CHAPTER 14

THE CONCEPTUALISATION AND MEASUREMENT OF LEARNING AT WORK

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ABSTRACT

This chapter begins with a consideration of rival conceptions of learning and their relevance or otherwise for understanding learning at work. It is concluded that the most influential conceptualisation of learning, one that has decisively shaped formal education systems, is very problematic when it comes to understanding learning at work. The same difficulties occur for standard approaches to measuring attainment. In fact, it appears that 'attainment' is not a very helpful way of thinking about much workplace learning. The chapter then outlines some of the main features that distinguish learning at work from mainstream formal learning. To illustrate these points, a case history of learning at work in a rapidly changing field is presented. This shows how various contextual factors make learning in the workplace difficult to fit into standard ways of conceptualizing learning. It also points to some factors that can contribute to improving learning at work.

INTRODUCTION

This chapter argues that the most influential conceptualization of learning, one that has decisively shaped formal education systems, is very problematic when it comes to understanding learning and measuring learning at work. In order to develop this argument, the chapter is organized in three main sections: conceptions of learning and

learning at work; measurement of attainment of learning at work; a case history of learning from work.

CONCEPTIONS OF LEARNING AND LEARNING AT WORK

In recent work (Beckett and Hager 2002), two major understandings of learning have been compared and contrasted. The first is called the 'standard paradigm of learning' and the second the 'emerging paradigm of learning'.

The standard paradigm of learning

This paradigm has been very influential. Educational thought has been dominated by a largely unquestioned assumption that the most valuable learning is of one particular kind. Other forms of learning have been evaluated by how well they approximate to this favoured 'standard paradigm of learning'. Major assumptions that characterize the standard paradigm of learning (Beckett and Hager 2002) include, *focus on mind, interiority, and transparency.*

First, with regard to 'focus on mind', the basic image for understanding learning is of an individual human mind steadily being stocked with ideas. The focus of learning as a *process* is on circumstances that favour the acquisition of ideas by minds. The focus of learning as a *product* is on the stock of accumulated ideas that constitute a well-furnished mind, the structure of those ideas, and how various ideas relate to one another. By emphasizing mental learning as the most valuable form of learning, the standard paradigm shows its allegiance to mind/body dualistic understandings of human beings as inherited from classical Greek thought and from Descartes. The effect of elevating

mind over body as the centre of the most valuable kind of learning is to make learning an essentially solitary process, an individualistic even narcissistic process, where the learner becomes a spectator aloof from the world.

Second, an essential 'interiority' is assigned to all mental events and activities. As Toulmin (1999: 56) notes, the standard paradigm of learning assumes that '.... the supposed *interiority* of mental life is an inescapable feature of the natural processes in our brain and central nervous system'. On this view, human sense organs are instruments that can add content to mental life, but are themselves part of the 'outer' world of the body, not of the 'inner' mental world. So the most valuable form of learning is focused on thinking (what minds do), rather than action in the world (what bodies do) (Winch 1998). As well, the contents of minds, such as concepts and propositions, belong in this separate world. Meanings of concepts are established via the activity of individual minds. Concepts in turn are combined in propositions that represent things and states of affairs in the world (Winch 1998). So the individual solitary mind becomes a spectator that is not itself in the world, but is able to represent the world to itself via propositions. Since this mind is in effect in a different, non-physical world, the same is so for the propositions. Thus we get the notion of propositions as timeless universal entities.

Likewise, learning is a change in the contents of an individual mind, i.e. a change in beliefs. Knowledge is viewed as a particular kind of belief, viz. justified true belief. Since belief is a mental state or property, learning is a change of property of a person (mind). So to have acquired particular learning is for the mind to have the right properties. However, properties, like propositions have been regarded as universals, i.e. the same in each instance. Hence the notion of knowledge as universal, true propositions

is linked with the traditional focus of formal education. So much follows from the essential interiority of mental events.

The third key assumption of the standard paradigm of learning is the 'transparency' of learning. As Winch points out: 'It is natural for us to talk about learning as if we recognize that we have both a capacity to learn and a capacity to bring to mind what has been learned' (1998: 19). The capacity 'to bring to mind' trades on the image of the mind as the home of clear and distinct ideas. If we have really learnt well, we will be able to bring the learning to mind. An inability to do so is a clear indicator that learning has been imperfect or unsuccessful. This also implies that for the standard paradigm of learning non-transparent learning is either an aberration or a second rate kind of learning, e.g. tacit knowledge, informal learning, etc.

It follows from the three assumptions in combination that the best learning consists of abstract ideas (concepts or propositions) that are context independent (universal) and transparent to thought. This immediately places such learning in a dichotomous relationship with learning that has very different characteristics such as the learning of skills by apprentices, which is typically concrete (rather than abstract), context dependent (rather than context independent), and somewhat intuitive and tacit (rather than transparent). Learning with these characteristics is thereby consigned to second-rate status.

To summarize, the main implications of the standard paradigm of learning are that:

- the best learning resides in individual minds not bodies;
- the best learning is propositional (true, false, more certain, less certain);

- the best learning can be expressed verbally and written down in books, etc.;
- the acquisition of the best learning alters minds not bodies;
- such learning can be applied via bodies to alter the external world;
- the process and product of learning can be sharply distinguished;
- the best learning is transparent to the mind.

The standard paradigm of learning has strongly influenced academic processes concerning selection of learners, what is learnt, how it is learnt, and how learning is demonstrated. A later theme in this chapter is on assessment/progression methods, and how they clearly show the influence of the standard paradigm, through their emphasis on learning being demonstrated by individuals reproducing verbal or written propositions in appropriate combinations and in response to set questions in examinations and written assignments. Here the main focus is on universal, context free knowledge, with numbers and grading to quantify the amount of learning demonstrated. Of course, the emphasis on assessment of this kind has not been without its critics. These have singled out: its excessive individualism; its devaluation of non-propositional learning; and the focus on intellectual understanding to the neglect of its application.

More broadly, the basic assumptions of the standard paradigm of learning have attracted significant criticisms (Beckett and Hager 2002). Some of the main ones are: first, assuming that the most valuable learning is mental sets up dichotomies and hierarchies that in turn have created intractable problems of their own. An example is the theory/practice account of workplace performance/practice. As long ago as 1949 Ryle pointed out the futility of this view which effectively seeks to reduce practice to theory.

Second, the standard paradigm offers no ‘convincing account of the relationship between “knowledge” as the possession of individuals and “knowledge” as the collective property of communities of ‘knowers”...’ (Toulmin 1999: 54). Likewise the assumption that meaning is established via individual minds creates the problem of accounting for collective knowledge (Toulmin 1999: 55). Third, the assumption that the most valuable learning is transparent has been challenged. For example, Winch (1998) argues that knowledge is largely dispositional in Rylean terms, thereby taking the central focus away from transparent propositions in minds. Likewise, there is the claim, taken up later in this chapter, that abilities or capacities are presupposed by other forms of learning (Passmore 1980, Winch 1998).

Finally, because the notion of ‘judgement’ will be important in later discussion, its role according to the standard paradigm of learning will be considered briefly. The term ‘judgement’ exhibits the so-called act-object ambiguity, denoting either the act of judging that something is true or the object which is judged as true (Honderich 1998). In the act sense, judgements are propositional attitudes, i.e. mental states or acts which have a variety of causes and effects, and vary from person to person and time to time. Judgements are distinguished from the sentences expressing them. In the object sense, judgements are propositions, i.e. abstract objects that are true or false, stand in logical relationships, and are composed of concepts or other judgements.

The standard paradigm of learning has exerted a profound two-fold influence on the perceived place of judgement in education. First, where judgements have figured in educational concerns it has been as intellectual judgements, viewed as true or false propositions. These are very different from so-called practical judgements which are about what to do. Here, the influential sway of the pervasive theory versus practice

dichotomy is apparent. Second, by emphasizing judgement as outcome (object), rather than as process (act), the effect has been to diminish its significance, since education has always concentrated in a major way on true propositions. So overall, judgement has been taken for granted in education. Judgement as it occurs in workplace practice is banished to the category of 'educationally uninteresting'. However, there is another significant view of learning that views judgement somewhat differently.

The emerging paradigm of learning

In contrast with the standards paradigm of learning, learning can be characterized as action in the world. Beckett and Hager (2002) refer to this alternative view as the 'emerging paradigm of learning' because, though a diverse range of critical writings on education can be seen as pointing to this new paradigm, it is still a long way from gaining the wide recognition and support characteristic of an established paradigm. On this view, learning changes both learners and their environment. Since learners are part of that environment, the basic formulation is that the outcome of learning is to change the world in some way. Rather than being simply a change in the properties of the learner (as in the standard paradigm of learning), for the emerging paradigm, the main outcome of learning is the creation of a new set of relations in an environment. This is why learning is inherently contextual, since what it does is to continually alter the context in which it occurs.

There are many writers who can be seen to be contributors to the emerging paradigm of learning. Beckett and Hager (2002) devote particular discussion to Dewey's contribution.

Dewey was a noted critic of dualisms, such as the mind/body dualism, and of spectator theories of knowledge. For Dewey, learning and knowledge were closely linked to

successful action in the world. While Dewey did not deny that concepts and propositions were important, he subsumed them into a wider capacity called judgement which incorporates, along with the cognitive, the ethical, aesthetic, conative and other factors that are omitted from the essentially cognitive standard paradigm of learning. It should be noted that Dewey is not totally discarding the explanatory items of the standard paradigm of learning. Rather they are part of his larger explanatory scheme. Thus, for him, the type of learning valorized by the standard paradigm is but a limited and special instance of a broader notion of learning.

There has been a range of theorists who stress the crucial role of action in learning. This is an important idea for the emerging paradigm of learning. For example, Jarvis (1992) views learning that lacks this action component, such as contemplative learning, as abnormal learning. Jarvis upends the standard paradigm that privileges contemplative learning at the expense of all other kinds of learning. He holds the standard paradigm responsible for the phenomenon of people rejecting as learning what does not fit under its assumptions (the ‘denial of learning’ syndrome) (Jarvis 1992: 5).

As noted earlier, one implication of the standard paradigm of learning is a sharp separation of the processes and products of learning. This distinction is plausible whenever learning is separated from action. However, when learning is closely linked with action, the two are not sharply distinguished at all. The process facilitates the product which at the same time enhances further processes and so on.

A number of central ideas from Wittgenstein's later philosophy reinforce the emerging paradigm of learning (see, e.g. Williams 1994). These insights include an undermining of the assumption of the mental interiority of the best learning that is central to the

standard paradigm. For Wittgenstein, meanings are not essentially internal. Rather, meaning emerges from collective 'forms of life' (Toulmin 1999). As well, for Wittgenstein, the basic case of teaching (training) is not about mentalistic concepts being connected to objects (as in ostensive definition and rule following). Rather, it is about being trained into pattern-governed behaviours, i.e. learning to behave in ways that mimic activities licensed by practice or custom. Another important idea is the social basis of normative practices.

Passmore argues that *capacities* are a major, perhaps the major, class of human learning. For Passmore in normal development '.... every human being acquires a number of capacities for action ..... whether as a result of experience, of imitation or of deliberate teaching....' (1980: 37). His examples include, learning to walk, run, speak, feed and clothe oneself; in literate societies, learning to read, write, add; particular individuals learn to drive a car, play the piano, repair diesel engines, titrate, dissect, etc.

Passmore stresses that not all human learning consists in capacities. As examples he instances development of tastes (e.g. for poetry), formation of habits (e.g. of quoting accurately), development of interests (e.g. in mathematics) and acquiring information. However, for Passmore each of these types of learning depends on capacities: to understand the language; to copy a sentence; to solve mathematical problems; to listen, read and observe. The argument is that capacities are the basis for other kinds of learning. So the mental enrichment seen as basic in the standard paradigm of learning actually depends on the exercise of learned capacities.

That capacities are much more than mental in their scope is evident from their definition and characteristics

> ‘Capacity’ - A capacity is a power or ability (either natural or acquired) of a thing or person, and as such one of its real (because causally effective) properties. (Honderich 1998:119):

Honderich characterizes natural capacities of inanimate objects, such as the capacity of copper to conduct electricity. These are dispositional properties whose ascription entails the truth of corresponding subjunctive conditionals. However, the capacities of persons, the exercise of which is subject to their voluntary control, such as a person's capacity to speak English, do not sustain such a pattern of entailments and are consequently not strictly dispositions. Thus capacities are vital features of human learning.

Passmore further distinguishes two types of capacities ‘open’ and ‘closed’ as follows:

> Closed capacities: ‘A “closed” capacity is distinguished from an “open” capacity in virtue of the fact that it allows of total mastery.’ Examples include starting a car, holding a chisel correctly, etc.
>
> Open capacities: ‘In contrast, however good we are at exercising an “open” capacity, somebody else - or ourselves at some other time - could do it better’, e.g. playing the piano, novel writing, wood-carving. (1980: 40)

The process/product distinction discussed above can be expounded further in relation to closed and open capacities. It is in the case of open capacities that the process/product distinction starts to blur. While the distinction remains fairly clear in the case of closed capacities (the process of starting a car can be readily distinguished from the achievement of the engine running. The latter is a state of affairs that obtains over and above the starting of the car (Ryle 1949), the same distinction is less clear in cases of open capacities. In playing the piano, for example, a state of affairs can be said to obtain of having played a particular piece, but the quality of this achievement can usually be

increased further by more playing, that is more process. So more of the process is the basis for the product being improved, yet at the same time such improvement will serve to enhance the performance of the process.

As Passmore's range of examples of capacities, e.g. titrating, dissecting, healing, etc., makes clear, their exercise often closely connects with the kind of judgement emphasized by Dewey.

From this brief survey, the main principles of the emerging paradigm of learning are (Beckett and Hager 2002):

- knowledge, as integrated in judgements, is a capacity for successful acting in and on the world;
- the choice of how to act in and on the world comes from the exercise of judgement;
- knowledge resides in individuals, teams and organizations;
- knowledge includes not just propositional understanding, but cognitive, conative and affective capacities as well as other abilities and learned capacities such as bodily know-how, skills of all kinds, and so on. All of these are components conceivably involved in making and acting upon judgements;
- not all knowledge can be or has been expressed verbally and written down;
- acquisition of knowledge alters both the learner and the world (since the learner is part of the world).

Clearly the notion of judgement is an important feature of the emerging paradigm of learning. This sits with its holistic, integrative emphasis that aims to avoid dualisms such as mind/body, theory/practice, thought/action, pure/applied, education/training,

intrinsic/instrumental, internal/external, learner/world, knowing that/knowing how, process/product, and so on. The argument is that judgements, as both reasoning and acting, incorporate both sides of these ubiquitous dualisms. Thus, this learning paradigm does not reject as such any pole of these dualisms. For instance there is no rejection of propositional knowledge. Rather, propositions are viewed as important sub-components of the mix that underpins judgements: though the range of such propositions extends well beyond the boundaries of disciplinary knowledge. What is rejected is the view that propositions are timeless, independent existents that are the epitome of knowledge. By bringing together the propositional with the doing, the emerging paradigm of learning continually judges propositions according to their contribution to the making of judgements. Because the judger is immersed in the world, so are propositions. So they lose their classical transcendental status. (For more details on judgement see Hager 2000a, Hager 2000b, Beckett and Hager 2002).

It can be proposed, therefore, that the emerging paradigm of learning is superior to the standard paradigm for conceptualizing learning at work. While the standard paradigm assumptions undermine attempts to understand what is happening in learning at work, the emerging paradigm offers concepts that provide a beginning of understanding. However, it should be emphasized that rather than the two paradigms of learning being polar opposites, the standard paradigm is best seen as a limited and special instance of the emerging paradigm. However the role of learning outside of formal classrooms is so vital in the contemporary era that we can no longer allow its understanding to be distorted by mistaking what is merely a limited and special case of learning for the norm.

MEASUREMENT OF ATTAINMENT OF LEARNING AT WORK

The influence of the standard paradigm of learning on the formal education system has been such that assessment of student attainment has been largely shaped by its assumptions. In standard assessment and progression systems, learning is demonstrated by individuals reproducing verbal or written propositions in appropriate combinations in response to set questions in examinations and written assignments. Here, there is a focus on universal, context free knowledge, with numbers and grading to quantify the amount of learning demonstrated. While relatively simple skills might be tested by direct observation of candidates performing the skills, a common strategy with more complex skills is to have candidates answer written questions. For example, in Australia there is an attempt to measure generic attributes of new university graduates via multiple choice testing (Australian Council for Educational Research). Likewise in the United Kingdom there have been recent moves to assess students' key skills by having them sit for written examinations (Fuller and Unwin 2001). In both cases, there has been significant scepticism about what, if anything, these tests are measuring. Certainly, it can be stated that they reflect both the assumptions and limitations of the approach to assessment favoured by the standard paradigm of learning.

Assessment arrangements such as these reflect the standard paradigm of learning principles that the best learning resides in individual minds as propositions and, because of their transparency, these can be readily reproduced in verbal or written form. Skills of all kinds, while regarded as inferior types of learning, also have their place. Guided by the right propositional knowledge, they can be applied via bodies to alter the external world in desired ways. Unfortunately for proponents of this approach, its theoretical basis has long since been undermined (e.g. Ryle 1949).

From the preceding, it will be clear that the emerging paradigm of learning, with its focus on holism, judgement, action and context, better represents the kinds of learning that occur in workplaces. At best, the type of learning valorized by the standard paradigm is but a small part of learning in workplaces. Thus, when it comes to assessing learning at work, retaining the assessment assumptions of the standard paradigm will only serve to guarantee ineffective assessment. To see further why this is so, we need to consider more closely some key assessment assumptions of the standard paradigm of learning.

The individuality assumption

A virtually universal assessment assumption of the standard paradigm of learning is that the individual is the correct unit of analysis. This discounts the possibility, indeed the likelihood, of communal learning, i.e. learning by teams and organizations that may not be reducible to learning by individuals. Adopting the individuality assumption has wide-ranging implications for vocational education, e.g. human capital theory incorporates this assumption. This is evident from a typical definition of human capital: '[T]he knowledge, skills and competences and other attributes embodied in individuals that are relevant to economic activity' (OECD 1998: 9).

The stability assumption

Another key presupposition of the standard paradigm of learning is that the knowledge being assessed remains relatively stable over time. It needs this characteristic so that it can be incorporated into curricula and textbooks, be passed on from teachers to students, its attainment be measured in examinations, and the examination results for different teachers and different institutions be readily amenable to comparison. Thus formal education systems want to deal with assessment of learning that is stable, familiar and

widely understood. Engestrom puts this assumption of what he calls ‘standard theories of learning’ as follows: ‘a self-evident presupposition that the knowledge or skill to be acquired is itself stable and reasonably well-defined’ (Engestrom 2001: 137).

The replicability assumption

The practice of comparing assessment results for students across different class groupings and different institutions was found to involve the stability of knowledge assumption. In fact, the everyday practice of comparing the learning of different students also requires an even more fundamental presupposition, the replicability assumption. This assumption is that the learning of different learners can be literally the same or identical. The sorting and grading functions of education systems requires the possibility of this kind of foundational certainty of marks and grades. These matters are reflected in the common term used to denote replicability of learning - different students are said to have the same ‘attainment’.

As several English dictionaries confirm, ‘to attain’ means 1. to arrive at, reach (a goal, etc.), or 2. to gain, accomplish (an aim, distinction, etc.). In either case, conscious development or effort is often involved. The noun ‘attainment’ has two distinct meanings reflecting the process/product distinction: 1. the act or an instance of attaining, or 2. something attained or achieved; an accomplishment. When applied to learning the verb to attain introduces metaphorical connotations - learners have arrived at or reached a place or gained an object. This is consistent with the Latin derivation from ‘attingere’ - to touch.

The metaphors associated with attainment appear to fit very well with various aspects of the standard paradigm of learning. For a start they encompass the process/product

distinction. Attaining learning, stocking the mind with contents is akin to arriving at a goal or gaining an object. The learning that has been attained is akin to the mind having 'touched' the relevant propositions. Recall that propositions are viewed as timeless, unchanging entities located in a world of ideas. Students with the same level of attainment can be thought of as mentally 'touching' the same range of universal propositions. Inside their individual minds each has completed the same mental journey, on the way calling at the prescribed places or destinations.

The metaphors associated with attainment seem to fit much less well with the emerging paradigm of learning. Perhaps 'attaining' is a more suitable notion here. Also, with this paradigm, the process/product distinction is less applicable, reflecting that finished products of learning are not so readily identifiable. In workplaces, typical learning involves developing the gradually growing capacity to participate effectively in socially-situated collaborative practices. This means being able to make holistic, context sensitive judgements about how to act in situations that may be more or less novel. As well, these judgements are often developed at the level of the team or the organization. So in these circumstances the propositions touched by individual minds may be of limited interest. It seems that each of the three key assessment assumptions of the standard paradigm breaks down when applied to workplace learning. The isolated individual is often not the appropriate unit of analysis. The learning is not stable as contexts continually change and evolve. In many occupations people with just the expertise of a decade ago are no longer employable. Much work requires practitioners to develop open capacities (in Passmore's sense) in an ongoing way. Nor will the learning histories of workers be the same because of the contextuality and particularities of their different work experiences. Hence it makes little sense to look for replicability of learning across individual workers.

Scheffler in a discussion of the centrality of metaphorical language in educational theory, noted that metaphors indicate,

> that there is an important analogy between two things, without saying explicitly in what the analogy consists. Now, every two things are analogous in some respect, but not every such respect is important.... the notion of importance varies with the situation..... (1960: 48)

Scheffler added that every metaphor has limitations, 'points at which the analogies it indicates break down' (1960: 48). For dominant metaphors he suggested we need to determine their limitations, thereby 'opening up fresh possibilities of thought and action.' (Scheffler 1960: 49). My view is that the standard paradigm of learning, centred on the metaphor of the spectator mind, aloof from the world, steadily acquiring unchanging propositions, well illustrates Scheffler's claims. A very limited form of learning has been allowed to determine how we picture all learning. While we can envisage that different minds, themselves not part of the everyday world, can all touch (attain) the same timeless, transparent propositions, important instances of learning, such as the learning by a team carrying out a challenging workplace project, are nothing like this. Yet, just such assumptions have been allowed to dominate our ideas on assessment of learning in general.

As the above rejection of the attainment metaphor suggests, effective assessment of learning at work requires something of a paradigm shift in how we think about these matters (see Hager and Butler 1996). The judgemental model of assessment frightens people who want guaranteed foundations and the certainty that they think these bring.

The timeless propositions and logical essences of the standard paradigm of learning appear to provide just such foundations and certainty. Whereas the lack of stability and replicability for assessment under the judgemental model dashes any such hopes. However, it seems to be unavoidable that much learning at work belongs to a type of human practice that evades the standard paradigm. In such practices, it is simply the case that the practices are judged by standards which themselves evolve from the practices. We are stuck with a virtuous circle (or spiral) of practices and standards.

A CASE HISTORY OF LEARNING FROM WORK

To address further the differences between measuring learning at work and the assessment of learning that is characteristic in formal education systems, we will consider a case history of learning from work. The following case history probably represents an unusually rich instance of learning from work. However, if we are to understand a phenomenon better, it is helpful to consider some of the best instances.

Case history of a senior surveyor

Richard is Survey Manager for the Infrastructure Operating Unit of a large construction group. He describes himself as a 'hands-on' man and still goes onto sites to do surveys when he can so as to keep himself in touch. His current responsibilities are the development and control of survey staff and equipment to ensure that the group remains an industry leader, and the planning of the future surveying needs of the construction group in terms of human and physical resources. Richard has been in surveying all his working life. Although not a registered surveyor, he has broad experience in major construction companies as project manager, foreman, project surveyor, senior surveyor and chief surveyor. In 1980 he was promoted to a managerial position with the specific

task of streamlining the use of software packages, survey equipment and lines of communication with surveyors on various jobs.

A major influence on Richard's career was the shock of 'falling on his face' at the end of schooling because he 'spent his final year in the surf'. Being not eligible to go to university, Richard decided to become a surveyor and successfully completed a 4 year part-time Certificate in Surveying at a Technical and Further Education (TAFE) college, while working as a survey assistant. Failure of earlier university plans motivated him to do very well in the TAFE course. This brief case history focuses on the changes in surveying skills that Richard has encountered and on how he has acquired new skills to keep up with occupational change.

Richard views construction surveying as a service industry, whose purpose is to formulate methods to set out a project and to calculate the relevant data and quantities. While this basic purpose has not changed, Richard has seen the way it is done change, and continue to change, dramatically, as technology has evolved. The scope and extent of the major revolution in surveying is reflected in a number comparisons. First, when Richard started, he calculated survey data with log tables or small calculators averaging 10-15 property blocks per day. Now with Global Positioning Systems (GPS) he does anything from 600-10,000 shots a day on site, with the calculations of the data happening in the office using sophisticated PC software. Second, Richard's first surveying calculator had a memory capacity of twenty-five programme steps; now he uses software that can deal with a million survey points. Third, early 'modeling software' of the 1980s ran overnight processing survey data. Now the same calculations require a few seconds.

Richard summarizes these enormous changes as follows. ‘Broadly speaking, there was the introduction of the computer, followed by an electronic survey equipment revolution, then a software revolution. Now all three are merged to control and drive sophisticated machines that in the future may not require an operator.’

Essentially, Richard believes he has learnt his job skills, both technical and managerial, from experience on-the-job and his own personal research. He claims that, basically, there is no training for construction that can replace actual on-the-job experience. He sees his learning as being self-developed gradually over the course of his career, including gaining the knowledge and skills to perform in higher positions. Thus, for Richard, the role of formal training in his moves to higher level jobs has been largely negligible.

The rapid computer innovations in a small field such as surveying are such that there are not a lot of worthwhile courses available. Richard works with the software writers to understand and assist in directing the latest innovations. For Richard and most software users they either pay for training or work it out for themselves. In doing the latter, Richard has become used to ‘pushing himself to the limits’. Survey equipment manufacturers run some training sessions and there are university workshops available from time to time. He is about to attend an intense 3-day workshop at a university on GPS. These workshops are the result of organizations combining to give a more structured training alternative to that of manufacturer organized sessions. He comments that this is better than manufacturers’ sessions as they feature more intensive learning. Another benefit is that you come away from these workshops with not only the course literature, but also your own set of reference notes for applications and procedures experienced.

Richard compensates for the lack of suitable courses in these specialized areas through personal research. A common instance of self-teaching is venturing into the software to try out what it can do. If he makes a mistake, he just starts again. Richard keeps in touch with software package writers by conducting trials of their products and providing feedback and advice. He does the same with prototype survey instruments. He also belongs to a software user group made up of people from all sections of the industry. A software company technical support manager runs the group. Richard's company pays for him to attend this user group, which discusses the problems experienced, the needed innovations or applications and the overall directions for the industry. He sees this as invaluable as no university or TAFE course can possibly keep pace with the speed and cost of the equipment being developed. This applies also to the use of survey instruments.

There is no specific construction training in Australian degrees in surveying, but studies in surveying and civil engineering can be merged, which Richard sees as a logical combination of skills. Richard learnt and developed his skills on the job by working extremely long hours. Summarizing his development and maintenance of up-to-date technical surveying skills, Richard sees some of it coming from formal off-the-job learning, some of it coming from formal on-the-job learning, but by far the vast majority of it is from informal off-the-job reading, research and testing, that he does for himself.

The other area where Richard has had to gain and maintain skills is as a manager. As with his technical surveying skills, Richard sees experience on-the-job as the significant source of his acquired management skills. He describes his management roles as centering on running smoothly operating teams, structured surveying methods and clear

company policies. His first experience of management evolved from frustration at the rather ad hoc surveying methods at the firm. He approached his manager with procedures to improve and streamlined survey methods for better efficiency. He was encouraged to implement his ideas and manage them.

Until this job, Richard's role as manager occurred at all hours of the day. This was because he had to provide site survey services to various large construction sites, using junior surveyors, and simultaneously assist surveyors at other sites all over New South Wales with methods and procedures, this latter invariably by telephone. The on site management was a 'hands-on' situation in which he could gather his team to show them something when needed, whereas the telephone assistance to other locations Richard believed to be restricted and difficult. Richard's new management role is not tied to a site and allows him more time for face-to-face assistance, time to solve problems and provide solutions to sites and surveyors. Regular site visits also helps to maintain quality and motivation. This role structure also allows Richard time to assist with Head Office tenders and variations.

Implications for learning from work

Richard's case history provides further strong evidence for the inapplicability of each of the three key basic assessment assumptions of the standard paradigm of learning to workplace learning. Although Richard's case history describes the learning trajectory of an individual, he is certainly not, *qua* learner, an isolated individual. His proactive work with the software writers to understand and assist in development of innovative products, together with his membership of the software user group illustrate this. Accepting a mainstream definition of 'learning' ('the acquisition of a form of knowledge or ability through the use of experience' (Hamlyn in Honderich 1998: 476),

it is surely plausible that in such activities learning by teams and groups is likely and is not reducible to learning by individuals. If such communities as the software user group develop abilities that transcend the abilities of individual members, then the individual is not the appropriate unit of analysis for understanding this learning.

Certainly much of Richard's learning is not stable as the contexts in which he works change and evolve so rapidly. In some areas the rapid change means that cutting edge formal courses are an impossibility. Nor is Richard's learning trajectory one that can be replicated by others. The contextuality and particularities of his learning from work experiences impart uniqueness to that learning. Others might have an equally rich learning trajectory, but it will still be a very different one from Richard's. Richard was 'headhunted' for his current position on the basis of holistic judgements made by others about the quality of his work performance; not because he outperformed other individuals on standard assessment tasks.

Richard's responsibility for planning the future surveying needs, both human and physical resources, of his company requires continual learning for him to make wise judgements, e.g. which equipment to buy and which to lease. In a field undergoing such rapid and continuing change, Richard depends very much on his ongoing learning to keep him well-informed. There are no textbooks to tell him what to do. His continuous learning underpins the series of integrated judgements that his job requires him to make to ensure that his construction company continues to act successfully in and on the world.

It appears that Richard's motivation for learning is multi-facetted. From the time of his youth he preferred learning from real work to academic learning. His failure to qualify

for entry to university seems to have motivated him more strongly to learn from work. He creates and drives his own learning opportunities, sometimes 'pushing himself to the limits'. He also enjoys strong support from his employer, who pays for him to attend the software users' group.

CONCLUSION

This chapter has argued that the most influential conceptualisation of learning, one that has decisively shaped teaching and assessment practices in formal education systems, is very problematic when it comes to understanding learning at work. Nor is the standard assessment concept of 'attainment' very helpful for thinking about what is learned atwork. Three basic assumptions have been identified as underpinning common understandings of learning and its assessment. Firstly, that individuals are the locus of learning, secondly, that what is learnt is stable over time, and thirdly, that learning trajectories are common across learners. It has been shown that learning at work challenges each of these assumptions, thereby casting doubt on their importance for our understanding of learning. Instead this chapter has drawn on various authors to outline an alternative conceptualisation of learning, one that provides a better fit with learning at work. The value of the alternative conceptualization of learning has been illustrated by testing it against salient points of a case history of learning at work in a rapidly changing field, viz. surveying. This illustrated how various contextual factors make learning at work difficult to fit into standard ways of conceptualizing learning and assessment. The case history also pointed to some factors that can contribute to improving learning at work. Overall, further research is needed to expand our understanding of learning from work and the most appropriate ways of measuring its progress and of enhancing its development.

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