

A knowledge-based economy landscape: Implications for tertiary education and research training in Australia

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This paper discusses the higher education sector's role in a knowledge-based economy through research training, that is, doctoral education. It also examines how a Faculty of Education supports its doctoral candidates in their endeavours to become 'knowledge producers'. Two themes are explored: one is Australia's limited investment in education by international standards; and the other is the research training needs and circumstances of doctoral candidates who are located in professional and workplace contexts. The paper discusses the role of online support and a Doctoral Studies in Education (DSE) online seminar program to support primarily off-campus, part-time mid-career professionals. These are typical of many of Australia's doctoral candidates. E-learning is examined as part of a comprehensive support and research training strategy for doctoral candidates studying at a distance. We discuss the sorts of opportunities and experiences our candidates receive and the extent to which they are readied to work effectively in a knowledge-based economy.

Introduction

A knowledge-based economy can be defined as: 'an economy in which the production, distribution and use of knowledge is the main driver of growth, wealth creation, and employment across all industries' (Department of Industry, Training and Research, in Andrews, 2004, p. 4). Accordingly, a knowledge-based economy is reliant on harnessing the human and social capital produced by knowledge workers for growth and prosperity. Adapting to a knowledge-based economy requires a significant shift in thinking—at government, academic, corporate and personal levels. It stands to reason that education broadly, and higher education in particular, has an important role to play in the development of new knowledge practices and processes. Amid the social transformation from physical to abstract forms of

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production it is crucial that coherent and comprehensive educational processes are put in place. While it is widely accepted that highly developed 'Western' nations have a huge advantage in developing the social conditions to forge a knowledge economy, several recent reports suggest that some such countries are more committed to this process than others.

A recent report by the Australian Council of Deans of Education (Kalantzis & Harvey, 2004) claims that, 'Commonwealth expenditure on education in Australia has declined as a percentage of GDP over the last three decades ... whereas in the UK, US and Singapore, substantial public investment increases are being made in the education sector.' (p. 9). This observation was foreshadowed in a 2001 report that examined Australian knowledge-based economy indicators over time against OECD benchmarks, wherein it was revealed that:

Australia is undergoing an investment crisis in a range of factors of production in the knowledge economy. If this crisis continues unabated not only will Australia fail to become a leading producer of knowledge economy products and services; the nation will become increasingly dependant upon others for these things, leading to further adverse consequences for the trade position, for the level and character of jobs and opportunities, and for the accumulation and distribution of wealth. (Considine et al., 2001, p. 4)

Despite rhetorical recognition of the increasingly important role that education will play in helping societies to participate actively and robustly in the knowledge economy (Kalantzis & Harvey, 2004), Australia, it seems, is less forthcoming with resource allocation. Wood (2003), for example, argues that when measured against knowledge-based economy trend indicators, Australia is an 'under-performing nation', spending well under the OECD mean for investment in knowledge. Table 1 clearly positions Australia below the OECD mean in relation to commitment to knowledge production as a percentage of Gross Domestic Product (GDP).

In critiquing Australia's lack of commitment to the advance of the knowledge-based economy, extensive commentary has been assembled around the work of universities (see DETYA, 1998; Kemp, 1999; Singh & Knight, 2002). Underpinning this is a wide recognition that the higher education sector has an important role to play in producing graduates with the sorts of skills, aptitudes and understandings that will allow them to contribute effectively to the development and practice of a knowledge-based economy. With an increasing demand for flexible, autonomous, self-directed, collaborative, adaptable, resourceful and sensitive graduates (Senge, 1990; Drucker, 1999; Salmi, 2002), universities are being forced to review many of the core assumptions that have long underpinned their pedagogic theory and practice. Concern exists here that calls to change across the higher education sector are being driven by tightening funding models, rather than by perceived social and educational need.

It is in this context that we seek to explore the relationship between doctoral education and knowledge-based economy theory. In the context of this paper, we focus our attention on the practices associated with doctoral education at a distance,

Table 1. OECD comparisons, by percentage of GDP for investment in knowledge, 2002

	Higher education	Research & Development	Software	Total	Change in investment in knowledge to GDP ratio since last review (1999/2000) ¹
Sweden	0.9	4.1	1.8	6.8	1.7
USA	2.2	2.7	1.8	6.6	1.2
Finland	1.1	3.4	1.5	6.1	1.3
Korea	1.9	2.5	1.4	5.9	1.0
Denmark	1.3	2.5	1.6	5.5	1.8
OECD ²	1.4	2.5	1.3	5.2	0.9
Japan	0.7	3.1	1.3	5.0	1.2
Canada	1.7	2.0	1.1	4.7	0.1
Australia	1.1	1.6	1.4	4.1	0.3
Germany	0.7	2.5	0.7	3.9	0.5
Belgium	0.9	2.2	0.7	3.8	–
EU ²	0.7	2.1	0.9	3.8	0.5
The Netherlands	0.8	1.8	1.2	3.8	0.3
France	0.6	2.3	0.8	3.7	0.3
UK	0.7	1.9	1.1	3.7	0.2
Austria	0.5	2.1	0.8	3.4	1.2
Spain	0.9	1.0	0.8	2.8	0.7
New Zealand	1.1	1.2	0.5	2.8	–
Ireland	1.0	1.1	0.2	2.4	–0.2
Italy ³	0.6	1.1	0.7	2.4	0.3
Greece ³	0.8	0.6	0.5	1.9	0.8
Portugal	0.7	0.9	0.2	1.8	0.5

Source: OECD (2005). ¹1994–2001 for Greece and Italy. 1995–2002 for Korea. EU figure excludes Belgium, Greece and Italy. OECD figure excludes Belgium, Greece, Italy and New Zealand. ²Exclude Greece and Italy. ³2001 data.

and the extent to which this work engages with the emerging demands of knowledge economies. Specifically, we focus on our own practices associated with doctoral education and our involvement in the management and implementation of a doctoral education program. We reflect on the attributes our graduates develop through their involvement in our doctoral program and the extent to which they are readied to be effective workers within a knowledge-based economy. To achieve this we provide an overview of the principles and practices of a doctoral program offered by the Faculty of Education at Deakin University and draw on the examples from this program to describe the ways that we seek to prepare our graduates for work in a knowledge-based economy.

New knowledge and education

As the 21st century opens, tertiary education is facing unprecedented challenges, arising from the convergent impacts of globalization, the increasing importance of knowledge as a principal driver of growth, and the information and communications revolution. The

role of education in general, and of tertiary education in particular, is now more influential than ever in the construction of knowledge economies and democratic societies. Tertiary education is indeed central to the creation of the intellectual capacity on which knowledge production and utilization depend and to the promotion of the lifelong-learning practices necessary for updating people's knowledge and skills. (Salmi, 2002, p. 1)

Salmi (2002) clearly believes that the tertiary education sector must play a central role in preparing societies for new times. Here, graduates of research-based university programs that have appropriate research training and preparation are positioned to play a pivotal role in the progress of the knowledge-based economy. More specifically, Salmi argues that research and development activities, particularly higher-degree programs, are where the convergence of a knowledge-based economy and knowledge production and utilization will have a significant impact for organizations and nations. It is clear to Salmi that a shift to knowledge-based societies demands different ways of thinking about learning. Foremost here is the need for tertiary programs to find new ways of reaching and teaching people across an array of globalizing economic, cultural and social circumstances.

It is therefore a concern for higher education that people are identifying Australia's lack of strategic planning and commitment to education, including higher education, in addition to a general lack of investment in knowledge. The following comments exemplify the level of concern:

This view has been reinforced by many leading business people and entrepreneurs. To use an example, media magnate Rupert Murdoch noted the significance of expenditure on education and the future growth of a knowledge-based economy [and] dramatically emphasized that, because of the relatively low level of expenditure on higher education in Australia, its economy was threatened with something far worse than global disadvantage, namely global irrelevance. (Murdoch, in Wood, 2003, pp. 144–5)

Despite 'Backing Australia's Future II', the overall level of Australian research is projected to remain steady at 1.6% of GDP. Indeed, public investment in research is actually projected to decline over the next decade. This is disappointing given the clear links between research and economic growth. If for no other reason, the pragmatic case to invest in research is strong. For the discipline of Education, however, the problem is greater still. Education remains almost alone as a discipline of national importance without a dedicated research funding body. Indeed, there is less research funded in the field of Education than in nearly any other field. Redressing this imbalance is a key priority if Australia is to thrive in the knowledge economy. (Kalantzis & Harvey, 2004, p. 31)

While Kalantzis and Harvey are clearly concerned about the overall lack of resource that is being allocated to research and development in Australia, it is the discipline of education that they single out as being acutely under-resourced. Underpinning their concern is recognition that the shift to creative or knowledge-based society demands

different ways of thinking about learning and knowledge transfer. As a discipline, education has the potential to play a pivotal role in developing new learning frameworks. For example, existing pedagogic theory and practice around ‘communities of practice’, ‘collaborative learning’, ‘reflective practice’, ‘experiential learning’, ‘workplace learning’, ‘lifelong learning’ and ‘e-learning’, all provide educational frameworks for reaching and engaging people amid the increasing globalisation and massification of work and learning.

Accordingly, it is interesting to contemplate Breckenridge’s (2002) forecast of the ‘university of 2015’. Here, Breckenridge identifies an increasing demand for transformation around the conditions that are emerging amid the rise of the knowledge-based economy. He rehearses the wider emphasis being placed on the need for lifelong learning skills that already permeate the educational sector. This, Breckenridge explains, emanates from the need to create a flexible and continually developing workforce to both produce and cope with change. In more specific terms, he foregrounds the changing practices of ‘community’, ‘collaboration’ and ‘e-learning’ as important areas for the tertiary education sector to negotiate if it is to produce learners capable of an active and sustained engagement with a knowledge-based economy.

Many contemporary organizations are already moving towards knowledge organization models to better position themselves within a knowledge-based economy. Knowledge organization literature has itself evolved from the ‘learning organization’ ideas of Senge (among others) in the 1990s and is based on the notion that ‘to excel in the future organizations [must] discover how to tap people’s commitment and capacity to learn at all levels in an organization’ (Senge, 1990, p. 4) and master the five disciplines of the learning organization—personal mastery; mental models; shared vision; team learning; and systems thinking. Knowledge organization theory further extends learning organization theory and emphasizes the importance of harnessing the human and social capital of an organization. However, there are more recent theories that take into account a broader and more diverse understanding of the process and significance of knowledge production not only to the wealth of an organization, but also to the social, cultural and economic wealth and attractiveness of nations.

Florida (2003) draws on Drucker’s (1993) notion of the knowledge economy to propose that the engine of modern societies will be driven by a ‘creative class’ comprising of people who are not only well educated, but who can create new ideas, knowledge and products within and for the ‘creative economy’. In his terms, it is not just knowledge that is being traded, although this is important, but also styles, fashion, artefacts, imaginings, ideas, etc. Membership of the creative class, especially what Florida called the ‘super creative core’, comprises people in occupations within sciences, arts, computing and education. A society that is open to creative knowledge production is one that values ideas, difference, and even eccentricity and idiosyncrasy. More recently, Florida (2005) has noted that changes in government policy in the USA in response to the to the September 11 tragedy, such as the

Homeland Security Act and the Patriot Act, have diminished the levels of both formal and informal tolerance to others and to differences in the USA. In particular, he notes that there has been a decline in the numbers of international doctoral students, especially from origins deemed to be risky, and a decline in the numbers of international doctoral graduates remaining in the USA for postdoctoral work and residency. He argues that, from the USA's perspective, this is a potentially serious long-term problem, in that the size and diversity of the pool of research and innovation talent in the USA will gradually decline. Florida suggests, however, that major cities in nations such as Australia, Canada, New Zealand and Taiwan are becoming magnets for international doctoral talent that would otherwise have gone to the USA. To this extent, governments and universities may be well advised to consider refining their policies to take advantage of this flow of talent, because international doctoral graduates, whether they remain in their country of study as citizens or return back to their own countries, make contributions—during candidature and beyond, directly and indirectly—to the wealth of knowledge of and opportunities for the host country.

Producing the new researchers and thinkers in these fields is essential to what might be called the creative project and is central to our work in supporting our own doctoral candidates who are creating the new ideas and knowledge upon which future educational activities can be built, sustained and nourished. A demand for the production of new researchers helps to explain the motivation and energy that is behind the growth of PhDs in Australia (and elsewhere) across a diverse range of traditional and emerging disciplines (Evans et al., 2003b), including new forms within the creative and performing arts (Evans et al., 2003a). The work of Breckenridge, Florida and Kalantzis and Harvey, among others, encourages broader and more diverse thinking and imagining for/of the future.

The contemporary doctoral candidate

Using data derived from student enrolment figures from the Department of Education, Science and Training, Cumming and Ryland (2004) found that the profile of the doctoral candidate varies across disciplines. Table 2 summarizes their findings in this regard.

Table 2. The contemporary modal doctoral candidate based on 2003 DEST figures

Discipline	Mode of Study	Age	Gender
Agriculture, Engineering, Natural and Physical Sciences	Full time	Between 25 and 29	Male
Arts, Education, Society and Culture	Part time	Between 40 and 49	Female
Health	Full time	Between 30 and 39	Female
Architecture, Management	Part time	Between 40 and 49	Male

Source: Cumming & Ryland (2004, p. 3).

The notion, then, of a ‘young, full time, on-campus lab-coated male’ is no longer representative of contemporary doctoral candidates, although this image persists among policy-makers in government and the tertiary education sector in Australia. For example, only full-time doctoral candidates are eligible for Australian government scholarships, but of the 35,875 doctoral candidates enrolled in 2003, 36% were enrolled as part-time candidates. This percentage increases markedly in the professions, where, for example, 67% of candidates enrolled in the discipline of Education in 2003 were studying part time (Cumming & Ryland, 2004, p. 2).

Cumming and Ryland (2004) also recognize the important relationship between well-trained doctoral candidates and a knowledge-based economy:

Leaders and managers of doctoral education may need to give greater consideration and attention not only to the backgrounds, experiences and career trajectories of PhD candidates, but also to the quality of the learning environments in which they are operating. In knowledge-based economies and societies, the connections between study, research, training and work—especially at the doctoral level—are becoming increasingly interrelated and interdependent. Indeed, for many PhD candidates, the concept of ‘work’ embraces a broad range of activities including their own research, study, training, paid and unpaid employment—not to mention entrepreneurial initiatives and family/community responsibilities. (Cumming & Ryland, 2004, p. 12)

In recent years there has been a marked increase in doctoral candidates who undertake their work part time and, either formally or informally, at a distance (Evans, 2002; Cumming & Ryland, 2004). This growth is consistent with the rise of a knowledge-based economy, and the attitudes and practices it privileges. Understandings of the knowledge economy emerge from the rapid changes produced through globalization and its associated rapid changes in information and communication technologies (Drucker, 1999; Spender & Stewart, 2002). Embedded in the social consequences of these changes is an increasing emphasis on the need for people to develop sophisticated new literacies and advanced thinking skills in order to survive and prosper in an increasingly complex world.

The need to comprehend and manipulate the new communication technologies that are currently reshaping the fundamental ways people live are at the forefront of contemporary educational agendas. Whereas books and other print were the repositories and transmitters of knowledge in education, the application of digital information networks has become synonymous with contemporary understandings of best educational practice. To this end, there is a symbiotic relationship between e-learning and the emerging knowledge-based economy and society. By adding two-way communication opportunities to the knowledge base, e-learning changes the way individuals, teams and organizations interact and learn. Spender and Stewart (2002) believe that e-learning provides a new independence for learners that is ‘balanced by the new desire for collaboration, peer-to-peer exchange of information and the making of new collaborative solutions (as distinct from doing your own work)’ (Spender & Stewart, 2002, p. 9). Here, e-learning is understood as a

pedagogical device that encourages individuals to sort and share knowledge, rather than just accumulate it.

The nature of off-campus doctoral study is such that it strongly correlates with part-time study and it is the part-time/full-time distinction that is arguably more significant in terms of the differences between the doctoral candidates than the on-campus/off-campus distinction. As Barnacle and Usher (2003), and Evans (2002, 2006) argue, there is a case for explicitly recognizing the special contexts and potentials of part-time doctoral candidates. There has been some consideration in the literature of the matters of doctoral education and distance education, and its soul-mates open learning and flexible learning—see, for Australian examples, the work of Evans (1997), Evans and Pearson (1999), McWilliam and Palmer (1998), Pearson and Ford (1997) and Taylor (1998). Wikely and Muschamp (2004) have recently considered the issues involved in part-time professional doctorates at a distance in the UK.

Doctoral studies in education

Distance education has a long history in the schooling, college and university sectors, especially in the settler societies of North America and Australasia (Bolton, 1986). Since the rise of open universities in the last half of the twentieth century, there has been a considerable increase in the range and number of undergraduate and postgraduate courses offered through distance education. For example, in Australia, both university education and schooling has been offered by distance since the beginning of the twentieth century, and both have grown and developed over the past century as the needs, contexts and media have changed. There has also been a considerable increase in the range and number of undergraduate and, later, postgraduate courses offered through distance education in the last 40 years. Deakin University—along with the University of New England and The University of Queensland—was among the first to offer Master's degrees by coursework programs at a distance, in particular, its MBA and MEd programs (Bynner, 1986). Deakin University first offered doctoral programs by distance in 1980, including the Faculty of Education's doctoral program for on-campus and off-campus enrollees. Indeed, since 1989, DEST enrolment figures show that every Australian university has enrolled external doctoral candidates at some time between 1989 and 2004. There have been some universities, especially Deakin University and the University of New England, which have enrolled significant numbers of external doctoral candidates each year since 1989. We have also seen other universities, such as the University of South Australia and Curtin, expand their external doctoral enrolments strongly over the past few years.

Deakin University's Faculty of Education enrolled 'off-campus' doctoral candidates within three years of its establishment in 1977 and had its first doctoral graduates in 1984. The then School of Education was at the forefront of offering PhDs in Education at a distance. This was commensurate with the new university's

passion for educational innovation and what the foundation Vice-Chancellor called 'parity of esteem' between on-campus and off-campus programs and their graduates (Jevons, 1984). Deakin University's Faculty of Education also developed one of Australia's first Doctor of Education (EdD) programs through distance education, but unlike its American predecessor, opted for a research degree focusing on workplace-based research that would have 'parity of esteem' with the PhD (Brennan & Walker, 1994).

There are currently about 150 doctoral candidates enrolled in doctoral programs in the Faculty. About 85% are off-campus and part time and many candidates live overseas—from North America and Alaska through Europe, the Middle East, Asia and New Zealand. Most doctoral candidates in the education and training sector come to their studies as busy mid-career professionals who work full time in the sector and are often researching their own workplaces as part of their doctoral studies, hence their interest in off-campus part-time study. They are enrolled in research degrees which means that they study under the supervision of a principal and associate supervisor on an approved research project, a particularly isolating kind of study—and very different from their experiences of coursework degrees—and the majority of them live a long way from any of the Deakin University campuses.

The Faculty is mindful of these circumstances and a major focus has always been to provide a supportive environment for doctoral candidates who find themselves studying a research degree at a distance. For many years the Faculty has offered residential workshops twice per year, one each February on the Geelong (Victoria, Australia) campus and the other in New Zealand each August where a significant cohort of candidates reside. The Internet is used extensively—listservs, webpages, etc.—to promote opportunities for networking with peers and their supervisors at both the social and academic level. In 2002 an additional feature was added to this suite of support programs for doctoral candidates when an online seminar program called Doctoral Studies in Education (DSE) was launched. The catalyst for this new program was a review of the Doctor of Education (EdD) program in 2001 that concluded that the EdD structured research program, while helpful, was perhaps too onerous. It was felt that the research training aspects of the EdD program needed to be streamlined and that the new program should be made available to all doctoral candidates, not just those in the EdD program.

Planning for the new program began in 2001 and was undertaken by those in the Faculty most concerned with the issues of doctoral education and the program was developed with the most appropriate pedagogies and outcomes to support candidates in mind, while the means of providing this support, that is through electronic ('e') media was seen as an important, but secondary, concern. We knew that technology would change over time and did not want to be wedded to a particular company or type of proprietary technology. Therefore the program was designed to 'bolt on' the most appropriate technology for the times. There have already been two major changes in technology provision, from FirstClass[™] to WebCT[™] to the trialling in 2005 of Moodle, an open source course management

system for online learning (<http://www.moodle.org>). This is not to say that the ‘computer support’ systems were not absolutely central to the provision of the program, but rather that our expertise was in program design and development and our influence over the technology was limited, to a large extent, to what the university was committed to at the time(s).

The online seminar program was designed to support the candidate–supervisor relationship, while, at the same time, ensuring that all candidates have access to the best possible practice for the research training aspect of their candidature. This has provided the following benefits for the candidates and the Faculty:

- it allows the expertise of academics in the Faculty to be shared by all candidates. Academics with particular expertise in ethics, reviewing research literature, the colloquium process, online research, etc. now share their expertise with the whole doctoral community, not just their own doctoral candidates;
- to a certain extent, it frees up supervisors to concentrate on the scholarly part of supervision knowing that the research training aspects are being covered in the seminars;
- it provides a qualitative and quantitative measure for quality assurance purposes (e.g. AUQA—Australian University Quality Agency) where it has been difficult to measure research training competencies in the traditional supervisor–candidate only model.

Doctoral e-studies

Even though the ultimate goal of the doctorate is the production of an original contribution to knowledge, collaboration—particularly computer supported collaboration or e-learning—plays a vital role in the support and research training and as the means of building our doctoral community. Broadly, the Doctoral Studies in Education (DSE) online seminar program complements the suite of support services and practices described previously that are designed to forge a doctoral community in the Faculty. More specifically, the seminars within the program are designed to provide appropriate research training for each doctoral candidate as they move through their program of study with two major milestones in mind—the colloquium about one third of the way through the program and, ultimately, the examination of their thesis or folio.

It is believed that this online seminar program that began in 2002 is the first of its kind to be adopted for doctoral studies, certainly in Australia and quite possibly elsewhere. Collaboration is absolutely essential to the success of the online seminar program; it is also seen as a core competency for a knowledge-based economy. Our cohort of candidates, as already indicated, are recognized as being experienced education professionals—many are academics themselves, school principals, consultants and dedicated educators—and understandably their body of experience and knowledge is extensive. The convenors of each seminar understand their audience and work with them on a peer-to-peer level.

The online seminar series provided for all of our doctoral candidates is a primary source of collaborative research training. That said, in the quest for quality and timely completions, we continue to give primacy to the relationship between candidates and their supervisor(s). Indeed, an important element to the design and implementation of our online seminars is the need for them to supplement, not supplant, the role of the supervisor(s). To this end the seminars are overwhelmingly comprised of activities that articulate with each candidate's research agenda. For example, in the seminar titled '*Locating and Interpreting the Research Literature*', candidates are shown how to access and search a wide range of online databases. Candidates are given online tutorials on how to use these databases to access the sort of information they are looking for. The accompanying task invites them to locate and present ten citations that are relevant to their field. Several of these are expected to be full text versions. Candidates are required to submit their findings within the seminar, thus contributing to a pool of information shared and used for discussion. Further to this, the sifting and sorting process also becomes part of the seminar discussions. The '*Locating and Interpreting the Research Literature*' seminar culminates with instructional advice on how to set up, build and maintain a reference library using bibliographic software like Endnote, a skill that most researchers and employers of researchers already see as mandatory.

Our approach to the design and implementation of this online seminar program is supported in the literature by Garrison and Anderson (2003), who believe 'the essential features of e-learning extend beyond its access to information and build on its communicative and interactive features. The goal of e-learning, then, is to blend diversity and cohesiveness into a dynamic and intellectually challenging learning ecology. This interactivity goes far beyond the one-way transmission of content and extends our thinking regarding communications among human beings engaged in the educational process' (Garrison & Anderson, 2003, p. 3).

What makes the seminars work well are the candidates' levels of engagement and collaboration with one another around the readings and subsequent discussions in each seminar, and the collective building of knowledge in a collaborative learning environment (see Okada, 2005). This is where the extra dimension that e-learning can provide over more traditional correspondence or distance learning, or even some face-to-face master-student structured classes—the opportunities afforded to allow candidates to work with peers and really engage in the readings and discussions, providing their own experiences as examples—is evidenced. It is this cohort of candidates who best understand what each other is going through with their studies, often they do not get this level of engagement (or support) from their family or work colleagues who may, or may not, be sympathetic to their study. Outsiders may understand that their wife/husband/work colleague is studying for a PhD but they rarely understand just what doctoral study actually involves.

The other important practice we have in place in the provision of research training is the colloquium. The colloquium process is placed about one-third of the way through doctoral candidature as a vehicle for vetting the research design and practice

prior to it being undertaken. This is a fairly rigorous process within which the candidate must present a 10,000/15,000-word document outlining the relevance, significance and implementation of the research they are proposing to do. A five-member panel of academics and experts are convened for an oral presentation of this proposal. To this end, the colloquium stands as the only point of candidature where face-to-face contact is required. The colloquium serves a number of purposes in the progress of research training. The obvious being its carriage of the academic requirement for cogent oral presentation and argument. Lasting around two hours, the candidate can expect to explain and argue many aspects of their proposal. More importantly, the colloquium is a time where the candidate will receive important advice and guidance to take with them into the empirical phase of their program. Conducted in a spirit of support, not examination, we have found the colloquium to be a very productive process wherein intensive 'research training' is provided around the particular needs of each candidate.

Concluding comments

The notion of a 'learning ecology' (Brown, 2000; Garrison & Anderson, 2003) is pertinent to the conceptualization of new learning environments in which curriculum, pedagogy and learners coexist. Such a 'learning ecology', especially in terms of doctoral education, requires understanding within a knowledge-economy framework in order to provide appropriate and relevant doctoral education for the next decades. Developments in technology have paved the way for new learning communities to be established and nurtured globally in ways that were hitherto unavailable. Through e-learning we have been able to promote a learning framework for our doctoral candidates that places them at the centre of the learning and knowledge production process.

We recognize that the DSE is a work in progress, if for no other reason that 'learning ecology' and 'knowledge economy' are dynamic concepts and entities. We expect that our candidates' needs and contexts will continue to change and we will need to adapt to rapid advances in the technological capacities upon which we can draw. We expect these things to shape our future practices, as will changes to government and institutional policy. We suggest that such initiatives may help to develop research training strategies in Australian universities that enable the rising generation of research-based knowledge producers to learn their research skills and produce significant and original new knowledge where it counts: embedded in a knowledge-based economy.

There is a need, however, to develop institutional and governmental policy to address the current and future circumstances of doctoral education and its social and economic impacts. We have noted above how the patterns of enrolments have shifted in Australia to the extent that part time, professionally related doctoral candidates are now a significant proportion of the total. We have also discussed Florida's argument about the ways in which major cities in nations such as Australia are talent

magnets for international doctoral students, especially when the USA appears to be less tolerant of international students (and visitors more generally). Our work suggests to us that the development of new policies and new approaches to doctoral education that address the contemporary Australian and international circumstances may well produce strong and enduring benefits for all those involved.

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