home) has the right to enter university, and to be given help to meet admission requirements. Although many adults enroll in further education there is an even greater invisible process of learning going on among the majority of those workers who are not formally enrolled in further education. People cannot be stopped from thinking, but their ability to think can be harnessed. Adults who have had the opportunity to learn from their experience of work and who are given the chance to return to formal studies may be a valuable source of pragmatic ideas for transforming the curriculum as a complement to curriculum reform designed in abstracto.

If learning-by-doing is as vital as has been suggested adults employed in productive activity need to be supported in their learning. The findings about the attributes of labour suggest that the task of management is be misconceived if it is thought of as one of hiring, training and supervising labour to carry out only specific, predetermined tasks. Cognitive abilities are active, creative and dynamic. They are underutilised if they are merely employed in producing current output.

The learning that goes on while deciding how to do something is at the root of a process by which productivity is generated endogenously. The ability to develop generic knowledge and apply it to different tasks is a quality which enables a worker to be mobile among jobs and employers and also to modify the task in hand.

Intrinsic motivation is more important than extrinsic inducement. If workers are to learn more effectively during their work they need scope to exercise discretion. Management techniques frequently embody the assumption that workers have to be closely controlled or given extrinsic inducements to work. This is true of even the most enlightened such as those derived from the famous "Hawthorne" experiments which aimed to instill greater self-esteem in workers. A manager who instructs a worker precisely how to carry out a task deprives him or her of initiative and of the opportunity to learn and ultimately deprives the enterprise and the economy of an important means of progress. Enlightened managerial techniques which allow workers the liberty to identify and resolve production problems are essential to economic performance. Management can facilitate the ability to innovate in many ways but one important example is adopting a more "flat" organisation instead of the traditional hierarchy of command. In these kinds of structures the role of the supervisor becomes that of an adviser who helps workers resolve problems. It is the analogue of the role of a good teacher in school.

Work experience in school

The second example of doing preceding learning is during education at school. It has become a fashion for students to be offered a range of opportunities usually known under the generic term "work experience" to visit business enterprises to see what is going on. It is useful to give students some idea of the world of work in which they may spend about the next 40 years: roughly three times as many years as in school. Nevertheless there are dangers in giving students a restricted and superficial view of the work-place, the machines, tools, products and services, and leaving them unaware of the single most important feature common to all jobs: problem-solving.

Self-directed learning is central and can be done at all levels. It applies equally to explicit thinking and unconscious behaviour, so that the distinction between academic and vocational studies is based on a false premise. It applies equally to cerebration and manipulation.

Scientific research

The third example is research. The scientific method and the use of knowledge to change things is nothing less than learning-by-doing at a high level of abstraction or difficulty. Learning by the formal methods of scientific research and by ordinary people is the same process: an interaction between the observation of experience and its interpretation by the mind. This procedure is most rigorous in science but it applies to all learning which differs only in degree, not in kind. Einstein, reflecting on his life, expressed the opinion that the whole of science is nothing more than a refinement of everyday thinking (Einstein, 1950).

The translation of this principle into practical action is to be found in links between many colleges and universities and business enterprises. The practice of people in education advising businesses through consulting has become much less important than it once was. Because much advanced learning is happening in the course of technological development during work, many bridges are being built between business enterprises and colleges so that what is learned in production is brought into the curriculum of science and technology studies. In the exchange of ideas between business and tertiary institutions it is often the tertiary institutions which have the more to learn.

CONCLUSION

There is a symbiotic relation between doing and learning which provides a more satisfactory explanation of the relation between education and the economy than can be found in studies which measure their statistical association. Understanding this relation between doing and learning provides a common element among the philosophies of learning, work and production and is potentially a much better way of securing consistency among policies for education, employment and the economy than our attempts to design and manage programmes.

Reinventing education is necessary but not sufficient. The effort that goes into it requires comparable efforts to undertake two parallel tasks. They are to reinvent the labour market by better utilising workers' personal attributes in employment; and to reinvent production by giving workers the opportunities to discover new and better ways of doing things and apply them in improving performance.

In France people speak of the continuum: *savoir, savoir-faire, savoir-être* which means that to know leads to knowing how to do, and knowing how to do leads to knowing who you are. If knowing who you are is one of the central humanistic aims of education, then vocational education should not be a narrow functional exercise for people who are denied the best opportunities in education and employment. The joy of discovery is a vital part of everyone's personal development, of social growth, and of human evolution.

The purpose of this paper has not been to suggest specific policies but to offer some ideas which may be helpful in the tasks of reinventing education, employment and productive activity in The Bahamas.

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