

Vocational education institutions' role in national innovation

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ABSTRACT. This article distinguishes research – the discovery of new knowledge – from innovation, which is understood to be the transformation of practice in a community or the incorporation of existing knowledge into economic activity. From a survey of roles served by vocational education institutions in a number of OECD countries the paper argues that vocational education institutions have a potentially crucial role in mediating between the creators of new knowledge – researchers and their institutions – and the users of knowledge. They are ideally placed to develop this role since innovation is a local activity and vocational education institutions are much more widely geographically dispersed than research intensive institutes. The paper concludes by posing six steps vocational education institutions should follow to establish a role in national innovation.

Introduction

Whether they are of the highest status and exclusivity such as France's *grandes écoles* or more commonly held in lower esteem with less selective entry, vocational education institutes are rarely accorded a role in research and development. An explicit role in and funding for research is becoming even more exclusive as the research race intensifies with the publication of world ranks of universities. The most credible world ranks such as those published by Shanghai Jiao Tong University's institute of higher education and the Swiss *Zentrum für Wissenschafts- und Technologiestudien* (Centre for Science and Technology Studies) are based heavily on research, mostly in the empirical sciences. Spooked by the dominance of the top of the ranks by Harvard and other US universities funded at extraordinarily high levels, governments in the UK, China, Singapore, Germany and Australia are concentrating research funding in a few select universities. Even within universities vice chancellors are seeking to match the top universities in at least some fields by concentrating internal research support in a few designated areas. Some universities' research policies seem to be building skyscrapers in the desert – denuding research resources throughout the campus to build considerable concentrations in prominent fields.

Yet, as the then joint editors argued in their editorial in the first issue of this journal (Elliott & Moreland, 1996) 'research is at the very core of all teaching and attempts to uncouple the two do both a disservice. For the editors, the value of research is not only that it can inform and improve practice, but also that it can provide a conceptual framework within which the complexities, tensions and contradictions of the practitioner may be explored.' This observation can be expanded to establish a vital role for vocational education institutions in research and development by building on the recent work on the contribution of research to economic development.

Pure research is useless; innovation is gold

Research – the discovery of new knowledge – has intrinsic worth, and many scholars undertake research for this reason and to satisfy their curiosity. While this may be a sufficient justification of research for an individual, institutions require further justification and a means for deciding on the allocation of resources between researchers and very often between research and other institutional roles. A common method is to value research that is valued by other researchers – peers in the field – and much research and research policy is directed at winning esteem from other researchers. There is a hierarchy of research esteem which differs somewhat by discipline and context. A rough hierarchy starts with publication of a research article and proceeds upwards to earning a research doctorate, refereeing manuscripts submitted for publication, winning research grants, being cited extensively by other researchers, occupying a senior academic appointment, winning prizes awarded by peers, membership of editorial boards of research journals, refereeing grants, and membership of learned academies. At the acme of research esteem is winning a Nobel prize other than for peace or literature and winning a Field medal in mathematics.

Yet governments invest far more heavily in research than in the creative arts, music or poetry not for its intrinsic worth nor to win research esteem and still less to indulge researchers' curiosity, but for its contribution to economic development. To generate economic benefit and thus to warrant its extensive support by governments research has to be incorporated into the productive process. As Salter & Martin (2001, p. 512) observe paraphrasing the OECD, 'knowledge and information abound, it is the *capacity* to use them in meaningful ways that is in scarce supply' (original emphasis). Notwithstanding its prominence in the self perceptions and projections of universities and their academic staff, research is a relatively minor if important contribution to national innovation. A view repeated more commonly than there is probably data to support it is that to turn a new idea into a product for every 1 unit of currency invested in research 10 have to be invested in development and 100 in retooling manufacturing. (Although for some empirical support see West, 2004, p. 29.)

Gibbons (2004, p. 97) argues that 'much innovation, and hence economic development, is dependent, less on original discoveries, and more on the timely take up, modification, and marketing of knowledge solutions that already exist but need to be adapted to local environments.' Marceau (2001, p. 8) and Lundvall & Borrás (1997, p. 133) observe that 'Incremental technical innovation based on learning, diffusion of technology and organisational change are certainly more important for the performance of any single national or regional economy than major innovations'. This is supported by Moussouris (1998, pp. 93-4) who argues that there is too much concentration on research 'breakthroughs' and too little attention to the importance of research diffusion in generating economic development.

The Australian Department of Industry, Science and Resources (1999, p. 9) defined innovation as 'the process that incorporates knowledge into economic activity'. The Department (1999, p. 9) argued that 'Innovation covers "the million little things" which improve the operation of firms or other institutions. It is a much broader concept than research and development (R&D), although the outcomes of R&D are among its most powerful expressions' (reference omitted). Denning (2004) describes innovation in its most general form –

An innovation is a transformation of practice in a community. It is not the same as the invention of a new idea or object. The real work of innovation is in the transformation of practice. In this definition, community can be small, as in a workgroup, or large as in the whole world. A transformation of practice in the community won't happen unless the new practice generates more value

to the members than the old. Value may not be economic; it may be pride, reputation, health, safety, freedom. Many innovations were preceded or enabled by inventions; but many innovations occurred without a significant invention.

This is a radically different orientation to cultivating research esteem which is judged by the interests and values of other researchers, not those who use research. Nobel laureates are as successful at stimulating national innovation as olympic gold medalist are at improving a nation's fitness or prima donnas are at improving a nation's singing.

Innovation mediating processes and institutions

The traditional universities and other institutes that concentrate on research and maximising research esteem are rarely major stimulations of community innovation. Lundvall & Borrás (1997, p. 154) argue that knowledge production at universities needs to be integrated more closely with the innovation process since much innovation depends on tacit knowledge (Polanyi, 1967) which is socially embedded in organisational networks as Lundvall (1992, pp. 8-9) had earlier observed. They (Lundvall & Borrás, 1997, p. 154) argue that innovation blurs the conceptually distinct but in practice continuous stages of invention, innovation and diffusion.

Nowotny *et al* (2001, p. 90) argue that since the knowledge economy (Drucker, 1969) depends on the dissemination of research 'the small number of universities which are research-led rather than access-orientated . . . no longer occup[y] such a central role in this new economy. . . . Indeed, it is possible to argue that non-elite universities [and other institutions] may be better placed to play these "knowledge games", because they have more experience of – and less distaste for – training and building up "knowledgeable" communities.' Scott (2000, p. 200) notes that 'it has proved difficult to contain research within the emergent elite [research-intensive university] sector; it has spread into other, newer and more open, sectors of higher education'. While the spread of research beyond designated research institutions may be a problem for mode 1 research, it is a success for mode 2 research. Scott (2000, pp 200-1) says that 'mode 2 expands the number of research, or knowledge, actors. . . . Other actors, once dismissed as mere "disseminators", "brokers" or "users" of research results, are now actively involved in their "production" (which itself has become a more capacious, and ambiguous, category)'.

Shapiro (1993, p. 60) argues that 'It will, in the final analysis, be the quality of the mediating social, political and cultural institutions that enable a society to actually benefit from the value of its investments in higher education.' Edquist and colleagues (2001, p. 17) argue that organisational learning is important for gaining benefit from the knowledge economy and that this is developed by interaction with a range of organisations, presumably not just research-intensive universities and institutes.

Lasuen (1973, p 186) observes that innovation is promoted by successful agricultural extension programs that build constant technical assistance on long-term sales contracts because they reduce the adoption risks of agricultural innovations. He argues that the same measures should be introduced in industry and services to support the adoption of innovation. So part of the explanation for the high efficiency of much of Australian agriculture, which is in stark contrast to many other OECD countries, may be the broad diffusion of research and innovation through the applied research laboratories, demonstration farms and extension and outreach activities of State departments of agriculture that operated during most of the 20th century (Moodie, 2004). Australian rural research and development was restructured in 1989

into 14 national rural research and development corporations funded by industry levies and matching Government funds which are strongly committed to the uptake and adoption of research (Rural Industries Research and Development Corporation, 2005). One such corporation is the Grape and Wine Research and Development Corporation which plays an important role in the Australian wine cluster described by Porter (2002). In contrast there is no comparable applied research laboratories and diffusion, demonstration and outreach for secondary industries in which Australia's performance has generally been much weaker.

Gibbons (2004, p. 97) argues that since much innovation depends on 'the timely take up, modification, and marketing of knowledge solutions that already exist but need to be adapted to local environments', innovation 'remains a local phenomenon and serves as a constant reminder that globalisation turns on differences in sentiments of a population, in its particular institutional structures that are designed to achieve collective purposes, and in the cultures that give meaning and value to the decisions taken.' Innovative clusters are normally located within a relatively small geographic area, at least in the early stages of innovation. This is because innovation relies on tacit knowledge (Polanyi, 1967) picked up in the informal sharing of knowledge and ideas in 'dense' networks of firms and other relevant institutions (Salter & Martin 2001, p. 524). Rosenfeld (1998a, pp. 1-2) argues that the close proximity and spatial interdependence of clusters create 'collective externalities' that allow participants to transact business more cheaply and easily, achieve a scale that attracts specialised services and resources, resolve problems more quickly and efficiently, and learn sooner and more directly about new technologies and practices.

Since a country normally wants to foster innovation more widely than it can afford to maintain research-intensive institutes, more widely dispersed bodies may have a role in knowledge production or reproduction, and vocational education institutes are ideally placed to take up such a role. Rosenfeld (1998a, p. 4) argues that in the US 'community colleges are particularly helpful to small and mid-sized enterprises, since they are better positioned to reach them than universities, consultants, and service agencies, many of which prefer not to bother with "know-how" needs that may not be technologically challenging or of a scale that can be sufficiently profitable'. Wolfe (2002, p. 22) argues that the highly decentralised nature of the US's post-secondary education is, amongst other factors, 'absolutely central' to the formation and success of Silicon Valley and many other innovative clusters studied in the US.

Bialski (2002?, p. 4) argues that Canada's technical colleges are a considerable untapped resource for innovation. Grubb (2005) elaborates that Canadian and US 'community colleges carry out a variety of activities intended to enhance the local community, including advice to local firms (especially small- and medium-size enterprises) about new technologies, convening industry clusters and groups of local employers around common needs, identifying the education and technology needs of local employers, surveying the business environment for new developments and technologies, and helping attract new employers by providing customised training'. The Association of Community Colleges of Canada adds that Canadian community colleges have a role in assisting product and process development, providing industry access to equipment and pilot plants and assisting with market and product feasibility assessments (Madgett *et al* 2005, p. 344). Grubb (2005, p. 26) adds that various research and development roles, particularly for their regions, are carried out by Finnish polytechnics (see also OECD, 2003, pp. 52-3; Curtain, 2004, p. 26), French *instituts universitaires de technologie*, 'German *Fachhochschulen*, which are responsible for research transfer into smaller and medium sized enterprises and for working with public administration' and Norwegian state colleges. Pickersgill (2005, p. 23) notes that 'Import substitution, market constraints, broad-based skills, familiarity with modern technology and production processes, and a need to adapt to local conditions, together meant that innovation in Australian industry

generally occurred through the extension and modification of existing technologies to fit new purposes. This typically relies on “trade” and “para-professional” level engagement with production, rather than research and development departments. It is this level that the Australian technical education system had developed to serve.’

Perhaps the strongest role of vocational education institutions in knowledge (re)production is in Yusuf & Evenett’s (1998, p. 52) description for the World Bank of technology development in the German *Land* or Federal State of Baden-Württemberg. Baden-Württemberg has one of the densest concentrations of advanced manufacturing in the world, producing cars and commercial vehicles (DaimlerChrysler), sports cars (Porsche), electrical products (Bosch, Boss), software (SAP) and printing presses (Heidelberg) amongst other high quality products (Ministry of Science, Research and the Arts of Baden-Württemberg, 2005). Baden-Württemberg coordinates and supports its vocational education through local chambers of industry and commerce and company levies in the standard arrangement in the German coordinated market economy. The universities have their own technology transfer advice services, there are public research centres and inventors’ advice services, and Fraunhofer institutes provide specific contract-based technology transfer and development services, mainly to large companies (Yusuf & Evenett 2002, p. 52). In addition The Steinbeis Foundation for Economic Promotion has established over 300 specialised transfer centres at the region’s universities (European Communities, 2003), mostly at *Fachhochschulreife* (universities of applied sciences) and ‘often in cooperation with a nearby technical college’ (Yusuf & Evenett 2002, p. 52). Baden-Württemberg is also distinctive in Germany in having ten vocational academies, or *Berufsakademie*, that offer ‘premium apprenticeships’ mostly in the field of commerce and technology/engineering (Deißsinger, 2005, p. 102). Technical schools (*Berufsschulen*) are linked to between 10 and 20 firms closely associated with the universities.

A role for vocational education institutions in stimulating innovation

While there are occasional references to Canadian and US community colleges’ contribution to technology transfer, this is rarely included community colleges’ core roles which are typically vocational education, preparing students to transfer to four-year institutions, adult and community education, and labour force development. Likewise further education colleges in the UK and technical and further education institutes in Australia are rarely thought to have a role in their countries’ national innovation aside from providing skills and skilled workers needed by innovative firms or an innovative economy, which is mentioned by a number of writers (Dockery, 2001; Toner *et al*, 2004; Whittingham *et al*, 2004, p. 116). Ferrier, Trood & Whittingham (2003, p. 16) report that vocational education and training has been involved only marginally if at all in Australia’s cooperative research centres, which they say are a small but crucial element in the national innovation system (Porter, 1990) in their strong commitment to applied research and to the implementation and/or commercialisation of research. Ferrier and colleagues (2003, pp. 80-9) and Curtain (2004, pp. 38-41) also considered vocational education’s role in the diffusion of technology and Pickersgill & Edwards (2005) usefully put the issue in a broader context before moving to their main interest, the contribution of vocational education to innovation in regional industry.

However, Rosenfeld (1998b, pp 20-4) includes acting as a technology intermediary in his systematic categorisation of vocational education’s contribution to innovation. This may involve operating a demonstration and teaching centre of advanced technology, providing industry with technical help and advice, and acting as a hub for specialised industry education and training, information, and services. Accelerating diffusion may also involve the institution in scanning information about new developments in markets, techniques, and technologies

which it may then pass on to its clients. Vocational education institutions may also host cognate services provided by other agencies, such as technology deployment offices, R&D centres, and small business assistance centres. Vocational institutions may also operate new business incubators.

Table 1: Rosenfeld's categories of vocational education's contribution to innovation

Activity	Features
Education programs: entry to the work force	Academic standards articulated with higher education Comprehensive programs Strong links to industry Target industry clusters with special programs Serves disadvantaged groups Effective student recruitment
Upgrade skills and retraining: adapting to technology	Customised and contract education Forms training networks Uses flexible learning Teaching 'soft' technologies and skills Educating managers Retraining displaced workers
Technology intermediary: accelerating diffusion	Technology centres Technical help and advice Industry sector hubs Host technology services Operate new business incubators
Fomenting alliances: learning companies and learning communities	Forming alliances with industry Forming consortia with other colleges Cooperating with development agencies Facilitating intra-firm learning and technology diffusion

Source: adapted from Rosenfeld (1998a) table 2: categories of activities at technical colleges, p 9

Acting as a technology intermediary almost always also involves what Rosenfeld calls fomenting alliances. Together they suggest this action if vocational education institutes wish to participate in the innovation process directly in addition to providing services to innovative firms and industries.

1 *Emphasise innovation; eschew research*

Vocational education's role should be to stimulate 'the timely take up, modification, and marketing of knowledge solutions that already exist but need to be adapted to local environments' (Gibbons, 2004, p. 97) and not to conduct research in any of its pure or applied forms. Vocational education needs to emphasise this at the outset and keep reminding itself and everyone else since governments, universities and research institutes will, with some justification, repress what they perceive to be research aspirations entertained by vocational education and any other institution not currently engaged in research. It is necessary to keep emphasising this because research so heavily dominates many countries' thinking about innovation that many assume that it is not possible to contribute to innovation without also having a research role. Furthermore, vocational education needs to protect its role in innovation from migrating to and being overtaken by the very powerful research paradigms.

To do this vocational education should forswear all the trappings of research and research esteem: it should not seek research grants (although participating in funded research extension services would be appropriate), and while its staff should read research journals they should generally not publish in research journals and they should not have research titles. In areas with a rudimentary innovation system it will be necessary to adapt processes, structures and symbols of innovation from successful areas locally overseas.

2 *Develop a distinctive role in the national innovation system*

Vocational education should develop a distinctive role in the national innovation system. This will be different for different countries and perhaps for different industries, but vocational education's distinctive role could be based on two characteristics: that they don't conduct research and that they operate locally.

3 *Act locally, learn globally*

Innovation is a local activity, although it often applies knowledge learned from overseas. Each vocational education institute should therefore identify opportunities to stimulate innovation in their region. Innovation opportunities will be different for each vocational education institute since they are in different regions and have different strengths.

4 *Form multiple partnerships*

Vocational education institutions will contribute to innovation by broadening the partnerships they already have with local businesses, service providers and industry associations. They should also form partnerships with businesses and service providers in other regions in their own country and overseas which have practices of interest to those in their own region, and other partnerships with universities and research institutes locally and overseas conducting research relevant to their region.

5 *Establish a national network of vocational education innovation institutes*

Since much knowledge about innovation is tacit it is best learned and shared by networks of bodies with shared interests. Vocational education institutes interested in contributing to national innovation should therefore establish a national network to share experiences and insights.

6 *Act in the long term*

While the final introduction and impact of a new technique may happen remarkably quickly, innovation builds on knowledge, skills, attitudes, capabilities and processes developed over a long period. Vocational education should therefore develop its role in stimulating innovation over a long period, say 10 years initially.

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