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From learning for the knowledge-based economy to learning for growth: re-examining clusters, innovation and qualifications

Laura James, David Guile and Lorna Unwin

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From learning for the knowledge-based economy to learning for growth: re-examining clusters, innovation and qualifications

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Abstract

Policymakers have claimed for many years that the UK should develop a knowledge-based economy (KBE). This vision shaped New Labour's policies for vocational education and training (VET), higher education, and skills, and was based on the assumption that the UK required a better skilled workforce with higher levels of education to compete in a globalised economy. Learning for the KBE, according to this analysis, requires individuals to acquire measurable knowledge or skills in the form of qualifications through formal education and training, which will allegedly improve national economic competitiveness and productivity. This paper argues that quite different conceptualisations of learning for the KBE can be drawn from the 'cluster' literature, which analyses the processes which underpin innovation and learning in regional agglomerations of economic activity. It shows how the cluster literature can and should be used as a basis to open up a debate about the nature, scale and location of the learning processes that support the KBE, the implications of which have not yet been fully appreciated in the fields of VET and skills policy. The paper concludes with some recommendations for the new Coalition Government as it develops polices to rebalance and grow the UK economy.

Introduction

It has been widely claimed by policymakers for over a decade that the UK should develop a knowledge-based economy (KBE) in response to economic globalisation and the transfer of manufacturing jobs to lower cost countries. According to this view, the UK can only remain competitive by specialising in innovative, high value-added goods and services, produced by highly skilled 'knowledge workers'. This vision shaped New Labour's policies for vocational education and training (VET), higher education, and skills, based on the assumption that the UK required a better skilled workforce with higher levels of education to compete in a globalised economy (e.g. DTI, 1998; 2001; 2003; BIS, 2009). Learning for the KBE, according to this analysis, requires individuals to acquire measurable knowledge or skills in the form of qualifications through formal education and training, which will allegedly improve national economic competitiveness and productivity.

In this paper, we argue that quite different conceptualisations of learning for the KBE can be drawn from the fields of economic geography and regional studies; in particular, the 'cluster' literature, which analyses the processes which underpin successful innovation, knowledge transfer and learning in regional agglomerations of economic activity. The cluster concept has been very influential in the areas of regional development and innovation policy; informing, for example, the creation of Regional Development Agencies (RDAs) in 1999 (see Keep *et al*, 2006, for a critical assessment). However, there has been limited engagement with skills policy[1], despite the fact that 'learning' is a concept that features prominently in the literature. This is partly because New Labour linked both educational and economic policies to the notion of the KBE and therefore saw no need to discuss the similarities and differences between learning in each. It is also partly because those writing about clusters have drawn on notions about learning from the Organizational Science (OS) literature, such as 'cognitive thresholds', that take learning for granted, or mixed the term (apparently) indiscriminately with concepts such as knowledge flows, exchanges, spillovers and interactions (see, for example, Malmberg and Power, 2005). In this paper, we aim to draw out the conceptualisations of learning that underpin the cluster literature and consider their implications for VET and skills policies in the context of the KBE. We identify three important insights: a) that learning is interactive, involving both

[1] An exception to this is David Finegold's (1999) work on 'High Skills Ecosystems', which draws explicitly on the cluster literature, although he does not discuss learning processes in any depth.

individual and institutional actors, and therefore territorially embedded; b) that learning is a collective process that can be conceptualised at the scale of the firm and region, as well as the individual; and c) that learning should be seen not only as the acquisition of specific technical (or 'component') knowledge but also in terms of routines and informal institutions ('architectural knowledge'). The cluster literature continues to evolve, particularly in response to criticism of its over-emphasis on regionalised interactions (Bunnell and Coe, 2001; Bathelt *et al*, 2004). We recognise this geographical critique and stress that our argument is *not* that the assumptions of the cluster literature should be uncritically translated into policy prescriptions, as has largely happened in regional development, with mixed results. Rather, we argue that the significance of the cluster literature lies in the way it opens up a debate about the nature, scale and location of the learning processes that support the KBE. We suggest that these issues should be considered carefully in relation to policies which aim to support innovation and economic growth.

The Coalition Government, elected in May 2010, has continued the emphasis on individual credentials and also New Labour's demand that colleges of further education and universities needed to raise their game in relation to meeting employers' needs. In addition, the new government has picked up Peter Mandelson's call for the creation of a 'modern class of technicians, associate professionals and people with higher level craft and trade skills' (BIS, 2009, 6). This appears to be part of the new government's vision for rebalancing the UK economy in order to lessen the reliance on financial services and support manufacturing. To that end, there has been more talk from Coalition ministers responsible for skills policy about increasing the number of apprentices and establishing a new form of 'technical school' (University Technical Colleges) for 14-19 year olds than there has about the KBE. Yet, the dream of the KBE, and continued faith in the potential of the cluster model, remains alive. In his first major speech as Prime Minister, David Cameron, announced that rebalancing the economy did not mean 'picking winners, but it does mean supporting growing industries – aerospace, pharmaceuticals, high-value manufacturing, hi-tech engineering, low carbon technology. And all the knowledge-based businesses including the creative industries' (Cameron, 2010). Similarly, Vince Cable (2010), Secretary of State for Business, Innovation and Skills, has stressed the importance of developing 'business driven high technology clusters with academic links' in the UK which would bring higher education and leading edge businesses together to maximise knowledge creation and transfer. The Coalition Government faces a considerable challenge

in relation to creating the conditions necessary to both rebalance and grow the economy. This paper argues that it will need to move beyond the obsession with a qualifications-led approach that has dominated skills policy for so many years *and* adopt a more nuanced perspective regarding the insights that can be drawn from the cluster literature.

UK skills policy and the KBE

Although the idea of a KBE can be traced back to the work of the management theorist, Peter Drucker (1959) and the sociologist Daniel Bell (1973), the term 'knowledge economy', and its synonym, the 'knowledge-based economy', did not emerge until the early 1990s. The development of a KBE has since become the guiding principle for economic development policy across the world, although it remains a poorly (often tautologically) defined and contested concept (Fuller and Unwin, 2010; Dankbaar and Vissers, 2009). Brinkley (2008) suggests that the idea of a KBE has been operationalised by defining: knowledge industries (i.e. high tech manufacturing or knowledge intensive services); knowledge workers (i.e. those with degrees or in the top three occupational codes); knowledge assets (e.g. investment in R&D); and knowledge services (i.e. value/volume of trade in knowledge industries). These represent relatively narrow, quantitative definitions of the KBE. Alternatively, the KBE can be seen as an umbrella concept, used to represent complex processes of socio-economic restructuring, which seem to be characterised by the increasing importance of information processing and knowledge creation across all areas of economic activity. These include economic growth based on investment in Science, Technology, Engineering and Mathematics (STEM), the development of information and communication technologies, economic globalisation, increasing numbers of well-educated workers and customers, and the development of entirely new hi-tech sectors and industries.

The ambiguous definition of the KBE allows it to be used as shorthand for on-going economic restructuring, as an aspiration for economic development, or in reference to specialised industrial sectors or sections of the population. This malleability of meaning is clearly evident in the development of the KBE concept in British policymaking. In 1998, the DTI described the KBE as 'a general phenomenon encompassing the exploitation and use of knowledge in all production and service activities, not just those sometimes classified as high-tech or knowledge intensive' (DTI 1998, 2). This was set in the context of economic

globalisation in which individuals faced the expectation of less stable career trajectories, and so would need to participate in lifelong learning. Initially at least, policy-makers did not focus solely on degree or postgraduate level skills, but also encouraged individuals with lower level skills to gain accreditation for them in the workplace through competence-based assessment leading to National Vocational Qualifications (NVQs) grouped within the National Qualifications Framework (NQF). The number of NVQs grew considerably to cover occupations and sectors where previously credentials had not been available below a certain level (or not at all – e.g. in retailing). NVQs were made the mandatory qualification for all government-funded training programmes for young people and adults (including apprenticeships). Following the Leitch Review of Skills (2006), intermediate level skills were also given greater attention, with the aim of creating a 'technician class'. These measures sat alongside the expansion of universities and targets for 50% of 18-30 year olds to enter higher education.

The creation of the Department for Innovation, Universities and Skills (DIUS) in 2007, which was later merged into the Department for Business Innovation and Skills (BIS) in 2009, reflected a shift towards a narrower definition the KBE and the kind of skills that it requires. From this time, the KBE was increasingly referred to in terms of technology and science-driven innovation, although policies continued to focus on qualifications. Thus, the 2009 BIS White Paper, *Skills For Growth*, stressed the importance of increasing the number of students studying subjects such as life sciences, digital media, advanced manufacturing, engineering construction and low carbon energy (BIS 2009, 10).

Developing skills for the KBE continues to be seen in terms of improving *inputs* of knowledge in the form of qualified labour (albeit with a narrower set of disciplinary priorities) rather than supporting *processes* of learning or innovation. Learning for the KBE, according to conventional skills policy analysis, can therefore be characterised as the individualised acquisition of existing knowledge or skills, with clearly defined disciplinary (or occupational) boundaries, in the form of qualifications. Learning is seen as an activity undertaken during discontinuous periods of study or training, which can largely be distinguished from 'work', and the knowledge that is learned in one context (e.g. college) is assumed to be readily transferable to others (e.g. a workplace).

There has, however, been a sustained critique of the pursuit of 'knowledge-based' economic growth via the credentialisation of the UK workforce. Firstly, there is criticism of the idea that increasing skill levels leads straightforwardly to increased productivity, or economic growth (Wolf, 2004). Keep and Mayhew (2009) also point out that the Government's focus on skills' supply ignores the fact that there is relatively weak demand from employers (see also UKCES, 2009). Secondly, it is clear that the interconnections between processes of restructuring must be analysed carefully, rather than using the KBE as shorthand for all, or reading off a simplistic relationship between them. Globalisation, for example, has generally been used to support a standard argument for more 'knowledge' and more 'skills' to improve economic competitiveness. This has been strongly criticised by Brown and Lauder (2006) and Brown *et al* (2008), who question the assumption that a high skill, high wage equilibrium in developed countries is possible in a globalised world. Similarly, as Zuboff (1988) argued, technological advances may in fact reduce, rather than increase, the skill requirements of certain jobs through a process of routinisation or automation. Finally, addressing the question of learning directly, Guile (2002; 2003) identifies three key problems with the UK policy framework for VET and skills. Firstly, it falsely equates learning with the acquisition of formal qualifications or certified knowledge and skills. Secondly, it implies that learning can be achieved through the adaptation of existing educational institutions or the use of ICT. Thirdly, it assumes that the constant accumulation of qualifications in line with national targets for education and training is sufficient evidence of the creation of a 'learning society' (Guile 2003, 11).

Clearly the argument that increasing skill levels through formal qualifications is the most important form of learning for the KBE is problematic. As Brown *et al* (2008) suggest, education levels are only part of the story. Rather, 'it is how the capabilities of the workforce are combined in innovative and productive ways that holds the key [to economic competitiveness]'(ibid, 141). In this respect, the cluster literature is helpful because it conceives of learning not in terms of qualifications but as an integral part of the process of innovation and the production of goods and services (see also Felstead *et al* 2009). The next section gives a brief overview of the cluster literature before examining two key contributions in greater depth.

Clusters

The cluster literature developed from a longstanding academic interest in the endurance of regional-scale agglomerations of economic activity and the competitive advantages they endow upon firms located within them. This interest dates back to the work of Marshall (1890) who first identified what he termed 'industrial districts' in northern England. Renewed interest was sparked in the 1980s by the recognition that certain regional agglomerations (e.g. Emilia Romagna and Baden Württemberg) were highly competitive in the face of globalisation and the crisis of Fordism (Storper, 1995).

Porter (1998, 199) defined a cluster as 'a geographically proximate group of interconnected companies and associated institutions in a particular field, linked by commonalities and complementarities', although there are many other definitions abound (see Asheim *et al*, 2006). Feser (1998, 26) argues, for example, that '…clusters are not just related and supporting industries and institutions, but rather related and supporting institutions that are more competitive by virtue of their relationships'. Although clusters are most often identified empirically at a regional scale, they are not necessarily coterminous with administrative regions (themselves extremely varied in size).

Gordon and McCann (2000) identify three ideal types of cluster, summarising the different theoretical arguments about the benefits that supposedly accrue to firms located within them. The first is the 'pure agglomeration model', in which firms within a cluster benefit from positive externalities such as enhanced local skills supplies, specialized services, and localized knowledge spillovers. This model presumes no co-operation beyond what is in the individual interests of each firm. By contrast, the 'industrial-complex model' is based on vertical disintegration and outsourcing where firms benefit from reduced transaction costs and an improvement in supplier quality and productivity by clustering together. Finally, the 'social network model' is based on the idea that social networks within a cluster transcend firm boundaries and engender trust, which makes firms within the cluster willing to undertake cooperative and joint ventures, and act collectively to reach common goals.

A range of different cluster theories, often combining elements of these ideal typical categories, developed over the same period that the KBE became preeminent in economic policy discourse (see Asheim *et al,* 2006, for a review). Consequently, a large part of this literature focussed on the importance of innovation and 'localised' learning. Innovation was seen an interactive process involving a variety of actors, hence the importance of proximity between firms and other organisations located in a cluster, which supposedly increases the potential for frequent and intensive 'knowledge interactions', easy observation and comparison of peers. Such interactions are mediated by a range of formal and informal institutions, and Amin and Thrift (1995, 101) used the term 'institutional thickness' to characterise localities where these institutions are numerous and supportive. Storper's (1997) notion of 'untraded interdependencies' also captures the web of relations and intangible resources, such as embedded routines, reciprocity and trust, which firms located in regional clusters are allegedly able to draw upon.

The kind of knowledge involved in regionalised interactions has been the subject of intense debate, particularly regarding the contentious distinction between tacit and codified knowledge (Gertler, 2003; Duguid, 2005). Contributors to the debate have tended to perpetuate the idea that tacit knowledge (that is difficult to express) and codified knowledge (that can be represented through words or numbers) are separate types of knowledge, rather than 'interdependent' dimensions of knowledge (Polanyi, 1967). From the former perspective, tacit knowledge, being 'sticky' and difficult to transfer, confers localised advantages that cannot easily be emulated elsewhere whereas it is easier to transfer codified knowledge over long distances (Asheim and Isaksen, 2002). However, this assumption has been challenged by a more nuanced set of arguments about the learning that takes place between actors who are not permanently co-located; for example, through networks of practice and temporary clusters (Maskell *et al,* 2004; Bathelt and Schuldt, 2008). Nevertheless, it was from these arguments that learning emerged as a central – if poorly defined – concept in the cluster literature.

As Visser and Atzema (2008, 1171) describe, the cluster concept has spawned countless policy initiatives across Europe and elsewhere as policy makers have accepted the assumption that regionalised economic systems are an appropriate scale at which to address economic development and competitiveness by promoting collective learning, innovation and collaborative networks. Despite the impact of the cluster literature on regional policy, it

has, however, had little influence on education and skills policy in the UK. Yet the cluster literature suggests that the kind of learning which underpins the KBE is quite different to that which is currently prioritised by VET and skills policy-makers. Although skilled labour is acknowledged as an important feature of successful clusters, it is the way in which production processes are organised and institutionally supported, rather than the training of individuals or supply of skills, which is considered crucial for competitiveness. Innovative products or services, rather than qualifications, are the most important outcome of learning. Critics have correctly identified the limitations of the cluster concept in over-emphasising regionalised interactions when most firms are involved in multi-scalar relationships (e.g. Simmie, 2004; Moodysson, 2008; Wolfe and Gertler, 2004). This does not, however, detract from three key insights that can be drawn from the cluster literature.

The first is that *learning is interactive.* Running through the cluster literature is the idea that a web of interactions and relationships between firms and/or other institutions facilitates and supports learning. The second is that that *learning can be conceptualised at different scales*. The cluster literature has relatively little to say about learning by individuals, but opens a debate about whether and how firms, institutions and regions might be understood to engage in collective learning, and how learning at different scales is connected. The importance accorded to territorially embedded institutions and routines in the cluster literature implies a third insight: that *learning resources* include both *'component knowledge'* which is specific to one part of a production system (e.g. technical or marketing knowledge), but also *'architectural knowledge'*, which relates to the organisation of a whole system or set of overarching institutions[2].

In the following discussion, two models of localised learning within clusters are used to unpack these key insights and explore them in greater depth, before critically assessing their potential contribution to skills and VET policy in the UK. We first examine the work of Maskell and Malmberg (e.g. 1999; 2007) who have written extensively on the concept of 'localised learning', which is interactive and dependent on place-based institutional resources. We then turn to the work of Pinch *et al* (Henry and Pinch, 2000; Pinch *et al*,

[2] Architectural knowledge differs from 'work process knowledge' (Boreham *et al*, 2002), which refers to workers' understanding of how their work role fits into the work processes of the organisation as a whole. Architectural knowledge encompasses a much wider understanding of the institutions and networks within which an organisation is embedded.

2003; Tallman *et al*, 2004) who have developed an alternative model of localised learning based on the concepts of architectural and component knowledge. Their work suggests ways in which different learning resources are combined at the scale of the firm and the regional cluster.

Localised learning in clusters

The concept of 'localised learning', developed by Peter Maskell and Anders Malmberg, is designed to apply across industrial sectors and is based on a conception of learning that is both interactive and context dependent. They propose that the key to industrial competitiveness is now innovation rather than static price competition. They argue that innovation is often incremental rather than radical, and this leads them to focus on the ways in which firms learn through the 'everyday' production of goods and services, rather than the activities of specialised research and development teams. Their work is set within an evolutionary framework which comprises two elements. Firstly, firms' learning trajectories are path dependent over time as they develop routines to manage the process of innovation. Secondly, regions themselves develop path dependent localised capabilities, which comprise a variety of 'assets' such as infrastructure, a skilled labour force and supportive institutions. Maskell and Malmberg take a broad perspective on institutions, and include very 'informal' institutions such as norms of behaviour and business conventions, as well as 'formal' institutions such as chambers of commerce or universities. They argue that the localised capabilities of a particular region evolve slowly over time and guide processes of economic development. They also represent an important source of competitive advantage for firms. Within this general framework Maskell and Malmberg identify three specific ways in which firms learn from each other: monitoring rivals; interaction with suppliers and clients; and 'buzz' (spontaneous learning through social or professional interactions).

Innovation and path dependent learning

Innovation lies at the heart of Maskell and Malmberg's ideas about learning, which is understood in terms of the processes through which firms learn how to produce new and better goods and services. It is therefore a collective, rather than individualised, notion of

learning, and is seen as dependent upon interactions between firms and other organisations, rather than the inspiration of a lone genius. As Mytelka and Smith (2002, 1472) describe, innovation is seen as 'path dependent, locationally specific and institutionally shaped'.

Maskell and Malmberg (1999, 180) argue that 'most new knowledge emerges from problem-solving, often on a trial-and-error basis, and as such it is normally arrived at incrementally'. Thus, firms learn through problem-solving as they try to develop new products and processes, although the kind of knowledge involved is not specified. Maskell and Malmberg argue that firms develop routines and internal procedures to manage the process of innovation. These become extraordinarily durable and establish path dependent 'learning trajectories' (1999, 180). Thus firms become 'myopic' as:

> …evolutionary processes of social or technical innovation, selection, and retention lead to the gradual build-up of routines that allow actors to economize on fact-finding and information processes...They tend to look for solutions close to already existing routines, but they also tend to concentrate their search in their spatial vicinity (2007, 613-14).

The concept of myopia implies disequilibrium and heterogeneity. In other words, firms in similar fields of activity vary in their learning trajectories rather than converging towards one 'best practice', and the differences between firms 'provides material for a continuing process of selection and interactive knowledge creation' (Maskell and Malmberg 2007, 609). However, whilst there is variety (and competition) between firms, there is also some degree of cohesion in terms of the meso and macro level institutional contexts in which they operate. This is a result of the development of path dependent 'localised capabilities'. Figure 1 shows a stylised regional trajectory based on a set of localised capabilities that shape the learning trajectories of individual firms.

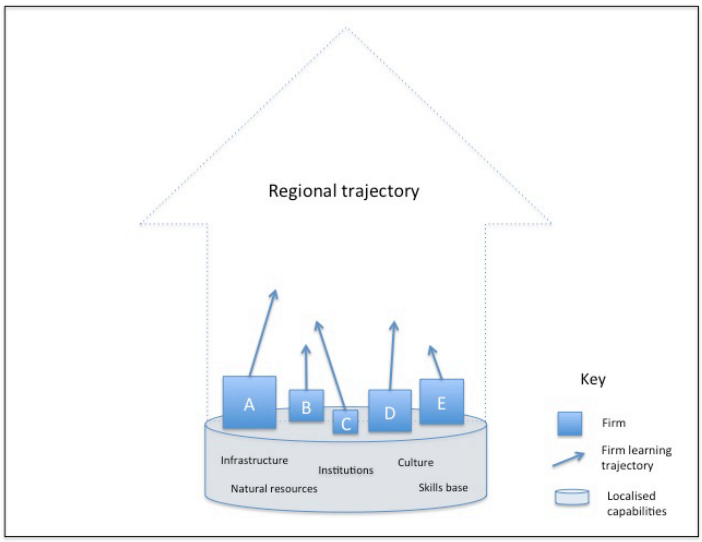

Figure 1: Heterogeneous firm learning trajectories within an overall regional trajectory

Localised capabilities

Maskell and Malmberg argue that localised capabilities underpin and give direction to processes of knowledge creation and exchange. They consist of infrastructure and the built environment, natural resources, institutional endowment, knowledge and skills. As a result of globalisation and advances in ICT and transportation, many factors of production and previously unique capabilities are now available in (or can be relatively cheaply transferred to) most parts of the world. Malmberg and Maskell call this a process of 'ubiquitification'. However, some forms of knowledge creation and exchange are rooted in the cultural, institutional, and social structures of regions and clusters (the terms are used interchangeably). Institutions develop over time alongside economic specialisation, and form distinctive and resilient combinations. Successful routines and institutions that have developed over time are shared assets that support competitive advantage because they are difficult to imitate elsewhere.

There are, however, obvious drawbacks to durable localised capabilities. The path dependence of innovation processes privileges knowledge accumulation rather than radical developments. When circumstances change (as in, for example, the introduction of new technologies), old routines, institutions, and assets may become out-dated. The decline of the old industrial areas of northeast England exemplifies the problems that may beset

regions in this situation (Hudson, 1999). In light of this criticism, Malmberg and Maskell insist that the concept of localised learning does not mean that 'local' learning is necessarily superior to learning between actors who are not located in the same regional cluster. They argue that the ability to build 'absorptive capacity' (Cohen and Levinthal, 1990) and develop network relations, or 'pipelines', to knowledge sources elsewhere is probably one of the most important localised capabilities. Thus, strategic partnerships of interregional or international scale may help to prevent damaging 'lock-in' when learning 'myopia' and out-dated institutions prevent renewal.

Learning by monitoring, interacting and 'buzz'

In addition to setting out a conceptualisation of localised capabilities that support and guide localised learning in general, Maskell and Malmberg (1999) identify three specific mechanisms through which firms learn from one another: learning by interacting; learning by monitoring; and learning through buzz (Figure 2).

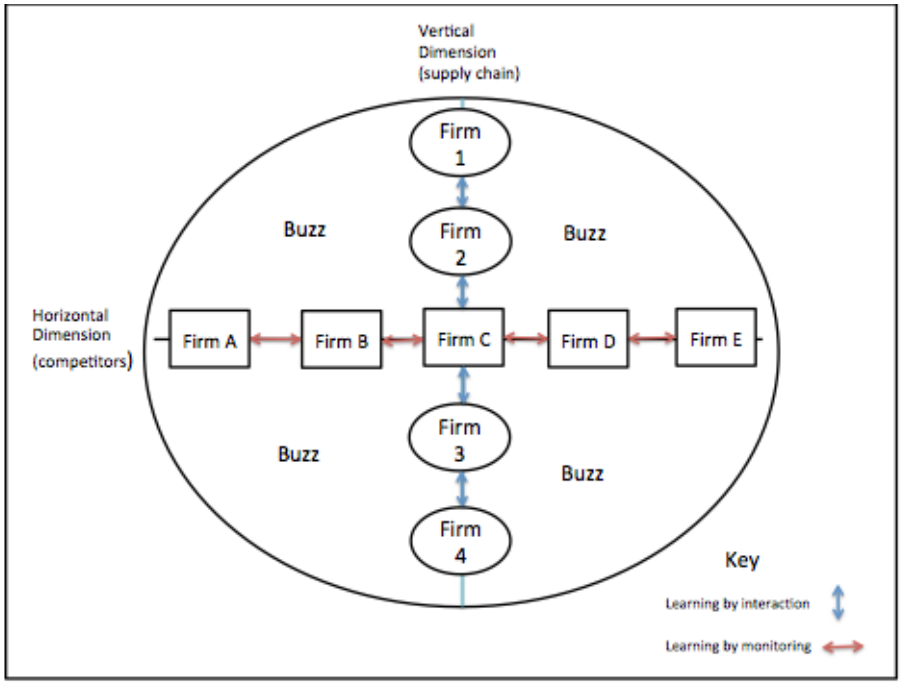

Figure 2: Learning by interacting, monitoring, and buzz

Learning by interacting takes place along the vertical dimension of a region or cluster, which, '... consists of firms linked through input-output relations while possessing

knowledge, experience, and skills useful for undertaking dissimilar but complementary activities' (Malmberg and Maskell, 2002, 438). Malmberg and Maskell acknowledge that the importance of localised interactions between suppliers and clients have been exaggerated in the cluster literature (as few studies have found significant linkages between co-located firms; see Malmberg and Power, 2005). Nonetheless, they suggest, firms do learn from those with which whom they trade and jointly solve production problems. The success of this process depends upon a sophisticated division of labour, where firms become specialised and knowledgeable in different parts of a value chain. This may happen as a cluster of economic activity evolves over time and new firms 'spin off', or through the attraction of specialised suppliers and demanding customers who move to a developing cluster.

Learning by monitoring takes place along the horizontal dimension between firms who are engaged in similar activities and are therefore rivals and competitors. Firms learn from each other by watching the activities of rivals, and comparing dissimilar practices in order to identify and imitate superior solutions. Crucially, trust is not a prerequisite for learning and it does not require any direct contact between the firms. It does, however, require a situation where are many firms are undertaking similar activities and are able to observe each other with little effort or cost.

Inter-firm learning is subject to what Malmberg and Maskell (2002, 440) term 'cognitive thresholds', where the knowledge bases of firms are sufficiently different for learning to take place, and 'cognitive ceilings,' above which cognitive distance is too great and learning is very difficult. Proximity between firms is important for information and knowledge exchange that requires regular and direct face-to-face contact. Proximity also makes it more likely that firms will share a common institutional context and set of localised capabilities, which will facilitate learning between them. In other words, Malmberg and Maskell argue, the ability to benefit from the heterogeneity of rival (or collaborating) firms, is related to clustering which supports cognitive correspondence through shared institutions and practices.

The third process through which firms learn - 'buzz' - is more difficult to grasp, not least because of a number of competing and ambiguous definitions. Bathelt (2007, 1290) describes it as 'a thick Web of information, knowledge and inspiration that circulate (sic)

between the actors of a cluster'. A similar concept is 'noise' (Grabher 2002, 209) where 'actors are not deliberately 'scanning' their environment in search of a specific piece of information but rather are surrounded by a concoction of rumours, impressions, recommendations, trade folklore and strategic information'. The key features of buzz, then, are that it enables spontaneous or incidental learning, and is dependent on regular face-to-face interactions within social and professional networks. It therefore contrasts with both the monitoring of competitors and the deliberate sharing of knowledge between suppliers and customers, and is represented in Figure 2 in the space around 'vertical' supply chain relationships and 'horizontal' monitoring of rivals.

Malmberg and Maskell's invocation of both cognitive and social processes indicates some ambiguity in their underlying conceptualisation of learning. Their model of localised learning incorporates both collective learning (the development of routines and localised capabilities) and individualised learning, (notably buzz), which implies an understanding of learning as participation, *and* as acquisition (e.g. assimilating knowledge through observation). Maskell and Malmberg do not, however, specify the relationship - or differences - between individual and collective learning. There is also little recognition of different kinds of learning resources, particularly of different kinds of knowledge, beyond noting the importance of tacit knowledge in the development of localised capabilities.

Learning resources in the firm and region: architectural and component knowledge

Pinch, Henry, Jenkins and Tallman's alternative model of localised learning in clusters, which is set out in two publications - Tallman *et al* (2004) and Pinch *et al* (2003) – addresses the latter weaknesses of Malmberg and Maskell's work. This model is based on two key ideas. The first is that nature of organisational learning depends upon the kind of knowledge involved, and here they build on the work of Henderson and Clark (1990) and Matusik and Hill (1998) in distinguishing between 'component' and 'architectural' knowledge. The relationship between these kinds of knowledge determines whether, and how, firms can learn from one another. The second argument, which builds upon this insight, is that stocks of component and architectural knowledge exist both at the scale of

the firm and the region. Pinch *et al* argue that asymmetry in the flow of component and architectural knowledge between firms and regions helps to explain competitive advantage. Their detailed empirical studies of the motor racing industry in the so-called 'Motor Sport Valley' in the UK enable a much more fine-grained analysis of the processes that support individual and collective learning than is achieved by Malmberg and Maskell, although they too struggle to distinguish clearly between them conceptually.

Component knowledge and architectural knowledge

The terms 'component' and 'architectural' knowledge, which are understood as dimensions along a continuum rather than discrete categories, capture the distinction between knowledge that relates to identifiable parts of an organisational system (component) and knowledge that relates to the structure of the whole system (architectural).

Pinch *et al* define component knowledge as:

> ...those specific knowledge resources, skills, and technologies that relate to identifiable parts of an organizational system, rather than to the whole…in high-technology-oriented industries, such knowledge would include scientific, technical and design skills. In consumer industries it would include knowledge of consumer behaviour, marketing, sales and promotion (2003, 379).

Component knowledge is not necessarily codified and may be simple, tangible and explicit ('technical') or complex, intangible and tacit ('systemic'). Tallman *et al* (2004, 264) suggest that 'highly technical knowledge includes blue-prints, product patents, step-by-step instructions for an operation, and so forth, whereas systemic component knowledge includes scientific theory, complex process patents, activities that require "learning by doing", organizational routines, and so forth.' Nonetheless, a key feature of component knowledge is that it is *relatively* transparent and therefore relatively mobile between organisations with similar knowledge bases.

Architectural knowledge, by contrast, relates to the organisation of an entire system and the structures and routines within which component knowledge is created and used. Pinch *et al*

(2003) suggest that aspects of architectural knowledge are captured by concepts from organisational and management studies, such as 'routines' (Nelson and Winter, 1982) and 'core competencies' (Prahalad and Hamel, 1990). They describe architectural knowledge as '... typically intangible and tacit in character … tied to routines and capabilities that involve multiple individuals working in teams … both its exact nature and ties to performance are likely to be ambiguous' (Pinch *et* al, 2003, 381).

The key characteristic of architectural knowledge is the difficulty of transferring it between organisations, because it evolves endogenously over time and is highly path dependent. Pinch *et al* argue that architectural knowledge is crucial in determining the capacity of firms to 'acquire, assimilate and adopt' new component knowledge. Common elements of architectural knowledge may enhance the ability of firms to exchange component knowledge and vice versa.

The key characteristics of component and architectural knowledge, as ideal types, are shown in Table 1.

Component Knowledge	Architectural knowledge
An identifiable element of a body of knowledge. Relates to exogenous conditions or laws. Relatively transparent. Runs from highly technical to highly systemic. Relatively mobile among organisations with similar stocks of knowledge.	Relates to an understanding of a system of knowledge or organisation. Path dependent and endogenous to the system in which it is embedded. Non-transparent and causally ambiguous. Tacit, systemic, and embedded. Relatively immobile between organisations.

Table 1: Key features of component and architectural knowledge (adapted from Tallman *et al*, 2004, 263)

Learning at the scale of the firm and the region

Pinch *et al* (2003) and Tallman *et al* (2004) build on the distinction between component and architectural knowledge to make a second argument: that these knowledge types can be

conceptualised at the scale of the firm *and* the regional cluster. From this proposition they develop a model of 'localised learning' based on 'stocks' and asymmetrical 'flows' of component and architectural knowledge between these levels. They suggest that most knowledge-flows between firms in a regional cluster are composed of component knowledge. Where firms are clustered, are engaged in similar activities, and there is frequent interaction between firms or movement of employees between them, 'spillovers' of component knowledge are more likely. Component knowledge that is kept internal to the firm may generate competitive advantage for a limited period of time, but this is unlikely to be sustained, depending on the degree to which it is technical (more mobile) or systemic (less mobile).

Firm-specific architectural knowledge is not readily accessible by other firms and results in differences in the stocks and applications of component knowledge among firms in a cluster. However, cluster-level architectural knowledge, developed as firms interact with one another, is shared between them. It represents:

> … understandings developed at the regional cluster level through the routinisation of the network of interactions, interdependencies, and common interests among the members. It is a sense of the "rules of the game," available as a tacit understanding to members of the cluster (Tallman *et al*, 2004, 265).

Pinch *et al* argue that a stock of common cluster-level architectural knowledge increases collective absorptive (or learning) capacity within the cluster because it facilitates the flow of component knowledge. However, because it is 'socially embedded' and evolves 'organically through localized practices' (Pinch *et al*, 2003, 385), it is very difficult for firms located outside the cluster to emulate. In other words, 'stocks of cluster-level architectural knowledge will enhance the transfer, absorption, and application of component knowledge across firm boundaries within the regional cluster and retard flows of component knowledge across cluster boundaries' (Tallman *et al*, 2004, 266).

The concept of architectural knowledge supposes a situation where individual employees are members of one, firm-level community, which exists within a larger community at the scale of the region, where firms themselves make up the membership. Henry and Pinch's (2000) empirical study of the so-called Motor Sport Valley in the UK demonstrates

ambiguity of this model, which conceptualises learning at multiple scales but does not clearly specify the relationship between individual and collective forms of learning. Henry and Pinch (2000, 195) follow Blackler (1995) and invoke the idea that knowledge can be '*embrained' in individuals and 'embodied'* in organisations. Based on this well-known distinction in the Organizational Learning literature, Henry and Pinch (2000) firstly identify a number of routes by which knowledge 'travels' between firms. They describe the movement of key engineers and designers between firms in the Valley (and occasionally outside it) as one of the most important ways in which knowledge is 'spread'. High staff turnover, together with constant start ups of new firms, results in constant 'churning' of highly skilled workers who develop technical knowledge in specific areas such as composites or aerodynamics, as well as an understanding of different firms' architectural knowledge. It is assumed that when individual engineers or designers join a firm their individual knowledge automatically, and unproblematically, becomes part of the collective knowledge of the firm. How this takes place and the effects of a key employee leaving a firm remain, however, a rather under-developed feature of their analysis. Similarly, although they argue that firms learn through interactions with suppliers who provide components or machinery, and by observing engineers from competitors in the pit lane, at test tracks and race meetings, there is no analysis of the 'scaling-up' of individual employees' learning into firm-level routines.

Furthermore, Henry and Pinch, like Maskell and Malmberg, assert that learning by individuals is translated into collective learning at the scale of the region. Indeed they conclude that it is individuals rather than firms who make up the community of knowledge and the 'churning of personnel [which] raises the knowledge base of the industry *as a whole within the region*' (ibid, 199). In this sense, regions themselves can be understood as capable of 'learning'.

Clusters and learning

Despite operating with a broader conceptualisation of learning compared with the educational policy, the cluster literature also, paradoxically, relies on individualistic and mentalistic notions to explain the process of learning that they describe. As a consequence,

there is an unresolved tension: on the one hand, writers stress the collective outcomes of learning at the level of the firm, regional cluster, and by extension national economy; and, on the other hand, assume that these collective outcomes occur because individuals are somehow able to absorb and scale-up different forms of knowledge that they have learnt.

This tension exists primarily because the cluster literature has adopted unproblematically ideas about learning from some sections of the Organizational Science (OS) literature; for example, the notions of 'stocks', 'flows', 'transfers' and 'absorption'. These are predicated on cognitive assumptions about learning that have been demonstrated (by social scientists working with social theories of learning) to be deeply problematic (Engeström, 1987; Lave, 1988; Hutchins, 1995; Sfard, 1998). The gist of the critique is that Cognitive Science encourages a focus on individuals and, in the process, plays down or ignores the constitutive role of the social in individual and group learning.

Brown and Duguid (2001) use Lave and Wenger's concept of 'participation' to explain the way in which people develop forms of occupational expertise and identity as they engage with the customs, habits, and ways of thinking associated with specific workplace 'communities of practice'. Participation can be used to explain the way in which individuals and groups with common occupational identities and preoccupations firstly, learn to think, communicate and act as they gradually internalise insights from more experienced members of a community of practice. Secondly, they learn to share knowledge amongst themselves by telling 'war stories' about practice-based problems they have encountered and strategies they have used to overcome them. Thirdly, they move between their workplace community of practice and 'community networks', which comprise of people from the same occupation but different workplace, and, in the process, gain ideas about how to tackle current problems or match innovations that are occurring elsewhere (Duguid, 2005).

This conception of learning, which is based on a very subtle and nuanced account of how people engage with ideas and practical suggestions in different contexts, and use them as a resource to help them to develop and/or extend their expertise, is radically different from the way in which Pinch *et al* (2003, 383), paraphrase Brown and Duguid (2001). They suggest that component knowledge constitutes the 'cargo' that is moved around on the 'rails' of cluster-level architectural knowledge. This implies that the former is a specific entity whose immediate and/or future significance can be grasped in workplaces when it is

located within a wider system of knowledge. In contrast, the former account of learning makes it clear that firms have to address not only the "epistemic-social issues of different kinds of knowledge", but also the "psychosocial ones of different levels of trust and motivation" (Brown and Duguid, 2001, 209), if they are to maximize all the forms of knowledge held by their workforces. Addressing these challenges requires firms to establish work practices that encourage people to commit themselves to, 'bridge occupational epistemologies' (Cook and Brown, 1999). This requires that established conventions about how to think and act do not inhibit members of occupational communities from recognising the value of the insights offered to them by members of other occupational communities. In the case of trust and motivation, cultures of inquiry where the emphasis is on the mutual benefit of sharing ideas and practices must be fostered.

These arguments, based on a view of learning as a social and collective process, provide alternative framework to interpret the insights from the cluster literature. In Malmberg and Maskell's conceptualisation of learning, for example, firms use social processes, such as formal rules, norms of behaviour, and routines to interpret information, to build individuals' and the firm's absorptive capacity. At first sight, this account of learning appears similar to Brown and Duguid's ideas. On closer inspection, however, it is apparent that the writers are using the terms social and collective in rather different ways. Brown and Duguid see social processes, such as participation in workplace practice, as having a constitutive role; in other words, people develop their knowledge and skill as they undertake tasks by following instructions, observing others and asking questions. In contrast, Malmberg and Maskell see the social processes as the organisational conditions that enable people to exercise their cognitive capabilities.

In Henry and Pinch's (2000) study it is assumed that when individual engineers or designers join a firm their individual knowledge automatically, and unproblematically, becomes part of the collective knowledge of the firm. From Brown and Duguid's perspective, however, the engineers and designers are able to 'transfer' knowledge between them as they participate together in work practices by creating the conditions to firstly, bridge different epistemologies (i.e. disciplinary and occupationally-specific ways of thinking, communicating and acting) so as to share war stories in ways that are meaningful to other colleagues and secondly, foster a climate of trust and mutual respect and support for one another.

Thus, Brown and Duguid's conception of learning as a social process has a two-fold advantage. It explains, firstly, how participation in extant work practices reproduces local capabilities and, in the process, reinforces path dependencies. Secondly, participation in new work practices is essential if firms and/or regions want to radically transform existing path dependencies and create new capabilities to reflect the new industrial "paths" they wish to pursue.

Conclusions

Since the being elected in May 2010, the Coalition Government has emphasised the need to both rebalance and grow the UK economy. This will require a more sophisticated approach to VET and skills policy than has hitherto been envisaged and one that has significant implications for the current way in which government organises itself. Under New Labour (and to some extent since the 1980s) there was a division between policies that foster innovation/regional development (collective learning as innovation) and educational policies that promote the acquisition of qualifications (individualised learning). This artificial separation has led successive governments to invent and micro-manage a centralised system of vocational qualifications whose value has been called into question (see Wolf, 2011).

Whilst the cluster literature has been primarily associated with policies for collective learning as innovation, it also has the potential to help bridge this divide. One of the most important insights is that learning should not be equated solely with individuals acquiring qualifications. Rather, the critical issue is the extent to which production is organised and supported within firms and regions to facilitate individual and collective learning and, in the process, pave the way for innovation. Thus, the cluster literature affirmed the links between different kinds of individual and collective learning, although its unproblematic acceptance of the cognitive assumptions about learning restricted its ability to theorise the relation between the two. We have suggested that this may be overcome by drawing on the work of Brown and Duguid (2001). They have drawn on social theories of learning and, hence, used the concept of 'participation' to offer an integrated perspective on individual and collective learning. Learning occurs, according to Brown and Duguid, in one of two main ways. Firstly, as individuals participate in existing work patterns, become familiar with extant

knowledge and skill, and gradually work with other members of their occupational community of practice to evolve that knowledge and skill. Secondly, collectives participate in activities to borrow new ideas from other contexts and/or generate new ideas, use those ideas to redesign work practice, and develop the new forms of knowledge and skill required for work. The common link is that individual and collective learning is a social process.

In light of the challenge to facilitate growth in the private sector, the issue of supporting firms to innovate and to re-train people who have been made redundant is likely to move to the centre of public policy debates. Our argument is that when ideas from the cluster literature are reconceptualised in accordance with the notion of participation, new insights emerge. Above all, this reconceptualisation reveals the importance of developing integrated policies for: a) learning as innovation and b) learning as the acquisition of knowledge and skill. Although they represent two conceptions of learning, both are based on a common process – participation in different work practices, work-related discussions and work-related education and training. The difference between them is that the outcome from the former is to strengthen and/or create new industrial pathways based on the identification of new capabilities and new component and architectural knowledge, whereas the outcome from the latter is the creation of new company-specific approaches and/or partnerships with further and higher education institutions to facilitate skill development.

Having abolished the Regional Development Agencies in England, which championed ‘cluster’ policies, the Coalition Government has announced the creation of 21 ‘Enterprise Zones’ across the UK (to be overseen by the Department for Communities and Local Government) as part of its drive for economic growth. Within the zones, planning rules and business taxation will be relaxed in the hope of encouraging private sector employers to invest in areas that have become very reliant on public sector employment. At the same time, the government has announced that it intends to focus its attention on six sectors of the economy that it regards as being particularly important: advanced manufacturing; digital and creative industries; business and professional services; retail; construction; and healthcare and life sciences. (HM Treasury/BIS 2010) Cosmetic alterations to the architecture supporting business growth and skill development is, however, unlikely to move the country forward.

Driving forward economic growth and competitiveness clearly requires effort on a broad front and, given the current pessimistic forecasts about the UK economy, much needs to happen as quickly as possible. In order to translate the ideas in this paper into action, both in terms of policy and practice, we make the following recommendations. These are intended as stimulus for debate:

- Create a series of pilots (using the integrated concept of learning presented in this paper) aimed at stimulating innovative practices within the priority sectors listed above and any existing clusters, supported by pump-priming funds from government;
- Reconfigure the remit of the Sector Skills Councils so that they can work closely with Group Training Organisations (GTAs) and professional bodies to pilot new arrangements for the creation of skill development programmes linked to the proposed pilots;
- Give local authorities powers (and responsibility) to create the conditions for firms to participate in inter-sectoral discussions about how to diversify local path dependencies, develop new capabilities, and new combinations of component and architectural knowledge;
- Reclaim the role of vocational qualifications so as purely kitemarks of expertise rather than instruments for showing and boosting the UK's performance in international league tables;
- Enable the Skills Funding Agency and the Higher Education Funding Councils to allocate funding for non-accredited courses so that colleges, training providers and universities can support the above developments.

There is a wealth of expertise in the UK on innovation, regeneration and economic development, but it is fragmented across government, the research and development community, and a range of agencies. There is and always has been a great deal of innovative practice, but, due to a tendency to 'let a thousand flowers bloom', initiatives are often ad hoc and short-term, and the lessons gained from them quickly evaporate. We have hesitated in suggesting that a specific body be established to try and drive the ideas we

propose forward – rather, we would encourage government to build on and support the existing expertise spread across the relevant stakeholders. We do, however, want to stress that we need much more public debate (nationally and locally) about these matters and so, hence, rather than the creation of yet another quango, new mechanisms (such as the pilots suggested above) need to be found to try out new ways of working and to learn from the process.

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