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This is an electronic version of an article published in *Educational Philosophy and Theory*, 36 (5). pp. 509-522, November 2004. The definitive version is available at:

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## APPRENTICESHIP AND APPLIED THEORETICAL KNOWLEDGE

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### Introduction

With the introduction and further development of the Modern Apprenticeship a subtle reversal has occurred, taking the training system back to the 1950s or earlier. Instead of a comprehensive system of block release to college or workshop, we now have again day release or an evermore minimal college input. This was the norm of apprenticeship throughout the first half of the twentieth century, with all the dangers of the apprentice exploited as cheap labour. Instead of a belief in knowledge, including theoretical and technical knowledge as the underpinning of any practice, we have returned to the craft system of the nineteenth century, to experience as the key to learning a craft, to learning-by-doing. Instead of a more skilled labour process, with all trainees acquiring NVQ Level 3, as envisaged when the scheme was established, we have sunk back to an acceptance of the equivalent of NVQ 2. Instead of clear and comprehensive progression routes from apprenticeship to intermediate levels or beyond, there is an increasing problem in moving from NVQ Level 3 to higher national level due to a lack of underpinning knowledge, dramatic declines in the training of intermediate occupations and in the uptake of HNCs and HNDs and a consequent reinforcement of the old divide between manual and non-manual labour. And, finally, instead of the development of skilled occupations coming together to constitute an industry, and imbued with transferable skills and thus with the potential to innovate and develop, we have the atomised notion of skills as physical attributes associated with carrying out particular tasks and specific to the needs of individual firms. How and why has this process occurred, seemingly without comment? Does it signify the end of apprenticeship? What are the implications for the labour process? And what is the concept of learning and training that is implied? It is these questions that this paper addresses.

By apprenticeship we mean learning that is based in the workplace, referring to the system that developed from the nineteenth century, described by Lee as involving “a rudimentary assertion of the right of the workman to instruction, to participate in technical knowledge.”<sup>1</sup> This is distinct from the collectively bargained apprenticeship, often just a form of cheap labour in the nineteenth century, from the earlier statutory apprenticeship instituted by Elizabeth I in 1562 and from the mediaeval trade company apprenticeship.<sup>2</sup> As distinguished by a bricklayer participant to a workshop on training in the 1980s:

What we’re talking about with a traditional apprenticeship is a situation where there’s proper training. This means going to schools and having some standard instead of someone just working with Joe Bloggs down the road for four or five

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<sup>1</sup> Lee, David (1979) ‘Craft Unions and the force of tradition: the case of apprenticeship’, *British Journal of Industrial Relations* 17.

<sup>2</sup> For a further account of these different stages of apprenticeship, see Linda Clarke (1999) ‘The Changing Structure and Significance of Apprenticeship with special reference to construction’ in P. Ainley and Helen Rainbird, *Apprenticeship: towards a new paradigm of learning*, Kogan Page.

years and being called an apprentice and afterwards, if you had an indenture, being called a tradesman.<sup>3</sup>

Our understanding of apprenticeship therefore covers the situation where a student though based in a workplace and bound to an employer, spends a substantial amount of time in education through a system of block release. What characterises the apprenticeship system is really its dependence on the individual employer, the contract for the Modern Apprenticeship, for instance, being drawn up by the Learning and Skills Council and signed between the employer, the trainee and the body responsible for training (e.g. in the case of construction, the CITB as the Sector Skills Council). It is this dependence on the employer that really represents the Achilles heel of the system, as training provision then rests on the goodwill of individual employers. Its vulnerability is most apparent in the case of construction, where only 38% of construction trainees are now attached to an employer, whether through a Modern Apprenticeship or not, whilst 62% are based full time (16 hours per week) in Further Education Colleges and classified as unemployed.<sup>4</sup> Those on the college-based route then defer the problem of transition to work and obtaining work experience until they have obtained their qualifications. Colleges do try to accommodate to the shortcomings in training involved by, where resources permit, simulated practice in workshops and, where possible, arranging work experience in firms.

Individual employers show increasing reluctance to take on trainees for a variety of reasons. One may be their reliance on advanced technologies unsuitable as a learning environment for trainees because of safety risks and because of potential damage to valuable materials and equipment by those with no experience or knowledge. Another reason is that even should they go to the expense and effort of training, they are then exposed to the danger of having trainees poached on completion, given unregulated wage structures where employers are prepared to pay more to obtain the skills they acquire. And a third is that they may have very specific skill requirements, unsuitable for providing trainees with the range of skills associated with a particular occupation. In this situation, the questions posed are whether the apprenticeship can and should continue to be upheld as the main model of vocational learning and what are its values and relevance from both a philosophical and historical perspective?

## **Work-based knowledge and accounts of its acquisition**

### ***Situated knowledge and imitation/instruction***

One very influential account of the acquisition of practical knowledge, deriving from the work of Michael Oakeshott, is that of initiation into a community of practice. This account has been developed further through the studies of Lave and Wenger.<sup>5</sup> Apprenticeship has always involved initiation into practices and into communities of practice or occupations. Such initiation has involved observation, imitation and gradually growing participation. One can even imagine some occupations relying solely on such means of initiation. But modern technical and

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<sup>3</sup> The report on a series of workshops on training held with construction workers is to be found in Linda Clarke (1992) *The Building Labour Process: problems of skill, training and employment in the British Construction Industry in the 1980s*, CIOB Occasional Paper No. 50.

<sup>4</sup> CITB (2002) *Skills Foresight Report* and CITB (2002) *Trainee Numbers Survey*.

<sup>5</sup> For example, Lave, Jean and Wenger, Etienne (1991) *Situated Learning: Legitimate Peripheral Participation*, Cambridge: Cambridge University Press.

craftwork could only be learned like this with the greatest difficulty. The reason is that such work centrally involves *theory*, whether it be normative, scientific or both, which informs the techniques employed. Insofar as full participation in the occupation involves making use of that theory, largely non-discursive initiation into practice will be inadequate. However, one cannot explain mastery of a technique that is informed by theory either in terms of training in the German sense of *Abrichtung* (which is akin to drilling) or in the sense of following an instruction manual.<sup>6</sup>

### ***Technical knowledge and the learning of recipes***

One influential account of the application of theory to practice is Oakeshott's view of technical knowledge. Technical knowledge involves the application of a set of rules to a problem and the solution of that problem by the application of the rules. Technical knowledge is acquired through instruction, rote learning and reading.<sup>7</sup> This is a very limited vision of technical knowledge, which is quite inadequate to account for most modern technical work. One might be able to effect a repair of a car engine using a manual once one has *diagnosed* the problem to be solved. The skilled technical worker, however, will need to be able to *solve* the problem and in order to do that will need to know about how an internal combustion engine works. This is an important part of the technical knowledge of a skilled worker. It may well be necessary to use a manual to carry out a repair, like a part replacement once one has diagnosed the problem, but this is precisely what the relatively unskilled worker needs to do, not someone with a thorough technical knowledge of the general problem and of the particular kind of vehicle. The Oakeshottian account of technical knowledge belongs to a world in which skill is hierarchically organised and the operative is someone with minimal skills who follows instructions. However, neither a traditional craftsman nor an apprentice in a modern technical occupation would be expected to work like this.

### ***Applied theoretical knowledge***

There might be a puzzle about what it means to apply theory. After all, a theory is an intellectual construction and craft or technical operations involve manipulation of the physical environment. So how do they connect with each other? One largely discredited account of this would be the claim that the relevant part of the physical theory has to be first consciously entertained in the mind of the worker. A 'practical syllogism' is then inwardly constructed along the lines of:

The theory indicates that in circumstances C operation O is required in order to achieve result R.

This is a situation where the theory applies, circumstances C obtain and result R is required.

Therefore, I should do O.

This ratiocinative process then issues in a *volition* that sets the operative's body in motion to bring about R.

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<sup>6</sup>The English term 'training' is ambiguous between the sense of animal training, the learning of practical techniques like using ostensive definition, which can both be described as *abrichtung* and the acquisition of a complex skill, such as navigation, where independent judgement is central to successful practice. See Ryle, Gilbert (1949) *The Concept of Mind*, pp. 40-41, where the author distinguishes between drilling and training.

<sup>7</sup> Ibid. p. 7. Oakeshott's view is still influential, see Carr, David (2002) *Making Sense of Education*, London: Routledge, p. 53.

The criticism of this model by Ryle is very well known.<sup>8</sup> Leaving aside whether or not the theory of volitions is coherent, the objection is that our criteria for a third person ascription of theory-application does not *require* any such ratiocinative process. One may *either* infer application of theory from the performance *or* one may ascribe it on the basis of what the operative is inclined to say about what he or she is doing when asked.

We do not, however, think that Ryle's objection fully answers the case for the following reason. The aim of learning to apply theories in practice involves the identification and solution of problems explicable by the theory, in which the situations encountered are often novel, and then the confident embedding of theoretically informed action in practice. The acquisition of that confidence is likely to be a long process that may ultimately result in a reduction of the need for the conscious construction of trains of reasoning resulting in judgment, which issue in performance. But if one is right in thinking that this kind of process is necessary in the formation of maxims for action at an early stage in the practical learning process, then one owes an account of it that escapes Ryle's criticisms and those of later commentators like Beckett and Hager (2002).<sup>9</sup>

The first point to note is that 'inner speech' or the silent entertaining of thought does not entail a dualist ontology. The temptation to think that ratiocination followed by action entails dualism arises if one is inclined to think that inner speech can only arise through the *ab initio* communication of a solitary with itself. The private language argument of Wittgenstein has famously disposed of that account. But it does not follow from the incoherence of the Cartesian account of thought that we cannot give an account which involves mental as well as bodily and linguistic activity. Following the accounts of Vygotsky and Geach, one can think of mental acts of judgment as analogical extensions of overt acts of judgment in speech.<sup>10</sup> Thus one can silently rehearse a syllogism and maxim for action, having first acquired the ability to do that verbally within a social *milieu*. Our ability to do this bears no direct ontological implications about the non-material nature of the mind. It is important to note that silent rehearsal is not *sufficient* for the mental act to be one of judgment. Workers must also pay *attention* to what they are doing and this means principally that they take what they are doing seriously. Our criterion for this is not the occurrence of an inner mental focussing of which, by its nature, it makes no sense to say that others could judge whether or not it is taking place, but rather it is the way in which the operation that is being carried out is undertaken. We would thus expect the consideration of a mechanical problem, for example, to include features such as careful examination of components, reference to a theoretical manual, the drawing of a sketch or diagram, consultation with colleagues and senior workmates and some hypothesis testing. We can imagine the teacher or mentor looking for signs of these activities as indicators that the apprentice is taking the problem seriously and is actually consulting theory, forming hypotheses, testing them, revising them etc.

Such actions, carried out in appropriate surroundings, allow us to say that the action being taken is deliberate, because it has the required property of seriousness and goal-directedness. Both behaviour and surroundings demonstrate that the goal is the carrying out of objective O. It is, however, sufficient for an observer to say that the operative *deliberately* did O because they had worked out that this was the appropriate course, by the observer taking the sequence as a whole.

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<sup>8</sup> Ryle, Gilbert (1949) *The Concept of Mind*, London: Hutchinson, ch.

<sup>9</sup> Beckett, David and Hager, Paul (2002) *Life, Work and Learning*, London: Routledge.

<sup>10</sup> Vygotsky, Lev (1962) *Thought and Language*, Mass: MIT Press; Geach, Peter (1957) *Mental Acts*, London: Routledge.

This is a sufficient explanation and does not require that A issued a mental volition that set O in motion. So Ryle's other stricture does not apply.

There is, then, nothing intrinsically mysterious about applied theoretical knowledge, nor about the evidence that someone is using it. What we need are the results of the application of that knowledge. Given that we know that someone has received instruction, training and practice to acquire that knowledge, it is a matter of inference to the best explanation when we see someone carrying out activities that appear to require it, to conclude that they in fact have it and are using it. Observation of workers and discussion of what they perceive themselves to be doing when carrying out the operation can resolve any residual doubts. So we could say that applied theoretical knowledge could be exhibited in non-discursive practice alone. However, to describe it solely in this way in modern conditions would be seriously misleading. The reason for this is to do first with the interdependence of complex modern work processes and second with *assessment*. A group of specialists who combine together on one or more tasks, such as the construction of a complex building, need to be able to work together. Even if the individual knowledge that they possess is theirs alone, the totality of knowledge required in the construction of the building is not. In this sense, the knowledge required for successful completion of the whole task (the construction of the building) is a collective asset, belonging to the team as a whole. But this means that, in order to be effective, it is also something more than a set of discrete items of individual knowledge. It needs to be *articulable*, the knowledge of the different individuals concerned has to be shared so that subtasks can be coordinated. This implies a high degree of mutual understanding of how the knowledge and skill of each contributes to the work of the others. We may also assume that there will be problems to be solved, which require discussion amongst and cooperation within the team. This in turn requires that individual members will, on occasion, be required to explain and justify what they are doing and in doing so will need to deploy their knowledge verbally. It follows that someone who is not able to do this is not fully skilled to undertake the work, since such communicative skill is part of what is required for the task.

The issue with assessment is somewhat different. We may assume that skilled workers are, in the course of their careers, going to encounter a wide variety of cognate but individually different tasks. Occupational formation should be adequate to enable them not only to perform those that are currently within the technical capacities available to their occupation, but also to learn to perform tasks that, although not now within those capacities, are likely to be in the foreseeable future. It is impossible that apprentices could be practically assessed on those tasks in the course of their occupational formation, which will be limited in time. However, it is also reasonable to expect to form a reliable judgement about their capacities for performing such hypothetical tasks. Evidence is required that apprentices have a grasp of relevant theory and that they are able to apply the theory to the identification and possible solution of task-related problems. In order to provide a sufficient range of these, hypothetical situations need to be posed which sample the relevant situations. Some form of written examination is unavoidable as one aspect of the assessment required to validate applied theoretical knowledge.<sup>11</sup> Needless to say, this is hardly sufficient. Apprentices also need to be able to demonstrate the practical side of problem-solving through the manipulation and testing of materials and equipment. They also need to be able to demonstrate the whole range of diagnosis, testing and solution under realistic work conditions. The assessment of properly embedded applied theoretical knowledge is likely

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<sup>11</sup> Prais, S. J. (1991) 'Vocational Qualifications in Britain and Europe: Theory and Practice', *National Institute Economic Review* 136, May, pp. 86-89.

to be complex and involve work in the classroom, in a simulatory environment and probationary practice.

Lest it be thought that we regard applied theoretical knowledge directly concerned with work processes as the only knowledge that apprentices need to acquire, we need to examine further knowledge related to both technical and occupational aspects of their work. For instance, critical to the knowledge of a bricklayer is knowledge of: the building production process and its aims and the different subcontractors involved; agreements and contractual arrangements governing working time and output; social relations on site; and, above all, responsibilities for machinery, equipment, materials and the prevention of accidents and occupational diseases.

### **Learning in the traditional model**

The traditional apprentice model was attached to a craft system of production that had very distinct characteristics allowing for a much more practice-based mode of learning and at the same time exposing the problems and limitations of such a mode.

In the first place it was embedded within a craft hierarchy, originally the master/journeyman/apprentice/labourer, with the apprentice to begin with apprenticed to be a master and later, as this became increasingly difficult, to be a journeyman. In this respect it was, as Lave has shown, a form of initiation into a community of practice. The apprentice had a clear place in the hierarchy, one that changed significantly with the further development of capitalist relations into a new hierarchy of foreman, skilled worker, semi-skilled, labourer and apprentice. However, even this division has now changed dramatically in many sectors. In construction, for example, the collective agreement in the early 1990s differentiated wage rates for: craft operatives, various semi-skilled categories (e.g. benders, fixers and scaffolders), adult labourers, young labourers, and apprentices/trainees<sup>12</sup>. This in itself is significant as the 'trainee' is a new category of labour, distinct from the apprentice in not having employee status. By 2000 the categories had become: craft operative, skilled operative 1-4, and general operative, involving the disappearance of both labourers and apprentices/trainees<sup>13</sup>. The apprentice or trainee has disappeared completely from the terms and conditions laid down in the collective agreement, denoting the withdrawal of direct social partner involvement and responsibility for training and for the representation of the interests of trainees and apprentices. A dramatic change is thus indicated in the role of trainee, no longer having the status of training to become a skilled worker, paid at a skilled rate as regulated through the collective agreement. The trainee is now removed from the industrial relations system and the role of the apprenticeship as an induction to a collectively agreed and recognised occupation no longer exists.

A second characteristic of traditional apprenticeship was that, being attached to a craft system, the employer's main concern was with the output of the apprentice rather than with developing his potential – his labour power. It was in this sense that it could be based on the minimal skills required to follow instructions in the sense indicated by Oakshott. The apprentice was attached to a journeyman or craftsman who had an interest in teaching him how to carry out particular tasks in order to improve their joint output. It was for this reason that apprentice rates were always stipulated in the

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<sup>12</sup> National Joint Council for the Building Industry (1991) *Working Rule Agreement*, London

<sup>13</sup> Construction Industry Joint Council Working Rule Agreement for the Construction Industry 2000.

collective agreement and related to their productive output compared to that of a journeyman or craftsman. By their last year as they had become quicker, the apprentice rate was close to the craftsman's. However, as the labour process became less and less craft-based, and more and more collective, so it was difficult to maintain the position of the craft apprentice. The construction industry again provides an example of this. Here, the civil engineering sector was anyway largely outside the apprenticeship system, revolving rather around the position of the labourer with 'plus rates' rewarding the carry out of particular tasks. In the building sector, the crafts persisted but wages from the end of the nineteenth century until the end of the second world were time-based, following successful battles by the trade unions against piecework, so that time-served apprenticeship could continue without jeopardising the craftsman's earnings. With the introduction of the bonus system after the second world war, its extension to comprise often half the wage and its final development into the system of self-employment, the apprentice no longer had a place. Taking care of apprentices could even detract from the skilled operative earnings. Even the labourer and the traditional 'mate' became increasingly marginal as improvements in prefabrication and mechanisation rendered redundant certain labourers, such as hod carriers, and as the skilled worker subsumed remaining labouring tasks.

Another characteristic of the traditional apprenticeship, associated with the notion of implicit knowledge and non-discursive practice - with the 'mystery' which meant 'mastery' - was that it was based on the workshop, without formal technical instruction and a process of assessment. As criticised in the Report of the Royal Commission on Technical Instruction of 1884 this meant that, "at the best all that is learned in the workshop is manual dexterity and how to do things by 'rule of thumb', 'wrinkles' and 'dodges'"<sup>14</sup>. Trade unions that continued to try to maintain standards tended to be associated with those occupations or trades where apprentices were taught, as opposed to being simply exploited.<sup>15</sup> Thus apprenticeship as a process of learning on the job to become a journeyman was already reported as "abolished in all the more important trades" by the 1870s.<sup>16</sup> Instead, large employers, as reported by Charles Booth in the 1890s, preferred 'improvers', that is those who could also begin as labourers, "making it impossible to restrict admission to a trade to those apprenticed."<sup>17</sup>

Restricting numbers gradually ceased to be an issue for trade unions and the concern was rather with maintaining standards through the encouragement of technical education and practical examinations. The City and Guilds of London Institute for the Advancement of Technical Education was founded in the 1870s, followed in the early 1900s by local trade schools as local authorities gradually took over the old role of the Mechanics' Institutes.<sup>18</sup> By the 1930s and 1940s union proposals for reform included: joint regulation, the attachment of the apprentice to industry rather than the individual

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<sup>14</sup> Samuelson Commission (1884) *Report of the Royal Commission on Technical Instruction*, No 2096, HMSO, London

<sup>15</sup> Charles More (1990) *Skill and the English Working Class*, Croom Helm, 42.

<sup>16</sup> G. Howell (1877) 'Trade unions, Apprentices or technical education', *Contemporary Review* 30, pp. 833-57.

<sup>17</sup> Charles Booth (1875) *Life and Labour of the People in London ?? Population, Classified by Trades*, Macmillan.

<sup>18</sup> J. Lang (1979) *City and Guilds of London Institute 1878-1978 Centenary*, City and Guilds of London Institute.



employer, the involvement of education authorities and day release as a right.<sup>19</sup> This appears now to be more advanced than the Modern Apprenticeship, in particular in the move away from individual employers to a collective system of responsibility, similar to that in the Netherlands.

The great change in the apprenticeship system, one denoting the growing need to articulate with a more complex labour process, was the recognition that technical education and theoretical knowledge were essential elements in training for an occupation. This was supported through the 1944 Education Act, giving local authorities powers to provide further education and setting up National Joint Apprenticeship Boards enabling apprentices to be educated in the employer's time at training centres. With the Industrial Training Act of 1964, the role of formal vocational education was recognised but separated from industrial training, and the main responsibility for training was left with industry. In the construction industry by the 1970s the preferred method was concentrated block release enabling the further reduction in the length of apprenticeship to three years. Another successful innovation in the 1970s was skill centres, giving six months concentrated training to adults, followed by improverships in firms. As described by a bricklayer in the 1980s:

A six month course was much better than the training some of the apprentices on site had over three years. They were just filling up holes in the brickwork and doing bits and pieces, maybe the odd garden wall; the 'marvellous' three year apprenticeship with a tradesman who has time to train and isn't on bonus is a thing of the past.<sup>20</sup>

In this respect it is ironic that formal training has now been reduced to the almost universal day release system, frustrating for the trainees who have once a week to resume for a few hours subjects and tasks begun a week earlier and for employers who depend on the productive capacity of the trainee and may even encourage them not to attend college if pressure of work is high.<sup>21</sup>

A further key element of apprenticeship was that it was a means of entry into an occupation or trade rather than an industry. It was for this reason that it would remain a system essentially based on the specific activities of an individual employer and even fit with providing the skills of the independent or self-employed artisan. This was clearly one of its greatest weaknesses. In the context of a labour process described above which depends on collective knowledge, on knowing exactly what those around are doing, it made for a bounded, restricted and traditional range of skills which with increased subcontracting and outsourcing became less and less valuable and accessible to training. In a sense a vicious circle set in, one foreseen and even advocated by Adam Smith, as the very narrowness of the skill basis in itself made for a greater division of labour and at the same time a simpler type of skill, inappropriate to the collective skill sets of advanced labour processes.<sup>22</sup> This was well illustrated in a study of construction training where a 'fitter' who had worked for 27 years with the same suspended ceiling subcontractor claimed:

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<sup>19</sup> Lee, op. cit.

<sup>20</sup> Clarke 1992, op.cit.

<sup>21</sup> The effects of this were well illustrated in a study of the construction industry in Jersey, which closely follows the British model. See S. Arkani, L. Clarke, E. Michielsens (2000) *Construction Skills Audit*, Final Report to the Training and Enterprise Partnership of the island of Jersey, Channel Islands.

<sup>22</sup> Adam Smith (1789) *An enquiry into the nature and causes of the wealth of nations*, vol. 1, 5<sup>th</sup> ed.

It would be best if there was training but the difficulty is that this work is so specialised that no one else does it. If we were given the sack tomorrow, we could only go out and get jobs as ceiling fixers. In another field we'd have to start from scratch. It's hopeless.<sup>23</sup>

The main problem of maintaining comprehensive work-based training in a particular occupation relates to the structure of firms, the great mass of small enterprises, and to increased self-employment in Britain. In the construction sector, for instance, 36% of the workforce continues to be self-employed, at least three times higher than in other leading European countries. In addition to this the industry has 200,000 contracting companies of which about half are one-person firms and only 10,000 employ more than seven people. Most of the output of the larger firms is subcontracted, whilst the smaller firms do not have the capacity or will to train. As a result it is estimated that almost 70% of the workforce has had no formal training and the skills deployed have become increasingly narrow. In a system dependent on the individual employer to train, this is inevitable, as again explained by a tradesman: "You can't talk about training without talking about how people enter the industry and it's on that basis ... the lump itself."<sup>24</sup>

In construction there are now 35 different craft occupations and over 50 NVQs (compared with 16 occupations in Germany), not to mention the numerous professional occupations. The difficulty is that, because of a lack of general and transferable skills, firms continue to build on the skills of yesterday and that there is no capacity to extend into new areas, let alone to have some understanding of what other occupations are doing. This is little different from the situation in the 1870s, as described by George Howell:

The minute division of labour in many trades deterred the value of English craftsmen such as the extensive use of machinery, thereby impairing the efficiency of the workman as being able to undertake a complete branch in any one trade though greater skill is attained in the special parts assigned to each worker .. the work is done more rapidly and therefore cheaper.<sup>25</sup>

This was confirmed in a study carried out by the Inner London Education Authority in 1978, which found that in few crafts did final year apprentices have experience of the range of skill areas associated with their occupation. Indeed it was estimated that it would require ten years for a carpentry and joinery apprentice to achieve craft competency in terms of work experience<sup>26</sup>. The reality of the work situation now in an apprentice industry such as construction is an extremely fragmented system, built on a narrow skill base making for an ever greater gulf with college training, as general abstract knowledge appears often irrelevant to the situations with which the apprentice was confronted. A vicious cycle steps in whereby work experience is insufficient to practice the different skills of an occupation, let alone to give an idea of the industry as a whole, and college experience is far removed from practice. Such a critical situation is reminiscent of the situation after the war, and the need expressed by Harold Clay of the TGWU in 1947:

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<sup>23</sup> Clarke, L. (1992) *???? in the construction industry in the building labour process*, CIOB.

<sup>24</sup> Ibid.

<sup>25</sup> Howell, op. cit, p. 838.

<sup>26</sup> M. Hatchett (1982), 'The Development of Building Craft Skills in Inner London with particular reference to work experience' in *Bartlett International Summer School Proceedings on the Production of the Built Environment*, University College London.

There has got to be consideration of issues beyond the individual, beyond the firm, even beyond the industry... we have to get away from the idea that schemes of education and training represent something that a benevolent employer provides for his worker.<sup>27</sup>

How are we to understand what this involves?

### **Learning in modern ‘high-skill’ environments: the importance of applied theoretical knowledge in skill formation**

Our consideration of the learning requirements for applied theoretical knowledge on the one hand, and learning in the traditional style on the other, mean that, insofar as modern technical work requires applied theoretical knowledge, we may need to reconsider the pedagogy of apprenticeship for occupations that rest on it. But nothing about the pedagogy follows necessarily from the epistemological account of applied theoretical knowledge. Many national economies rely successfully on high-skill inputs, they do not all employ a common model of skill formation. Neither do individual high-skill economies all use the same model of skill formation within each sector. Thus we find college-based approaches in the US, UK and France, apprenticeship in Germany, Austria and, to some extent the UK, alternance which involves work placement without worker status in, for example, France, and on the job training in Japan and the US.<sup>28</sup> The apprenticeship systems of Germany, Austria and Switzerland probably come the closest to the ‘theory then practice’ model of the acquisition of applied theoretical knowledge that we have so far outlined. One point that springs to mind in surveying different skill formation models is that they are affected not simply or even mainly, by abstract pedagogical requirements, but by societal and industrial traditions. This suggests in turn that skill formation needs to work within political and sectoral traditions, at least to some extent, if it is to be accepted.

So there is a twofold task for the construction of effective pedagogies for the acquisition of applied theoretical knowledge. The first concerns a general account of the requirement – this is essentially an epistemological one. The second concerns the way in which such a requirement is put into effect in particular societies and particular sectors. This is largely a socio-economic and political matter. Let us look at the first requirement. Applied theoretical knowledge seems to require that workers acquire a body of theoretical knowledge to some extent embedded in practical skills. It does not, of itself, require a particular method of acquiring that knowledge. One possibility would be to acquire the theory prior to the putting of it into practice. The other would be the construction of theoretical knowledge from the exigencies of practice. We wish to defend the former model. The best way to start is by considering what a theory is.

Theories are interconnected bodies of propositions or norms which have a more or less general application. The fact that they are interconnected propositions or normative statements about a common topic is part of what gives them their generality.<sup>29</sup> The other general component of theory is that the propositions and normative statements within a body of theory do not simply apply to particular cases, but to classes of cases. Thus a law on theft defines a class of acts that fall under the legally defined concept, a natural law concerning the expansion of metals defines the behaviour for a defined class of elements and alloys. To learn a theory then, is to learn a

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<sup>27</sup> Lee, *op.cit.* 40.

<sup>28</sup> See for example, Green, Wolf and Leney (1999), Crouch, Finegold and Sako (1999), Brown, Green and Lauder (2000) for accounts of these different approaches.

<sup>29</sup> We include normative statements to take into account normative disciplines like law, theology, mathematics and logic, for example.

body of knowledge of some general application within a recognised subject matter. There seem to be two broad ways in which one could acquire such knowledge. First through learning the general propositions and the generality of propositions that make up the theory. Second by learning individual propositions and then forming a generalisation through *induction*. But before we leap to the conclusion that the first approach is obviously the most effective, we need to bear in mind that we are talking about *applied* theoretical knowledge, that is, knowledge that is displayed in practical industry-related activities. We cannot simply assume that learning theory and then learning application is the most effective way of acquiring such knowledge.

We need, first, to examine the second approach and ask whether it could be effective. If it is a more effective approach, then the clear implication is that the learning of applied theoretical knowledge should be largely a practical affair to be learned in the workplace or in conditions that closely resemble the workplace. The idea would be that apprentices would be taken through the range of tasks specific to the occupation over a period of time. They would gain experience and would be instructed in why some methods are more effective than others, which they would then be able to formulate. From a broad range of experience they would be able to form generalisations inductively about the theory that justifies the practice. It is in any case plausible to assume that at least some aspects of scientific enquiry are carried out in this way. There are, however, quite definite problems about going about the matter thus. First, one would need to have an adequate empirical base on which to form the appropriate generalisations about the theoretical underpinning of the occupation. It is most unlikely that this could be gained through the limited number of which would be available to the apprentice. Second, one cannot form a generalisation that presupposes grasp of technical concepts unless one first has a grasp of the relevant technical concepts. If F is a technical concept describing a process, then apprentices must be able to recognise instances of that process before they can generalise. In order to, they will need to know further technical concepts, if for example they are to understand that all instances of F are also instances of G. Third there is a danger of fallacious inference: any observed state of affairs may be a consequence of a number of different theoretical frameworks, only one of which is the accurate one. There is, therefore, a danger of fallacious generalisation. Fourth, even if generalisations are accurate, they may not be complete; some aspects of the theory may still be uncovered by the apprentices' experience. Finally, and not least, the ability to reason inductively is not a context-independent ability, but depends crucially on a grasp of the context in which inductive reasoning is to be carried out. Without this knowledge, the inductive reasoner will not understand what the scope of the inductive generalisation should be (whether there are contextual limitations, for example), what would be an appropriate empirical base for generalisation (what kind of sample would be sufficient for representativity for instance) and what level of risk of failure of inductive generalisation would be acceptable. Induction of theoretical properties from practical experience seems, then, to be fatally flawed as a pedagogy for the acquisition of applied theoretical knowledge.

The main alternative would be a deductive method. Here, trainees learn the relevant theory and then learn to recognise instances of theoretical propositions in practical situations. It can be seen that the difficulties with the inductive model do not obtain if applied theoretical knowledge is acquired in this way. First, the empirical base on which the theoretical generalisations are based has been accomplished by specialists using well-tried and accepted forms of scientific method, rather than *ad hoc* generalisations by non-specialists. Second, the specialist theory-constructor will already have acquired the theoretical concepts necessary to form generalisations. Third, the theory applied, although it may not be the only one that *could* account for the phenomena in question is the one that has emerged as the most powerful, economical and predictive of its rivals. Fourth, generalisations that are part of a properly constructed theory will be as complete

as it is reasonably possible to make them. Finally, and this is the point about applying theory, the learner has got to be able to recognise contexts to which the theory applies and those to which it does not. This requires both knowledge of the theory and also ability to *recognise* the contexts in which it does and does not apply. Part of this will be a practical recognitional ability of a situation as a particular kind of situation and part will be recognising that the theory is relevant in that situation. This cannot be learned in the classroom, but is not in itself a criticism of the deductive method.

The old model of apprenticeship is clearly based and depended on inductive learning. The apprentice was attached to the journeyman who belonged to a trade that claimed a wide range of tasks within its remit. If new technologies were introduced there were demarcation disputes between the different trades concerning any new skill areas. Each occupation, whether carpentry, bricklaying or painting, covered a wide range of potential skill areas and the time allowed for the apprenticeship was sufficient to allow the apprentice to generalise on the basis of experience. The introduction of technical instruction changed this in attaching a particular theoretical and technical body of knowledge to the occupation, strongly focussed on the properties of wood and on geometry in the case of carpentry, on the properties of brick, stone and mortar and on physics and mathematics in the case of bricklaying. In attending night school or day release, the apprentice learned this theoretical and technical knowledge and was shown examples of how it applied. Then over the course of the apprenticeship and subsequent work, through being employed on a range of tasks, he could in principle discover the validity of this body of knowledge.

The reason why more technical and abstract knowledge became more and more critical to the apprentice can be seen again in the case of the construction sector. With greater prefabrication and mechanisation, including the use of power tools and precision instruments, setting out and planning skills were increasingly required as well as greater accuracy and precision. It became more and more difficult to rely simply on a process of generalisation through experience.

But there were other factors besides this inhibiting such generalisation, including the narrowing of the range of activities attached to an occupation and reinforced through subcontracting. The activities of the carpenter, for instance, were subdivided into formwork, first fixing, second fixing and maintenance and it became difficult to find a carpenter not specialised in one or the other. This perhaps implied a decrease in the range of knowledge attached to the individual worker but, if it did, it went together with a deepening in the knowledge required by greater precision and more explicit application of mathematical knowledge. Skills required became more abstract and their level was no longer expressed through dexterity in the physical work process. For example, a heating and ventilating engineer involved in installing a complex system into a new office building may require experience of relatively routine skills in order to join plastic pipes. But in that he/she needs at the same time to conceptualise the functioning of the whole system and its interconnection with other service systems and parts of the building in order to understand how it is to be fitted, the skills demanded are very considerable.

In another sense the labour process has become more abstract as the pace of work has come to be determined collectively rather than on an individual basis or as driven by the foreman or gang leader. This in turn requires greater knowledge of the collective labour process. The rhythm of a concrete pouring pump, for example, or the capacity of a crane or hoist, while controlled by management, yet require the worker to conform to it. A craft system founded and paid according to the output of the individual worker cannot apply in this situation.

However, despite such clear pointers to the need for a different mode of learning, the notion of skill embedded in qualification systems and training programmes, including those applied in further education colleges, has largely been based on generalisation through induction. Studies carried on the building industry, for instance, including a large survey of operative skills in the mid 1960s and the ILEA survey all define skills in terms of the aggregate of physical observable tasks acquired by the individual (not collective) worker involved in a particular trade.<sup>30</sup> Recommendations put forward for training stemming from such studies then relate to the individual experience or transmission of knowledge of specific tasks or elements seen, when added together, to constitute the skill as a whole. This was a conception that also underlay the work of the Manpower Services Commission.

An important factor reinforcing such a conception has been the increasing reliance of any training system on employers alone, as the state has continued to abdicate responsibility and the unions have been weakened and marginalized. The policy, which continues today, was clearly expressed by government in 1984:

Decisions as to who is trained, when and in what skills are best taken by employers who have to satisfy the needs of the market rather than by central direction.<sup>31</sup>

Employers however are inevitably primarily concerned not with the training process itself but with its output, particularly in the short term. Individual employers seek to meet their immediate skill needs, which relate to the market and to reproduction of yesterday's skills, and simply do not have the capacity to build new skill sets. Without a process of negotiation and joint responsibility by all those concerned – the state, the employers, employees, and trainees and trainers – skill is inevitably conceived in traditional terms and training is devised to meet immediate needs.

With this traditional understanding, skills are divided into manual and mental, hand and brain, conceptual and executive and invariably seen as the attribute of individual workers rather than defined in social terms and as the attribute of workers as a collective. Braverman's notion, for example, associates skill with mastery of craft, described as the:

Combination of knowledge of materials and processes with the practiced manual dexterities required to carry out a specific branch of production.<sup>32</sup>

Such a conception also accords with the distinction between general and specific skills which pervades the training literature, with 'general' being based on broad-based knowledge and 'specific' as of value to one employer or one task. The danger with such a notion is that any specialisation of labour is regarded as a sign of a reduced need for skill, as part of a process of deskilling. This is an argument that stretches back to the eighteenth century, beginning with Adam Smith, and then carried forward in the nineteenth century with Babbage, Ure and Marx who equated specialised labour with 'simple' labour and regarded a more minute division of labour as implying a reduced need for skills.<sup>33</sup> And it was picked up again in the twentieth century by Braverman and, in a particular form, by the Institute of Manpower Studies, whose studies in the 1980s were critical to the thinking behind NVQs.<sup>34</sup> The argument was that the labour process could be and increasingly was subdivided into disassociated elements so that capacity need no longer be integrated into a single worker. This was the ultimate logic of a

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<sup>30</sup> Building Research Station (1968) *Survey of operative skills*, HMSO; Hatchett op cit.

<sup>31</sup> White Paper, command 9135, January 1984, p.5.

<sup>32</sup> Harry Braverman (1974) *Labour and Monopoly Capitalism*, MRP, 443.

<sup>33</sup> Adam Smith, op.cit., Vol 1, p. 188; Babbage (1932), London, pp. 75-6; Ure (1836), *Cotton Manufacturers of Great Britain*, vol 2, p. 195.

<sup>34</sup> For example, Institute of Manpower Studies (1982), *Skilled Manpower in Construction*, IMS Report No. 15, p. 53 and *Apprentice Training Support*, Report No. 46, p. 5, University of Sussex.

system of learning based on inductive reasoning and generalisation on the basis of practical experience. What then is an alternative, deductively based model of learning?

### **A revised model for apprenticeship learning**

Our account of one core aspect of occupational knowledge then allows us to inquire what is the most effective way of developing this. It has been argued that applied theoretical knowledge consists both of *applicable* theory and of practice appropriately *informed* by theory. It follows fairly directly from this that the applicable theory needs to be taught in a classroom environment where the key propositions and the logical structure of the theory can be clearly laid out and mastered by the students. We believe that it is important that enough continuous time is devoted to theoretical elements of occupational knowledge so that it is learned and assessed systematically, rather than on a piecemeal basis. This entails that, in many cases, block release, rather than day release, will be the appropriate allocation for college-based parts of professional formation, at least for the theory elements of the applied theoretical segment of occupational knowledge.

We have seen already that in a practical syllogism which one might use to construct a maxim for action, a crucial step lies in the second premise:

This is a situation where the theory applies, circumstances C obtain and result R is required.

Now learning applicable theory does not, of course, entail that one knows either *when* or *how* the theory is to be applied. There is an important sense in which this cannot be learned through instruction, since it is important that one recognizes situations as relevant and *that* certain circumstances obtain in them. At the very least, one requires an informed perception and the ability to make judgements 'in the field'. On the other hand, if after having learned the elements of the theory, one is immediately put in a situation where these recognitional and judgmental abilities are required, furthermore when it is a high stakes situation where the consequences of failure or of less than optimum performance can be serious and damaging and finally, where the time-constrained flow of an operational situation leaves little room for reflection, correction or for margin of error, the danger is that novices will not have a chance to fully develop their skill. Spectacular failure with ensuing damage may well wreck their confidence.

There is, therefore, a very good case to be made out for *simulatory practice*, prior to engagement in the workplace. Simulatory practice involves the setting up of a scenario in which the student has the opportunity to recognize a situation within which the relevant theory applies, circumstances obtain in which the theory informs one that a certain operation is required in order to achieve the desired result. Simulation allows the novice to recognize a situation, investigate the circumstances and make a theoretically informed judgment without operational pressures, time constraints and penalties. It has the further virtue of allowing students to face situations and use equipment that are not yet in use within the workplace, thus giving them a range of skills that will be relevant to operational and technical advance. Having gained the perceptual, judgmental and manipulative confidence that a simulated situation may bring, the student is ready to work in a *controlled* operational environment, where operational pressures are brought into play but in a way that the student is not exposed to their full pressure. Probationary practice of this kind allows novices to build up operational confidence and to gradually expand the range of their performance into more and more demanding situations in which an increasing element of independent judgment is required.

The upshot is that vocational education involving the acquisition of applied theoretical knowledge should contain substantial elements of college based work in which both the theoretical and the simulatory elements of the experience are introduced, followed by controlled practice in operational conditions under the guidance of a senior worker who is able to guide and monitor the performance of the apprentice. This in turn suggests an outline model for work-based learning against which the modern apprenticeship might reasonably be judged. Although this model cannot be rigidly applied in all circumstances it clearly implies an element of block rather than day attendance for the theoretical elements of the course, a substantial amount of simulated technical practice and a structured and assessed introduction to the pressures of the workplace. This analysis of applied theoretical knowledge has not, it should be added, addressed the whole curriculum of the modern technical worker. There is a substantial amount of occupational and industrial as well as task knowledge to be acquired, to do with the role of any occupation and industry in society and in its dealing with the public. There is also the important element of health and safety at work, which contains both theoretical and practical elements. These other elements of the curriculum, in our view lend themselves to both theoretical and practical development and hence should also be treated within the tripartite structure that we have outlined.

### **Conclusions**

The alternative model of learning proposed is one that is familiar in many European countries, including Germany, the Netherlands and Denmark. What we have attempted to draw out in this paper is that it involves a very different system of training from that currently in place in Britain. Both conceptually and in practice, the old craft-related model of learning in Britain, as reintroduced with the Modern Apprenticeship, can no longer be sustained. However any new model of learning requires that theoretical knowledge be applied in a different way, given the changes in the labour process that are required or have already taken place. It can no longer rest on generalisation through induction on the basis of a range of practical experiences. A system of learning relevant theories and leaning to recognise instances of theoretical propositions in practical situations, the deductive method, is proposed as an alternative. This could be built around three methods: block release for abstract and theoretical knowledge; simulatory practice combined with this to understand how this is applied; and work experience. But to be effective such a vocational education needs to become a combined responsibility of: those who regulate it (the state); those who train; those who receive training; and those in the workplace who accommodate the trainee through work experience and subsequent employment, both employees and employers. Thus it can no longer be a system resting on the goodwill of the individual employer, which the Modern Apprenticeship has well illustrated cannot anyway be sustained.