The new age of the PhD: Transforming the PhD from a product to a process

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Introduction

In science, technology, engineering, mathematics and medical (STEMM) discipline, one in three students graduate with a PhD, with the number of annual PhD completions doubling each year in most Organisation for Economic Cooperation and Development (OECD) countries[1]. Although many will start off as postdoctoral researchers, PhD graduates still hugely outnumber the demand for postdoctoral researchers. And those that successfully attain this position are quickly thrown into a harsh climate of 'publish or perish'[2]. As our world continues to grow scientifically and technologically, our communities need to become more literate in these fields to successfully compete within a knowledge-based economy. Universities are responding with a push towards skills development in doctorate programs, through the integration of transferable skills and a move to mainstreaming doctoral research portfolios.

For many years, the majority of science PhD graduates were able to quickly find a faculty position after completion of their studies. Nowadays, only 14% of biological sciences PhDs attain tenure five years after graduation[3]. In addition, those pursuing an academic career face a significantly prolonged career pathway to independence. In the USA, the National Institute of Health (NIH) in 2005 reported that new PhD investigators do not receive their first R01 (Investigator) grant until they are over the age of 40[3]. These systemic changes appear to influence graduate students interests in research careers, which declines with their training progress. In the end, many recent graduates pursue careers in non-academic fields, including policy, law, communication and public health[4] (Figure 1).

Figure 1. Schematic of the diverse career opportunities available for PhD graduates.

Surprisingly, the pursuit of postdoctoral training after attainment of a PhD is often independent of a clear career goal. For some researchers, postdoctoral training provides an opportunity to clarify career pathways, although for many scientists postdoctoral research is a default pathway upon award of a PhD (Figure 1). The NIH, for example, defines postdoctoral positions as "temporary and defined period of mentored advanced training to enhance professional skills and research independence for doctoral degree holders to pursue chosen career paths"[5]. Yet, it is common amongst PhD students and postdoctoral researchers to lack formal structured departmental or institutional career development as part of their training, either toward or away from academic positions.

With a changing academic landscape providing less opportunity for job security and promotion, there has been a push by stakeholders including the government and industry, for the development of competency skills to be part of the PhD program and global recognition in recent years of the PhD as a '*process* 'not a product.

The changing landscape of the traditional PhD

The Doctor of Philosophy (PhD) is the highest academic degree, awarded by universities for demonstrating the ability to carry out academic research and provide significant contribution of original research and to fundamental knowledge in a specific discipline. With reduced academic opportunities and an increasing number of PhD graduates, government, business and industry leaders are questioning the adequacy of skills acquired during PhD training to work in current markets of global economy, leading to the relevance of the PhD to undergo mounting scrutiny. The last few decades have seen an increase in reports demanding clarification of the purpose of the PhD. This topic is becoming a reoccurring theme in the UK[6,7] as well as the USA, as reported within the Carnegie Initiative on the Doctorate[8].

Over the last decade policy-led demands are increasing for more industry-focused doctoral education, and for PhD graduates to be industry-ready autonomous researchers at the culmination of their studies[9]. New types of doctorate have been established to extend the scope and direction of doctoral education[10], thus enabling more innovative and dynamic research programs that align with both academia and a breadth of professional practices.

The traditional product of a PhD was, and still is, the *thesis*, but doctoral output is currently changing to also encompass doctoral capabilities. For example, the Australian Qualification Framework (2002) that now suggests a 'doctoral research portfolio' best represents the graduate's knowledge products-achievements of research capabilities in addition to the traditional tangible forms of their doctoral output[11]. A doctoral research portfolio, an upskilling of a more traditional PhD graduate, is already embedded within creative arts doctorates[12]. Application of such a portfolio in other doctoral programs, including those in the STEMM field, has been largely inadequate, yet it is exactly those disciplines that are increasingly contributing to a global 'knowledge-based' economy.

The contribution of PhD graduates to the global economy

The world is rapidly transitioning from a traditional, commodities and manufacturing-based economy into a 'knowledge-based economy'[13-16]. This modern form of economy emphasizes the use of knowledge and innovation to create goods and services, employment and value to enhance economic productivity[13]. Therefore, there is an increased need for educated individuals who have strong analytical skills and innovative thinking to generate knowledge, and importantly, know how to use the generated knowledge to address contemporary global socioeconomic problems[14,16].

Since the 1990s, there has been a steadfast increase in global doctoral offerings combined

with an internationalization of doctoral student body, which raises concerns about the effects of globalization of doctoral education. Countries are responding by introducing descriptors and standards that focus on the capabilities required of doctoral graduates to be able to participate in the growing global 'knowledge-based economy'.

Australian universities over the last few decades have seen that additional factors impact upon the implementation of descriptors and standards. The Dawkins white paper (1988) initiated the restructuration of the binary higher education system and introduced government-mandated policy changes and guidelines for doctoral education as well as the introduction of professional fields including nursing, psychology, IT and design to the university[17]. In 2001, the introduction of the Research Training Scheme (RTS) in Australia resulted in a reduction of government-funded places for domestic students at doctoral level, masked by an increase in full-fee international research students[18]. This squeeze on funding has forced Australian universities to monitor and review of doctoral program quality.

The Australian Qualifications Framework (AQF) (2002, 2007) continues to expand and define the range of what can count as doctoral research and what the outcomes of that research are within its Doctoral Degree Guidelines[19,20]. The Council of Australian Deans and Directors of Graduate Studies (CADDGS) Framework, based upon the AQF guidelines (2002) emphasises importance for universities to identify timing, amount, method, type and focus of suitable activities offered to all research students in relation to generic capabilities, focusing on the transferability of research skills[19]. Supervisors are regarded as academic mentors in this model. They are required, as part of these activities, to assist students and give career advice and help in the development of discipline-specific, research-related skills as well as general skills, including technological literacies and ethics. Therefore, universities overall assume responsibility for supervisors having the correct training and processes being available to equip graduates with employment-linked capabilities while they produce doctoral research output. Together, this means that universities are directing policy-led imperatives to ensure generic capabilities are acceptable to funding bodies and industry employers, whilst ensuring availability of flexible and innovative programs that attract a diverse student demographics interested in doctoral research within professional disciplines[18].

A national survey by the Australian Mathematical Sciences Institute (ASMI) and the Commonwealth Scientific and Industrial Research Organisation (CSIRO) of Australia Data61's student-employer matching platform, Ribit.net, identified banking, finance and insurance followed by mining, oil and energy, and medical pharmaceutical industry as the top employers of PhDs[1]. The valued contribution of PhDs in these roles is becoming visible, in particular, in industry where graduates have assisted in the critical translation of research into products and services that have benefited the economy[13]. For example, the Australian Red Cross Blood Service is reputed for employing PhD graduates from diverse fields including medicine, psychology, economics and engineering to improve their services in blood processing and blood product quality. Recently, a Red Cross research team headed by a PhD graduate, Dr. Lacey Johnson (principal research fellow), developed a new way to freeze blood with a shelf life of up to 10 years, which allows the transport of frozen blood samples to frontline soldiers in the Australian defence force[13,21,22]. This illustrates how PhD graduates in positions outside of academia can have a profound impact to wider society.

Monash University, G8 Australian university, reflects its strategic aspirations in the 'Graduate Student Attributes', as the education of responsible and effective global citizens who engage in an internationalized world. Monash University's Central Clinical School is exemplary in its preparation of graduates, extending their career pathways beyond their research projects at the bench,

directing them through formative and summative programs to enter clinical research and medicine in hospitals, and participating in industry and beyond (Figure 1). Here, an emphasis has been placed on the re-evaluation of what constitutes doctoral research in terms of processes and outputs, such that the doctorate portfolio consists of a selection of products of research to affirm candidates as industry-ready, independent and creative researchers.

Transforming the PhD from a product to a process

To attain award of a PhD in the biomedical sciences, a PhD student's research findings need to be recognised to have contributed to the discovery or understanding of a novel mechanism or product which can advance the scientific field[23]. This great responsibility brings with it an equal share of challenges and rewards. At some point during their degree, PhD students face challenges, such as project redirection, maintaining work/life balance and supervisor relationships, that they have to learn to manage[24]. These struggles, along with more psychologically confronting situational changes, including intellectual solitariness, professional and social isolation and anxiety[25], are recognised by many higher education institutions. In particular, is recognised by institutions that run induction programs designed to support the doctoral student to adjusting to their new status of novice researchers. Despite these obstacles, the value in completing a PhD remains invaluable[26], and according to past doctoral students, it includes achieving extensive personal and professional growth, developing specialised and transferable skills and opening doors to diverse employment opportunities are just few of the long-term benefits of completing a PhD [23,27-30].

Traditionally, the skills learnt during a PhD were perceived to be mono-disciplinary, and research students were thought to have a limited breadth of skills and knowledge for work outside of their chosen fields of research, supporting the dogma that PhD students were better suited for careers in academia only[31]. Given that the expected outcome of a doctoral degree is to have made an original contribution to knowledge, it is almost contradictory to then suggest that students should also be developing a set of skills common to them all; however, in reality this is what occurs. There are numerous transferable skills acquired during the doctoral training process, which are applicable across a variety of disciplines outside of research. Some of the skills that candidates learn include the ability to ask creative questions and solve problems, to work in collaborative and independent settings, and to excel in oral and written communication[30,32]. This broad range of interdisciplinary skills acquired during graduate school are essential for success in any career[26,33].

The focus on doctoral education is now leaning away from simply regarding the PhD as a product (advancement of knowledge through an original piece of research) to rather seeing the PhD as a process which also provides knowledge and skills to meet the needs of the global labor market in a knowledge-based economy[34,35]. The competencies or outputs from a PhD can be categorized into six main areas[36].

1. *Knowledge and specialized technical skills*. This includes references to specific fields of knowledge (eg, signal transduction, cell death) and to particular techniques (eg, polymerase chain reaction, western blot).

2. *Transferable competencies that can be formalized*. This includes communication skills, project management skills, IT skills, language skills, commercial skills, innovation management and administrative management.

3. *Transferable competencies that cannot be formalized*. These are competencies that cannot be learned from courses such as intellectual capacities to deal with complex problems, ability to collaborate, leadership, innovation capacity, a broad vision and capacity to put oneself in question.

4. *Dispositions*. This includes aptitudes and qualities that complement transferable competencies such as rigor and creativity (eg, manage a project with rigor, or to be creative while designing a communication media).

5. *Behaviors*. These include stress management to perseverance and include curiosity, listening to others, resilience, dynamism, patience and honesty.

6. *Meta-competencies*. This includes competencies that can develop one's own pool of competencies to make better use of them in professional situations (learning and adaptation capacities).

Interestingly, in a study by Durette, Fournier and Lafon, 'Knowledge and technical skills' was not the most frequently cited category by graduate researchers[36], conversely, 'Transferable competencies that can be formalized', with communication skills (written and oral) were cited as core competencies. 'Project management' appeared in second position, and third was 'Innovation management'. 'Knowledge and technical skills' were cited only at fourth position, and included mono-disciplinary knowledge and technical skills. The core competencies highlighted in this study demonstrated that PhDs develop a common set of competencies through practical experience that require additional course learning to ensure diversity of skills and training for the divergent pathways existing beyond academia and not restrict the pool of competencies.

Universities play an important role in ensuring PhD students have access to information of alternative career options outside of academia[26]. It is particularly important to provide this information early to PhD candidates to ensure they have enough time to develop essential skills. This information, whether it is in the form of summative coursework, career development seminars or testimonies from past-students can assist PhD candidates to understand how to transition beyond academia.

The global evolution of the PhD program

In the UK, the GRAD program was developed to design opportunities for postgraduate research students to assess their personal skills, develop team building skills and career management skills. Under this program, thirty-four UK universities developed a new doctorate model, the 'New Route PhD', that combine advanced research along with transferable and professional skills modules[37].

The situation in the USA is decentralized, but there are numerous large charitable foundations that have reviewed the PhD degree and are working towards a reform. The 'Re-Envisioning the PhD' at University of Washington includes programs for career preparation, communication skills, academic and professional consulting, ethics, business opportunities, teamwork, entrepreneurship, teaching and leadership[38].

In Europe, industrial PhDs are continuing to be the preferred model of doctoral degrees that are undertaken at university in partnership with an enterprise[39,40]. In France alone, 20500 students have been reported to graduate from this industrial doctoral program since it was introduced in 1981, generating links between 7000 companies and 4000 research groups across diverse scientific fields[41]. Under the European Marie Skodowska-Curie Industrial Training Model, students have the direct opportunity to collaborate on a joint industry-academic projects, which could result in the generation of a valuable findings, production or intellectual property (IP)[42]. The advantages of this industry PhD programme is that it is based on the foundations of an open collaboration between academic and industry partners, which can lead to the PhD graduate developing skills and networks that open up job opportunities after graduation[39,42,43].

The Australian university system has not seen the large-scale national developments of the UK, Europe and USA, although there is a significant rise and activity gain in the initiation of such programs. The University of Queensland (UoQ) in Australia has developed a strategy to address this need of greater career development opportunities for PhD

students with the Career Development Framework (CDF). This framework is based on six key elements and is accessible for implementation in any institution. The framework includes: *1. Starting early*, 2. *Painting the landscape*, 3. *Creating structure*, 4. *Being relevant,* 5. *Being flexibl*e and 6. *Showing empathy*. In combination, this framework provides career advice about diverse job opportunities, teaches additional skills to help enhance student CVs, and facilitates network building between students and partners outside of academia[44].

Monash University is an example of a tertiary institution that has incorporated elements of the CDF into the doctoral degree - in the Translational PhD programme introduced in 2015 by Professor Robyn Slattery and Dr Steven Petratros[45]. The Translational PhD programme encourages students from the start of their degrees to consider their research in terms of its translatable potential, i.e., what impact will have on the target population. This PhD program has summative coursework modules on commercialization pipelines, intellectual property law and clinical trials, which simultaneously function as career development. There is also the opportunity for industry engagement, to develop professional skills useful in these non-academic positions and to learn about different pathways that a PhD graduate can follow[45].

In a large-scale study of thirty-four universities across Australia, the most frequently offered courses during a PhD included: leadership and communication, project management, collaboration and teamwork, commercialization and technological development, entrepreneurship, career planning, self-development, globalization and cultural awareness, public policy and teaching[46]. The authors concluded that although graduates were positive about the programs they chose and recognized the value of improving in the aforementioned capabilities, they noted the importance of providing for individual needs and highlighted the problems associated with meeting the demands of their thesis projects while undertaking the additional generic capabilities. They also identified the unmet need for the involvement of supervisors in promoting and supporting their participation in activities to strengthen generic capabilities.

It is obvious from the variety of diverse programs adopted worldwide, of which many identify shared common generic capability targets, that identifying, addressing and implementing processes to provide adequate training to PhD researchers is a dynamic, incomplete process. What remains to be addressed to facilitate the streamlining of programs is to evaluate the meaning of the word 'skills' and its use as a synonym for strikingly different abilities, attributes, qualities, sensibilities and competencies[47]. There continues to be a lack of agreement between government and industry leaders on what skills a doctoral student should develop. Furthermore, the discussion of transferability of skills from PhD to the workplace infers PhD students are predominantly developing skills during their doctoral program. However, this ignores the pre-existing skills a student has as they enters their PhD as well as a graduate's life choices, personal circumstances and employment market which is continuously evolving.

Conclusion:

There is a breadth of diversity in PhD programs around the world in regard to competency identification, skills definition and stakeholder involvement, yet each share the objectives of supporting multi-disciplinary cutting-edge research outcomes whilst building on the need to provide formative training and development of the generic skill set of graduates. Thus, these programs ensure their valued participation within an emerging knowledge-based economy. Universities are critical providers and facilitators of PhD programs, with the responsibility as education provider to create an academic environment to educate and support graduates to identify, choose and build career pathways within and outside academia. Universities will ensure the transfer of innovation to the community, thus creating global impact within a knowledge-

based economy, by providing the essential toolkit to promote the development of the PhD as a process rather than a product.

Online resources for PhD students:

Here there is a compilation of websites that provides testimonies from past students, some providing detailed information about the transition out of academia, and others providing an in-depth guide to students struggling to know what other opportunities are available for PhD students. Included is a link to an internship program called ARP.Intern that provides industry-based training opportunities for PhD students in Australia.

Is there life after a PhD - https://www.anu.edu.au/news/all-news/science-in-australia-gender-equity-pilot-program

Non-academic careers for PhD holders - https://www.findaphd.com/advice/doing/phd-non-academic-careers.aspx

Cheeky Scientist (provides a list of jobs) - https://cheekyscientist.com/top-10-list-of-alternative-careers-for-phd-science-graduates/.

Satisfaction in Science - https://www.nature.com/articles/d41586-018-07111-8

ARP.Interns- https://aprintern.org.au/available-internships/

Bibliography:

1. McCarthy, P.X. & Wienk, M. Who are the top PhD employers? Advancing Australia's knowledge economy (2019).

2. Borger, J.G. Once left can you really break back in? . in Women in STEMM Australia, Vol. 2018 https://womeninscienceaust.org/2018/2012/2005/once-youve-left-can-you-really-break-back-in/ (2018).

3. Stephan, P. How Economics Shapes Science, (Harvard University Press, Cambridge, MA, 2012). https://doi.org/10.4159/harvard.9780674062757

4. Fuhrmann CN, H.D., O'Sullivan PS, Lindstaedt B Improving graduate education to support a branching career pipeline:recommendations based on a survey of doctoral students in the basic biomedical sciences. CBE Life Sci Educ 10, 239-249 (2011). https://doi.org/10.1187/cbe.11-02-0013 PMid:21885820 PMCid:PMC3164563

5. Bravo NR, O.K. NIH-NSF Definition of Postdoctoral Scholar. (National Institute of Health, USA, 2007).

6. Park, C. Redefining the Doctorate. (ed. Academy, U.H.E.) (United Kingdom, 2007).

7. Poole, M., Harman, E., & Deden, A. Managing the quality of teaching in higher education institutions in the twenty first century. Australian Journal of Education 42, 271-280 (1998). https://doi.org/10.1177/000494419804200305

8. Walker, G.E., Golde, C.M., Jones, L., Conklin Bueschel, A., & Hutchings, P. The formation of scholars. (Jossey-Bass, San Francisco, 2008).

9. McWilliam, E., Taylor, P., Thompson, P., Green, B., Wildy, H., & Simons, D. Research training in doctoral programs: What can be learned from professional doctorates? (ed. Department of Education, S.a.T.R.E.P.) (Canberra, Australia, 2002).

10. Malfroy, J., & Yates, L. . Knowledge in action:

Doctoral programs forging new identities. Journal of Higher Education Policy and Management 25, 119-129 (2003). https://doi.org/10.1080/1360080032000122606

11. Clerke, T.L., A. . Mainstreaming the doctoral research portfolio? in Refereed preceedings of the 2008 Quality in Postgraduate Research Conference Adelaide (Adeliade, Australia, 2008).

12. Barrett, E. What Does it Meme? The Exegesis as Valorisation and Validation of Creative Arts Research. (2004).

13. Group, N.C. Enhancing the value of PhDs to Australian industry. (2017).

14. Lešer, V.J., Širca, N.T., Dermol, V. & Trunk, A. Career opportunities for PhD graduates in the knowledge-based economy: case of Slovenia. Procedia-Social and Behavioral Sciences 238, 104-113 (2018). https://doi.org/10.1016/j.sbspro.2018.03.013

15. Unger, R.M. The knowledge economy, (Verso Books, 2019).

16. Barkhordari, S., Fattahi, M. & Azimi, N.A. The impact of knowledge-based economy on growth performance: Evidence from MENA countries. Journal of the Knowledge Economy 10, 1168-1182 (2019). https://doi.org/10.1007/s13132-018-0522-4

17. Federation, N.S.W.T. The Higher education white paper of John Dawkins, July 1988 / Anne Junor, (New South Wales Teachers Federation, [Sydney], 1988).

18. Evans, T., McCauley, P., Pearson, M. & Tregenza, K. . Why do a 'prof doc' when you can do a PhD? in Conference proceedings for the 5th International Conference on Professional Doctorates, Working Doctorates: the impact of Professional Doctorates in the workplace and professions (ed. T.W. Maxwell, C.H.T.E.) 24-34 (Deakin University, Geelong, Victoria, 2005).

19. Australian Qualifications Framework Advisory Board, A. Australian Qualifications Framework (AQF) Implementation Handbook 3rd Edition. (Carlton South Vic 3053, 2002).

20. Australian Qualifications Framework Advisory Board, A. Australian Qualifications Framework: implementation handbook 4th edition. (Carlton South Vic 3053, 2007).

21. Service, A.R.C.B. Research and Development Annual Report. 76 (2015).

22. UTS. Alumni Profile: Lacey Johnson. (2015).

23. Bryan, B. & Guccione, K. Was it worth it? A qualitative exploration into graduate perceptions of doctoral value. Higher Education Research & Development 37, 1124-1140 (2018). https://doi.org/10.1080/07294360.2018.1479378

24. INOMICS, T. 10 Biggest Struggles of PhD Students. Vol. 2019 (2019).

25. Hockey, J. Establishing Boundaries: problems and solutions in managing the PhD supervisor's role. Cambridge Journal of Education 24(1994). https://doi.org/10.1080/0305764940240211

26. Woolston, C. Graduate survey: a love-hurt relationship. Nature 550, 549-552 (2017). https://doi.org/10.1038/nj7677-549a

27. Woolston, C. Science PhDs lead to enjoyable jobs. Nature 555, 277 (2018). https://doi.org/10.1038/d41586-018-02696-6

28. Mowbray, S. & Halse, C. The purpose of the PhD: Theorising the skills acquired by students. Higher Education Research & Development 29, 653-664 (2010). https://doi.org/10.1080/07294360.2010.487199

29. Zolas, N., et al. Wrapping it up in a person: Examining employment and earnings outcomes for Ph. D. recipients. Science 350, 1367-1371 (2015). https://doi.org/10.1126/science.aac5949 PMid:26659054 PMCid:PMC4836945

30. Kanwar, R. Skill set development of doctoral and post-doctoral graduates in life sciences.

Commun Agric Appl Biol Sci 75, 47-55 (2010).

31. Mulvany, M.J. Biomedical P h D Education-An International Perspective. Basic & clinical pharmacology & toxicology 112, 289-295 (2013). https://doi.org/10.1111/bcpt.12063 PMid:23461869

32. Fiske, P. A bridge to business. Nature 530, 243-245 (2016). https://doi.org/10.1038/nj7589-243a

33. Nerad, M. & Cerny, J. From rumors to facts: Career outcomes of English PhDs. ADE bulletin, 43-55 (2000). https://doi.org/10.1632/ade.124.43

34. Park, C. New Variant PhD: The Changing Nature of the Doctorate in the UK. Journal of Higher Education Policy and Management 27, 189-207 (2005). https://doi.org/10.1080/13600800500120068

35. Buckley, F., J. Brogan, J. Flynn, K. Monks, T. Hogan, and A. Alexopoulos. Doctoral Competencies and Graduate Research Education: Focus and Fit with the Knowledge Economy. Link Working Paper Series. (The Learning, Innovation and Knowledge Research Centre, Dublin City University, Ireland, 2009).

36. Barthélémy Durette, M.F.M.L. The core competencies of PhDs. Studies in Higher Education 41, 1355-1370 (2016). https://doi.org/10.1080/03075079.2014.968540

37. Tysome, T. & Farrar, S. New PhD to attract overseas students. Times Higher Education Supplement 12(2001).

38. Washington, U.o. Re-envisioning Project Resources. Vol. 2020.

39. Ori, M. The rise of industrial PhDs. University World News 300, 13 (2013).

40. Germain-Alamartine, E. & Moghadam-Saman, S. Aligning doctoral education with local industrial employers' needs: a comparative case study. European Planning Studies, 1-21 (2019). https://doi.org/10.1080/09654313.2019.1637401

41. Labiad, N.-e. What are Industrial PhDs Worth in the Labour Market? (University of Bergamo, 2013).

42. Doonan, F., Taylor, L., Branduardi, P. & Morrissey, J.P. Innovative training networks: overview of the Marie Skłodowska-Curie PhD training model. FEMS microbiology letters 365, fny207 (2018). https://doi.org/10.1093/femsle/fny207 PMid:30239741 PMCid:PMC6140915

43. Morrissey, J.P. Networking and collaboration: a stronghold of the yeast research community. (Oxford University Press, 2017). https://doi.org/10.1093/femsyr/fox043

44. Boreland, J. I have a PhD: now what? Future-proofing the careers of Australia's research students. (Career Development Association of Australia 2019).

45. University, M. Clinical Research and Translational Medicine courses. (2020).

46. Borthwick, J.W., R. Postgraduate research students and generic capabilities: Online directions. (ed. Department of Education, S.a.T.R.E.P.) (Canberra, Australia, 2003).

47. Gilbert, R., Balatti, J., Turner, P., & Whitehouse, H. The generic skills debate in research higher degrees. Higher Education Research and Development 23, 375-388 (2004). https://doi.org/10.1080/0729436042000235454