Working Group 2:
Impact of Changes in Doctoral Education

Institutional dimension: meso and micro level

Introduction

When discussing changes in doctoral education at institutional level, i.e. funding, organization/ administration of doctoral training as well as supervision, mentoring or doctoral education practices and pedagogies, differences are observed within different countries represented by working group members, i.e.

- well established systems that struggle to offer perspectives to PhD holders since higher education institutions can only absorb a minority of finished PhDs and the overall student population is shrinking due to demographic change (US, Canada, Germany, Australia, Japan, Luxembourg), and
- countries with rapidly expanding doctoral systems where universities absorb the majority of the PhDs (South Africa, Kazakhstan, Bulgaria). In these countries, the rapid growth of numbers of PhD is not necessarily accompanied with more funding, so that the PhD is often partly or fully self-funded and time to completion or drop out is high. Typical in these systems is also an insufficient supervision or support capacity and strong pressure on the insufficient number of qualified supervisors for the increasing PhD population.

Policies at institutional level are very different in these diverse contexts and the working group discussed examples from countries and contexts and tried to identify common denominators and trends.

The Working Group was moderated by Ulrike Kohl, Luxembourg Institute of Socio-Economic Research and comprised three zoom meetings with the following members:

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Contents

I. Changes in Funding and their impact on Doctoral Education Frameworks, by Marc Torka

1. Background: Changing Funding Landscapes

Funding for doctoral students is crucial to ensure reasonable completion times, reduce attrition rates and enable the development of promising researchers, research programs and innovations.

Different types of funding mechanisms co-exist and vary at large across fields and national higher education systems.

Doctoral students are employed in entry-level academic positions (often fixed-term, casual and teaching-based) and responsible for academic work beyond the PhD.

They may apply for personal, more independent, fellowships at universities, doctoral programs, charities and funding agencies.

PhD students also receive project-based funding from supervisors or institutions for carrying out a scientific project that forms the core of the PhD thesis or there is no directed funding. In this case doctoral students work in diverse casual jobs within or completely outside academia to support living expenses.

Funding structures and allocation mechanisms also vary and often combine tuition fees, performance and load-based institutional block as well as competitive project grants.

As funding for PhD students is not limited to specific resources, it is subject to general dynamics in national and international funding landscapes.

Most frequently reported global trends include the reduction in the rate of growth of public research funding, and sometimes an actual decline in its level; shifts from internal block grants towards external project funding, applied and priority research; more casual, fixed-term and project-based employment, long insecure career phases and the delay of tenure as well as declining capabilities of academic systems to absorb the growing number of PhD students (Laudel & Bielick, 2018; McAlpine *et al.*, 2018; Nerad *et al.*, 2014; Whitley *et al.*, 2018).

Working group 2 identified a lack of detailed comparative research to precisely determine the consequences of these trends for national doctoral education systems, institutions, ECRs, training practices and research contents as well as **five areas of concern**.

a) Funding Stability

PhD growth rates vary across systems from exponential (e.g. China) and moderate (e.g. USA, Canada, Germany) increases to an actual decline in PhD numbers (e.g. Japan, Russia). Funding often does not keep pace with actual or expected PhD growth rates. This leads to more competition for scarce resources at institutional, disciplinary and individual level; a higher rate of self-funded or/and working PhD students and a pressure to attract external project-based and/or industry funding.

b) Reasonable Funding

For PhD candidates who do find funding it is often impossible to live on insufficient funding in relation to average living costs (e.g. UK, Japan, Australia), to refund debts in their later career (e.g. US), to secure superannuation (e.g. Germany) or cover living costs abroad (e.g. Kazakhstan, Bulgaria). Part-time work is therefore necessary but usually extends and interrupts the PhD process.

c) Funding Flexibility

Increasing dependence on external funding impacts on the way institutions perceive and conceptualise doctoral education. One trend is to closely align candidature to three-year standard project cycles, although

completion times often exceed this tight timeframe. This 'Projectification of doctoral training' (Torka, 2018) implies a project management approach in which PhD students are expected to develop PhD projects at an early stage and 'carry it out' in a linear fashion. Within this model, institutions, faculty, supervisors and PhD candidates are expected to ensure that projects are 'doable', stay on track, progress continuously and will complete on time. This model, originally developed for experienced researchers, not only tends to disregard real completion times, field-specific conditions and ways of pursuing a doctorate, intellectual, social and personal challenges inherent to the PhD process or limitations to provide 'directive supervision' (Wichmann-Hansen & Herrmann, 2017) but also the developmental stage of PhD students. They are still learners in transition from dependent students to independent researchers and colleagues (Laudel & Gläser, 2008).

d) International Funding

While most funding schemes are national and may prioritise national approaches, international student rates increase in many doctoral education systems. International students often pay higher fees (e.g. Australia, South Africa, UK), are subject to strict visa regulations, are not always eligible for national funding schemes and international funding might not cover the costs at their host institutions.

e) Funding beyond the Doctorate

In recent years, global higher education policy focused on the growth of PhD numbers and funding. Funding for postdocs, permanent academic employment and research has not increased at the same rate. Growing job insecurity, fixed-term and casual employment during and after candidature are major trends across systems (Bredehoeft, 2018). Current funding policies address this gap between increased PhD output and stagnating growth of academic systems mainly by strengthening university-industry links, encouraging co-funding, internships and transferable skill training or providing a small number of highly attractive and competitive postdoc grants (e.g. ERC Starting and DFG Marie Emmy Noether Grants or European Marie Curie and VW 'Freigeist' Fellowships) or short 1-2 years postdoc positions often within research projects. It has been argued that the lack of sufficient funding beyond the PhD discourage doctoral students from pursuing an academic career (McAlpine *et al.*, 2018; Metz-Göckel *et al.*, 2016), undermines the development of long-term research programs and innovations (Laudel & Bielick, 2018) and overload especially developing systems such as South Africa which lack qualified supervisors and research capacity.

2. Regional Differences

Funding availability, types, mechanisms and areas of concern differ between national doctoral education systems. The working group suggests taking the regional conditions (outlined in the country reports) into account. The following overview distinguishes between established and emerging systems of different size and with different financial situations.[1]

Some established systems (e.g. the US, Canada, Germany and UK) have experienced a steady and modest increase in awarded PhDs backed up by diverse but not always sufficient funding opportunities. In the world-leading *US system* enrolment and degrees continue to increase but the growth rate has slowed over the last several years. The number of doctorate recipients increased from 42,539 in 1997 to 54,664 in 2017 (NSF, 2018). Enrolment of international students has shown a slight decrease over the past 2 years. Funding is mainly organised at the university level and consists of all kinds of mechanisms with disciplinary variation. In the arts and humanities, for example, a teaching assistantship is the modal type of support. In the "bench" sciences, project funding is the major source of support, through a research assistantship. Stagnation in tenured and tenure-track faculty positions have led to increased attention to non-academic careers, temporary and insecure employment as well as health related issues.

[1] The following examples refer to the country reports and additional literature.

The similar but much smaller *Canadian system* has also experienced a steady increase in PhD numbers from 4,185 (2005), 5,934 (2010) to 7,059 (2013) levelling off recently. Block grants (about 50%), tuition fees, donors and investments cover the operating costs. Research funding for doctoral education as well as funding mechanism types have been consistent over time. On average (for the 15 largest universities), 28% of funding is from internal scholarships, 22% from supervisor grants, 17% from teaching assistantships, and 13% from federal scholarships.

In the very different *German chair system* the rate of students pursuing a PhD after the mandatory Master degree is consistently high (22%) and differs by field (e.g. 4% in Arts and 57% in medicine). Over the period 2000 to 2017 the number of PhDs has slightly increased from 25,780 to 28,404. PhD students receive funding from different sources and the individual relationship to supervisors often determines access to funding. German PhD students work as teaching or research assistants in funded research projects at universities (77%), in non-university research institutes (6%) and non-academic organizations (17%) or apply for project-based stipends from charities, doctoral programmes and recently established graduate schools. In addition, there is an unknown number of self-funded PhDs (17% are unemployed but this may contain stipends or casual work). Only about 25% participate in 'structured' doctoral programmes and graduate schools (BUWIN 2017). A specific funding scheme for graduate schools known as Excellence Initiative has been discontinued in 2017 and reallocated to project-based research clusters. This recent development fits well to the generally project-based German funding structure and chair system in which most academic positions below full professorships are temporary. In 2014, 77% of the academic staff at universities and 93% of early career researchers had fixed-term contracts (BUWIN 2017). Finding permanent academic employment after the PhD is considered the most important concern in Germany.

The *UK system* has also experienced a modest increase of doctoral students entering (from 28,905 in 2007/8 to 35,340 in 2016/17) and graduating from a PhD programme in the same period of time (from 19,470 to 28,155). Funding for tuition fees (higher for international students) and living costs is available from a range of funding bodies, charities and a recently introduced loan scheme but stipends are often barely adequate for students to survive on. It is becoming increasingly difficult in the UK to find funding as research councils are reducing their contribution, some other funders have vanished and many doctoral programmes barely break even financially. Industry co-funding and the decline in the number of permanent academic posts have led to increased attention to non-academic careers and rising mental health problems have become a major concern.

In other established systems PhD numbers have increased (e.g. Netherlands and Australia) or declined considerably (e.g. Japan and Russia). The small *Dutch system* has doubled the number of awarded PhDs since 2000 (from less than 2,500 to almost 5,000 in 2016) with a recent slight decline. Most PhD students are employed by universities and funded for four years, although most students complete within 6 years.

Australia is a latecomer in doctoral education (first PhDs awarded in 1948) and has rapidly increased its PhD numbers, particularly since the end 1980s (1989: 1,209, 1999: 3,665, 2009: 5,796, 2017: 9,054). More than 90% of students entering PhDs receive fellowships provided by either the Australian government (~40%), the University (~40%), supervisors (~10%) or industry (~10%). Research training funding from the Government is allocated between university on the basis on completion (50%), research (25%) and industry (25%) income. A typical PhD fellowship will be for 3-3.5 years at a tax-free rate of A$30,000. This is less than half of the average income and actual median completion times exceed the maximum funding (Torka, 2019; Torka, forthcoming). The Australian Government had steadily increased PhD stipend rates and numbers until 2013. Since then Australia experienced funding stagnation and cuts. The proportion of fee-paying international PhD students increased rapidly from 19% in 2005 to 39% in 2017. Australia provides a small number of scholarships (<10%) for international students who may attract additional international funding. The number of doctoral degree holders far outweighs the number of available academic positions leading to a casualization of academic work.

Japan has a large established doctoral education system in which the numbers of PhD degrees and enrolments declined from around 17 to 15 thousand per year over the period from 2005 to 2015. This is due to a decreasing university sector with less research jobs and more fixed-term employment, a shift from per capita to competitive allocation mechanisms, a strong dependence on decreasing external project grants (23% in 2004 to 19% in 2018) and a focus on priority research areas. A rapidly aging population and a decrease in the population under forty also contributes to declining PhD numbers as the vast majority of doctoral students are 40 or under. Only about 10% PhD students receive a scholarship that covers minimum living costs and more than half of doctoral students do not get any financial assistance. As a result, the number and proportion of working students has increased and competition within the system has increased.

Russia has a large rapidly shrinking doctoral education system. Over the period from 2005 to 2017, entrants and degrees awarded at doctoral level declined from 142,899 to 93,523 and 28,898 to 9,672 respectively. The government funds doctoral education but stipends are insufficient (around 10-20% of average salary). A high share of self-funded PhD students (30%) and rising proportion of international students (from 2.2% to 7.8% between 2010 and 2017) are observable consequences of insufficient funding.

The situation in rapidly emerging systems such as China, Kazakhstan, Bulgaria, Malaysia, South Africa or Chile is different. These systems often report a mismatch between a state-driven growth in PhD numbers and the capacity of the surrounding academic system to supervise doctoral students leading to quality issues and talent migration.

China follows a "one country, two systems" approach with different doctoral education system in Chinese mainland and the Hong Kong Special Administrative Region (HK SAR). HK SAR has a small well-established system in which the regional government provides universities with funding for PhD students. Completion rates determine the allocation of funding between universities. Most doctoral students come from outside of the HK SAR and can apply for HK SAR, university and faculty level or cost-shared (faculty/supervisor grants) stipends covering tuition fees and living costs. In contrast, China is a latecomer in doctoral education and is the largest rapidly emerging system. In 1982, there were only about 30 doctoral candidates in China. By 1988, the number of doctoral students or candidates had increased to 10,525 and graduates to 1,538. Over the period 1995 to 2014, the number of new entrants and graduates at a doctoral level increased more than sixfold (from 11,056 in 1995 to 72,634 in 2014) and more than tenfold (from 4,641 to 53,653) respectively. Doctorate degrees awarded annually increased from 27,677 (2005), 48,987 (2010), 58,113 (2015) to 59,649 (2016). The Chinese government provides funding for most domestic, many international (11,116) as well as Chinese students studying abroad (about 3000) with only 6,935 doctoral students studying at their own expense in 2016.

Kazakhstan is a case of a small emerging system with rapidly increasing PhD student numbers from 960 in 2010 to 5,609 in 2018. Similar to South Africa (see below), the system is hardly capable to provide sufficient quality supervision and research capacity as less than 50% of university staff hold Soviet research degrees and less than 2% a PhD. As in most small systems the government steadily increased funding and provides most students (90%) with a small monthly stipend of about US$ 250 and an additional fixed amount for a mandatory overseas internships. State stipends are too low to cover living costs in most Kazakhstan cities and internship funding may not always be enough to stay in high cost countries for the period of time needed. As a consequence, almost all students work part-time as research assistants in projects, junior faculty members or often in areas that are not related to their research or academic careers. This negatively affects the time to degree and research quality.

The situation in *Bulgaria* is similar. The Government provides most of the funding in form of individual fellowships (93-95%), has increased PhD numbers at a lower rate from 5,079 in 2004/5 to 6,738 in 2016/7 and defines research priorities. As a consequence, PhD projects tend to be predefined rather than student specific.

Malaysia is a case for an unrealistic programme introduced in 2007 (MyBrain15) that aimed to increase the number of Malaysian doctoral degree holders to 160,000 by 2020. This programme provided funding to

cover tuition fees, stipend and examination fees delivered through research grants obtained by the supervisor. PhD numbers have been rapidly increased from 750 in 2009 to 4,556 in 2017 well below expected rates. The programme has been suspended due to the unfavourable economic climate. Since then most Malaysian doctoral candidates are either sponsored by their potential employer or self finance their studies.

South Africa also has an ambitious National Development Plan to increase PhD production rate by a factor of about five. PhD numbers increased rapidly from 761 in 1998 to 2,782 in 2016 but at a lower rate. This is due to a lack of funding, research and supervisor capacity because less than 50% of staff in South African universities have a PhD degree (Cloete *et al.*, 2015) and supervise a growing PhD population. Government funding of research at universities takes place through block grants. These funds are allocated according to the number of research master's degrees, accredited research publications that an institution produces each year and, most important, completed doctoral degrees (weighted 1:1:3). This led to a pressure to complete as soon as possible in order for institutions to receive the grant. Furthermore, doctoral education has become relatively lucrative for institutions and individual supervisors creating temptation to take on more students than is realistic and raising questions about quality. Funding schemes prioritise STEM fields, where doctoral students tend to work fulltime on funded projects, whereas the majority of doctoral students in the humanities and social sciences are self-funded (Mouton 2018). The main individual provider of postgraduate bursaries (NRF), offers a range of bursaries and scholarships for doctoral education in South Africa (SARUA, 2012) but the amounts (between $5 000 and $8 750 per annum) are inadequate for students to support themselves and families. A high percentage of doctoral students in South Africa study on a part-time basis (70%) and they are less likely to succeed and timely complete the PhD compared to full-time students (Cloete *et al.*, 2015). However, if they succeed it might be easier to find permanent academic employment within an emerging system with a low share of doctorate holders.

Chile is a case of a system in which opportunities for permanent academic employment have declined due to a rapid increase of PhDs and funding constraints. Doctoral degrees have multiplied by 42 in the last 30 years from 16 in 1985 to 685 in 2015 not including the 377 PhD students who study abroad. In sum, currently more than 1,100 doctoral scholarships are granted every year (740 national, 377 international). Over the period 2013 to 2017, the budget for scholarships has decreased 15% in the National Program, and 19% in Chile's program for studying abroad. The steady increase of faculty members has recently levelled off limiting the opportunities of new doctors to insert themselves in a tenure track position. As a result, the proportion of adjunct and non-tenure track temporary positions for research staff has increased.

3. Recommendations

These examples illustrate that doctoral education systems face different funding situations and dynamics around the globe. The following recommendations address the five most frequently reported problems outlined before.

a) Funding Stability

In many countries, funding for doctoral students has not been adjusted to the growing rate of PhD production, declined or has been reallocated to general research funding. The rise of part-time work and self-funded doctorates counter timely completion and the concentration of PhD projects in specific research areas hinder the development of new approaches in other fields. The **availability of funding** for all doctoral students and research areas should be ensured. This may imply **reasonable growth rates** in relation to the surrounding academic system.

b) Reasonable Funding

Many countries report that available scholarships do not cover minimum domestic and international living costs. This leads to the rise of part-time work, debts, mental health issues and interrupts the completion process particularly at the end of the PhD. Although the doctorate can be considered an apprenticeship

preparing for real employment and remuneration, **minimum living costs should be covered** to avoid these unintended consequences and enable international exchange.

c) Flexible Funding

Funding comes with a purpose and **strict timelines** leading to a trend toward more predefined and standardised project cycles. Many countries report a mismatch between expected or funded (usually 3-4 years) and actual completion times. While completing a PhD in a reasonable timeframe should be a goal, funding and regulations need to be flexible enough to account for personal, field and project specific needs and to ensure that doctoral candidates have the necessary **freedom to develop their research** along their findings. **Flexible funds to support PhD students particularly in the most challenging final stage** would help to avoid the negative consequences associated with excessive time pressure such as the quality of doctoral research and mental health of PhD students.

d) International Funding

Given that most funding schemes are national, they often focus on national priorities. To support international exchange and ensure that PhD projects can develop in an appropriate context, **international PhD funding should be expanded in all fields**. This may include short-term visits and exchanges between doctoral programs, carrying out entire PhD projects abroad or double degrees, e.g. cotutelle programs. Such internationally funded programs must ensure that collaborations are always dictated by the needs of projects rather than enforced from outside and that conflicting national PhD regulations do not infringe on the development of the PhD project.

e) Funding beyond the doctorate

PhD growth rates led to two **specific trends in emerging and established systems** with different funding implications. In **emerging systems high growth rates** tend to outweigh the capabilities of academic systems to supervise PhD students appropriately leading to **quality issues**. In **established saturated systems**, high growth rates led to more competition for scarce jobs, more attention to non-academic careers, a rise of temporary or casual work and **increased job insecurity**. Both developments suggest some kind of balance between PhD production and the entire academic systems.

This may imply opposing strategies from better 'tracking' PhD destinations due to a lack of reliable data and methods; 'revamping' the PhD by adding often unclear transferable skill trainings; 'splitting' the PhD in competing professional and research doctorates;'skipping' the PhD because Masters already provide a sufficient qualification for most non-academic jobs; 'cutting' the number of PhDs at the cost of research capacities (Gould, 2015); increasing the number of permanent academic positions (and thereby PhD numbers); or providing appropriate funding options after the PhD.

Available funding schemes for postdocs are either short-term or very competitive (e.g. ERC grants) and often imply a change of topics instead of capitalising on first results to develop PhD projects to more comprehensive research programs or industry-related innovations after completion. These options are all highly contested, certainly need further discussions and have to be adjusted to the different needs of national doctoral education systems.

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II. Changes in organisation and administration of doctoral training at institutional level, by Susan Porter

1. Institutional arrangements and administrative structures: Evidence of change

From the start of research doctoral education (i.e., within the past 100-150 years or less), the administration of doctoral education has tended to vary by country. Virtually all PhD education, however, has relied primarily on the 'master-apprentice' model, where a faculty member mentors students in conducting research, and traditionally, inculturates them in the ways of the academy.

In North America, this paradigm, from the start, has been buttressed by successive administrative structures. The graduate program, usually residing within a disciplinary department, provides coursework relevant to the disciplinary focus, makes the final decision on admissions (if the applicant meets university-wide entrance criteria), creates its own policies provided they are consistent with university-wide policies, provides direct academic oversight of its students (with limitations, described below), approves the selection of the supervisory committee (generally 2 other faculty in addition to the supervisor, who meet periodically to help guide the student) and otherwise creates the learning environment necessary for the academic development of students.

Most North American institutions then have a central 'graduate school' (which may also be called a Faculty, College, Division, or office) headed by an academic dean or equivalent. The purpose and mandate of these may vary to some extent, but usually involve the provision and oversight of registrarial-type activities, creation and monitoring of policy, high level administrative oversight of students and programs (e.g., upon recommendation by the program, deciding on exceptions to policy), quality assurance processes, oversight of student funding, and general support and advocacy for faculty, programs, and students.

The existence of administrative structures in North America is to some extent a function of a more structured approach to doctoral education generally. This includes the requirement of field-specific coursework in most programs and formalized monitoring of and support for student progress. The central unit also enables some consistency in quality (in both senses of the word) of doctoral education across the university, and provides considerable economies of scale and scope, with significant expertise and administrative processes localized to a central unit. Perhaps most importantly, however, the central graduate school, with a core mission of supporting and improving the *education* of students provides a critical balance to the significant interests of faculty and disciplinary units in the students' research output. These sometimes conflicting interests are manifest especially in the quality of doctoral supervision, students' holistic and career development, times to degree, examination objectivity, and admission standards and diversity.

Over the past decades, most North American graduate schools have gradually changed their role from that primarily of an academic 'gatekeeper' to one more responsible for student, faculty and program support (including the provision of student professional development and community-building opportunities, and supervision development for faculty), and strategic leadership in graduate education.

- *The model in the UK and many other countries is traditionally (and still commonly) the sole master-apprentice model, although increasingly, there are also variants of North American administrative structures. In Australia these tend to be university-wide, and in Germany the Faculty level is often more important.*
- *The model of doctoral supervision has also been shifting from a reliance on a single supervisor to that of two faculty or a committee of supervisors. Coursework, whether related to 'generic skills' or field-secific content, is more common, as is more regular monitoring of student progress.*

- *In Germany, 16 to 23% participate in new so-called 'structured' doctoral programs opposed to individual supervisory relationships.*
- *The changing administrative structures in non-North American universities include new internal structures (e.g. 'research training groups' in Australia) cross-university or cross-Faculty graduate schools as well as government-funded multi-institutional structures focused on specific fields of study, as is the case for doctoral schools in the UK and elsewhere.*

2. Causal tendencies for changes? Changes affecting the inputs, outputs and practices of doctoral education?

In non-North American institutions, the establishment of administrative structures in doctoral education has stemmed from a number of societal, economic, and institutional factors. While the structures may have somewhat differing frameworks and purposes, they have in common the goals of increasing the quality and the societal and/or career relevance of the education, and in some cases, to enable larger scale transdisciplinary, societally-relevant research endeavours.

In countries still developing their economy and academic infrastructure, academic institutions may lack a long history and culture of doctoral education, and have insufficient funding and numbers of qualified supervisors. In a competitive, global economy, it is crucial to ensure the highest quality of education of those who will lead the future academy and the nation's research and innovation agenda, and an increase in PhD numbers and accountability for doctoral education and research generally are increasingly government priorities.

The same global competitiveness is at play of course for all countries, and in particular, the shift from resource-based economies to those dependent on innovation and technological advancement has also led to an interest in both increasing the number of PhD graduates and in ensuring their education is relevant to the era. (Unfortunately, the 'receptor' capacity, both inside and outside the academy, for these highly educated citizens often does not keep pace with the rise in graduate numbers.)

The forms and modes that research can take have also changed considerably over the last few decades, and doctoral research engaging in these can often be better promoted and managed through central administrative structures. The mostly linear model of knowledge creation and mobilization (mode 1, according to Gibbons) has gradually lessened in importance to the iterative, multi-sector, transdisciplinary, context-based research and knowledge mobilization of Gibbons's mode 2. Mode 1 research, i.e., that is based primarily within a discipline, is performed solely within the academy and disciplinary structures, and is mobilized (if relevant) in a one-way fashion to external entities, is increasingly insufficient and ineffective to address our complex societal and planetary problems. In some cases, this mode is even unethical, as, for example, research related to Indigenous peoples. Individual faculty may not be proficient in or sufficiently equipped to undertake the more complex, context-based, transdisciplinary approaches in mode 2 research, and they may be disconnected generally to the forms of scholarship occurring outside the academy, into which most graduates will be immersed.

Parallel to the changes in research and innovation approaches, a significant cultural shift in modes of scholarship more broadly started to take hold in the United States in the 1990s, prompted largely by the seminal work by Ernest Boyer. He, and later many others, promoted a more 'capacious' view of scholarship within the academy, both to address new societal challenges and to increase the vitality and wellbeing of the professoriate. He and others argued that the scholarship of teaching, integration, and application and engagement should be valued and encouraged equally as much as the scholarship of discovery (traditional research).

Units within universities that normally function in 'silos', and/or that adhere strictly to disciplinary traditions are less able to cultivate in doctoral students expertise in these cross-boundary scholarly domains

and ways of thinking. University graduate schools can facilitate the movement of students across these domains through a number of mechanisms, including the development of interdisciplinary graduate programs, the creation of opportunities for students to interact across disciplines, the development of interdisciplinary and transdisciplinary courses, and other strategic initiatives that promote and support broadened forms of research and collaboration.

Higher order (usually transient) structures or grant programs facilitated by governments or funding agencies may broaden these interactions further. Examples of such programs that call for **multidisciplinary, multi-institutional, and often multinational research and doctoral education** include the European Commission's Innovative Training Networks (ITN); the US National Science Foundation's Research Traineeship program (NRT); the Canadian NSERC Collaborative Research and Training Experience (CREATE) program; the Australian Cooperative Research Centres Programme; and the German Excellence Graduate Schools.

Apart from that required for doctoral academic administration, support staffing relevant to doctoral education across the university is growing to address increasingly complex research needs (computing, technology infrastructure, legal and ethical issues, open access requirements, etc) and student services, especially related to increasing international student enrolment, diversified doctoral career pathways, and the more prevalent mental health issues facing students today.

Unanswered questions…

- *More examples for different countries…*
- *What can we learn from the various models of and changes in doctoral education?*

3. References

To be added

III. Changes in supervision, mentoring and pedagogical practices in doctoral education or training, by Ronel Steyn

1. Context

Working Group 2 focused on whether and to what extent changes in broader societal contexts have impacted on doctoral education at the meso- and micro levels. We considered how institutions are (or should be) responding to shifts in the broader higher education landscape, in terms of their organisation, processes and practices of doctoral education. This section of the report (Chapter 3) focuses specifically on the last item, namely on changes in the *practices* of doctoral education. It looks at how doctoral education is "delivered", by whom, in which settings, and how and by whom its outcomes are evaluated. Agreeing on common trends is especially challenging at the micro level, since we are not only dealing with different contexts impacting on doctoral education across our various locations, but also with a variety of ways in which the various trends are then *further mediated* by institutional and disciplinary structures and cultures, as well as the socio-epistemic properties of various research fields (Torka, 2018).

As a starting point to framing changes and variations in doctoral education practices we might review the broadly accepted description of the modern doctorate or PhD.[2,3] Its origin links back to developments in 19th century Europe, when disciplines became the bases for organising knowledge and the production of knowledge. Disciplinary scholars and researchers were responsible for maintaining and developing disciplinary knowledge, and PhD candidature was a period of apprenticeship through which successive scholars were developed to become the next stewards of the discipline (Boud & Lee, 2009). In line with this purpose, most doctoral systems have been based on an apprenticeship model of doctoral education, entailing a "learning-by-doing-approach" in which the doctoral candidate, under the guidance and supervision of a more experienced disciplinary scholar, conducts and reports on a research project. The research output would then be evaluated by other disciplinary peers based on the level of scholarship reflected in it and on its contribution to the field of knowledge. As this new kind of doctorate spread to the rest of Europe, the USA, the UK and further afield, considerable variations developed according to national systems and in different fields of study. These differences have typically had to do with the degree of structure in the programme, the methods of education and training, and the relative weighting of the research dissertation (Boud & Lee, 2009). However, at the same time as the modern doctorate continues to expand across the globe (Nerad, 2010a), broader societal changes have led to questions being asked about its traditional purposes, outcomes and therefore of its practices.

It is important to note that interest in doctoral education as a field of study has only really developed in the last twenty years or so. Before this, doctoral study was regarded as part of the research activities and life of disciplinary communities. Unlike other forms of education, the processes of doctoral work were not subject to outside scrutiny, nor were its educative elements made explicit (Gilbert, 2009; Lee & Boud, 2009). As such, research into doctoral education has not benefitted, until recently, from the full resources of educational research, including the key concepts of pedagogy and curriculum (Green, 2009). Furthermore, much of the explosion of research into doctoral education in recent years has been driven by policy concerns

[2] While doctorates had been awarded since the 12th century, these earlier degrees generally consisted of training programmes for the professions of the time, e.g. theology, medicine and law (ASSaf, 2010:35). Right up to the 18th century universities mostly concerned themselves with the preparation of the administrative elite for public service and other professions. The function of the doctorate over this extended period could therefore be broadly described as the *teaching of existing* knowledge and beliefs rather than *creating new* knowledge (McClelland, 1980 as discussed in Backhouse, 2009).

[3] Other forms of doctorate exist, such as those awarded at the end and in recognition of a research career. In Japan this was the major form of doctorate in the Humanities and Social Sciences, until the 1990s when the notion of the PhD as a certificate at the start of the research career was introduced in these disciplines.

and have focused on broad system features such as enrolments, graduation rates, and completion times. While there have been highly individual micro-level studies focusing on supervisor or candidate experiences, research on the daily realities and practices of doctoral education, understood within their variety of structural and cultural contexts, has been limited. The result has been national and institutional policies based on "thin conceptualisations" of doctoral education (Lee & Boud, 2009:18) leading to potentially counter-productive policy prescriptions (Pearson, Evans & Macauley, 2016) that do not take into account the complexity of doctoral work, what it actually produces and how it is produced.

Key recommendation

Our group felt strongly that policy processes need to shift away from normative regulations, and towards decision-making based on evidence about existing practices, as well as evidence on the impact of regulatory instruments on actual doctoral education. Torka's study in Germany (2018) for example shows how the socio-epistemic preconditions of research fields mediate how doctoral education policies are adopted and implemented. Our main recommendation is thus for more quantitative and qualitative empirical research into the variety of doctoral education practices, what it actually produces and how it is produced, to inform both national and institutional policies.

2. What are the outcomes of doctoral education?

The purpose of the broad description of the traditional PhD given above was that it would allow us to frame doctoral work as education and to frame any changes and variations in practices in terms of changes of variations in its traditional *purpose* (the maintenance and development of disciplinary knowledge), *outcomes* (an original contribution to body of knowledge and a disciplinary scholar), *methods of delivery* (apprenticeship, learning-by-doing, supervision by disciplinary community) and *evaluation* (disciplinary peer review of research report).

If the doctorate is regarded as a type of education, any analysis of its practices needs to include a sense of its (intended) educational outcomes. The modern doctorate has always produced both *new knowledge* (the scholarly product/research output) and *a skilled person* (traditionally the disciplinary scholar). Some of the calls for changes in doctoral education practices relate to suggested changes to the *kinds* of knowledge and the *kinds* of person to be produced and how (Boud & Lee, 2009).

What kinds of knowledge should be produced?

Debates about what kinds of knowledge should be produced in research universities revolve around contested notions of knowledge, and the relationship between its production and its application in the socio-economic system (Green & Usher, 2003). Gibbons et al. (1994) make the distinction between Mode-I and Mode II-knowledge (in Nerad, 2010b) and argue that the primacy of the specialised, disciplinary basis for knowledge claims (Mode I), is being challenged by the increasing importance and prevalence of Mode II-knowledge in the knowledge economy. While Mode I-knowledge is legitimated through its adherence to the epistemological canons of the discipline, the legitimacy of Mode II-knowledge is based on its usefulness and ability to solve a particular contemporary problem (Green & Usher, 2003). In the production of Mode II-knowledge, there is no distinction between discovery and application; it happens at the same time and in the same place (Green & Usher, 2003). Mode II–knowledge production typically involves various sectors of society – universities, industry, business, not-for-profits (NFPs) and governments – both in the framing of the problem and the discovery of its solution (Nerad, 2010b).

With the rise of the knowledge economy, questions arise about the role of universities in innovation processes and of the ideal structuring of the relationship between university research and society. Since the late 1980s, many national governments have tried to forge links between universities, industries and

government agencies – the so called into a "triple helix" (Etzkowitz & Leydesdorff, 2000)[4] – through policies and funding systems that emphasise commercial and applied research over basic research programmes, with the aim of producing marketable knowledge products (Marginson, 2010a). In higher education in some countries there has been a partial shift away from basic research programs towards commercial and commercialisable research projects often of shorter average duration (Marginson, 2010b).

While the importance of research for society is widely acknowledged, there have been some concerns about universities being too directly involved in Mode II-knowledge production. The Organisation for Economic Cooperation and Development (OECD) argues that the principal role of higher education in research and innovation lies in the production and dissemination of 'open science' and not in the direct production of marketable knowledge (OECD, 2008:120 in Marginson, 2010b:10). These concerns are not a criticism of the market economy *per se*, but rather question the role of the university within it. Numerous scholars have critiqued the tendency of both governments and development agencies to depict the relationship between knowledge production and development as a direct one, focusing narrowly on the relevance, utility and applicability of knowledge, where for-profit or in service of development goals (Castells, 2017; Cloete & Bunting, 2012; Frick, McKenna & Muthama, 2017; Marginson, 2010a; Youtie & Shapira, 2008). These critics argue that the Mode I-knowledge production in universities *enable* the existence and growth of adjunct knowledge producers (R&D divisions in industry; parastatals and Non-Profit Organisations) and that it is these adjunct knowledge producers who should specialise in short-term knowledge application (Mode II). Secondary knowledge institutions are dependent on the indirect, long-term knowledge-generating capacity of universities, from where they draw both their knowledge and their knowledge workers. Countries that have strong applied knowledge industries *also* have strong research universities (Cloete & Bunting, 2012). Universities should thus not erode their unique contributions on which these adjunct knowledge industries rest. These unique contributions include knowledge creation (mostly through basic research), the interpretation and dissemination of knowledge (through teaching and communication) and research training (ensuring the preservation and renewal of the knowledge system). The concern is perhaps most acute in those countries that have yet to develop strong and stable basic research sectors, such as those on the African continent. They run the highest risk of "conver[ting] the university into an applied knowledge producing institution, eroding its longer-term and far more critical mission, which is to produce the next generation capable of producing knowledge and innovation on a renewable basis" (Cloete & Bunting, 2012:5).

This emphasis on the long-term knowledge-generating capacity of universities does not imply retreating into old collegial modes of research separate from society (Marginson, 2010b). The OECD's notion of 'open science' refers to a networked and interactive global knowledge-creating environment in which universities, industry, and other stakeholders share a common information system (Marginson, 2010b). Public funding means that public universities are first and foremost accountable to their national and local communities. While public accountability does not mean uncritically accepting all government policies, reclaiming the autonomy of research requires universities to remain open and transparent and to find ways to work with their different "publics" - industry, civic society and perhaps especially, traditionally disempowered communities - to genuinely serve the public good. At the same time, knowledge is mobile and lends itself to globalisation. Through the worldwide exchange of knowledge, universities also create global public goods; and have a particularly crucial role to play in the formation of a world society and in addressing global challenges, such as climate change (Marginson, 2010b).

[4] Carayannis and others have built on this notion and have suggested the development of a Mode 3-knowledge production operating in a 'quadruple helix'- innovation system (see Schoonmaker & Carayannis, 2013).

Key point for discussion: Disciplinarity

The above arguments suggest that there is still space for the production of disciplinary knowledge in the doctorate, with the understanding that the disciplines themselves need to become more "open" – engaged with their publics, aware of their unique contributions to society and to other disciplines, but also of their limitations and potential to exclude and disempower. The Public Scholars Initiative at the University of British Columbia (UBC) encourages and supports doctoral students to broaden their dissertation scholarship, and to engage with external partners (if appropriate) on projects aimed at the public good. In the context of post-coloniality, broadened epistemologies are considered important for social equity and access to higher education in South Africa and Canada. UBC and the Canadian Association of Graduate Studies have done work on expanding the notion of scholarship and the scholarly products that should be valued in doctoral research. The idea of open disciplinarity is also one of the ways listed by Gasper (2010)[5] in his taxonomy of possible ways in which disciplines can interact. When disciplines are open, the pursuit and production of disciplinary knowledge itself shift and blur disciplinary boundaries and can lead to new interdisciplinary fields. Gasper shows that there are many alternatives to traditional mono-disciplinarity. Could it be that some of these types would be better suited to university research environments and others to adjunct knowledge settings? Also, could interdisciplinarity not be more effectively achieved through developing open disciplinarity attributes among researchers, rather than imposing multi-disciplinarity from outside.

What kind of attributes should be produced by doctoral education?

The different conceptions of knowledge and knowledge production, as well as the different perceptions about the relationship between universities and society discussed above, have led to questions being asked about the kinds of person being produced through the doctoral education process and the kinds of attributes required for new conditions of research and work (Boud & Lee, 2009). There are two aspect to the debate. First, there is the argument that fewer doctoral graduates pursue an academic career than before (Nerad, 2010b, a). In contrast to rapidly developing doctoral education systems (such as South Africa, Kazakhstan and Bulgaria) where universities can absorb the majority of the PhDs produced, well-established systems like Canada, the United States, Germany and Australia simply do not have enough academic posts to absorb the number of graduates. In Japan, the rapid growth of the system, followed by a decline in number of enrolments, have led to poor working conditions for newly graduated academics, making it an unattractive career option. The question arises whether the doctorate is equipping candidates with the requisite skills for entering diverse careers outside of academia.

Second, it could be argued that research and academic work itself is changing and that therefore, even if the primary function of the doctorate remains that of training people for an academic career, new and additional attributes are required and should be developed through the doctorate. These include applying for funding, reporting to a broader range of stakeholders, working with new and rapidly changing technology, and especially dealing with the increasing demands of interdisciplinary and transdisciplinary research and international collaborative research (Boud & Lee, 2009).

A broader argument is that irrespective of intended career trajectories, doctoral education should prepare society's brightest minds to tackle the urgent and complex societal and planetary problems we face. Higher education is in a good position to tackle global problems as it is also a contributor to globalisation and works across global platforms. Tomorrow's leaders, innovators, and scholars will be working in diverse and constantly changing work environments and will require attributes beyond what most doctoral programs consider or offer. Different names have been given to these attributes by different schools of thought (e.g. Stevens-Long et al., 2012; Sternberg, 1985; Stephenson, 1992), but at their core they include

[5] Also see Max-Neef (2005) for an alternative taxonomy.

the ability to see different perspectives (cognitive flexibility); abilities in abductive, integrative, and synthetic reasoning and acquisition of tacit knowledge; empathy; and metacognition.

Whether and where current doctoral education practices deliver any or all of these outcomes is uncertain. Peer review is the main process by which the quality and contribution of research is judged, and there has traditionally been little need or interest in making explicit how the scholarly community exercises its judgements, what counts as legitimate knowledge in a field and the more implicit aspects of scholarly activity. As noted above, there is a small but growing field of educational research focusing on doctoral education and some scholars within this field have attempted to elicit what doctoral examiners are looking for, drawing on interviews or surveys with examiners, supervisors and students, observing examination proceedings, and collecting the text of examiner reports (McKenna, Quinn, & Vorster, 2018; Holbrook, Bourke, Fairbairn, & Lovat, 2007).

3. How is doctoral education delivered?

In most education systems the primary focus of the doctoral research degree is on the research activity of the individual candidate, supervised by one or more qualified scholars in the field, although some programmes include coursework, as is discussed below. The common understanding is that the candidate will develop the expected scholarly attributes *in the process of* creating the research contribution to the field of knowledge.

Formal Coursework

In the USA, the research phase of candidature is traditionally preceded by 1-2 years of formal compulsory coursework, including examinations. Successful completion is a prerequisite for continuing to the research phase. A similar system exists in Canada, although coursework requirements differ widely between disciplines and overall tend to be less than USA coursework requirements. In other established systems such as the UK, Australia and Europe, the PhD typically does not involve formal coursework. As always there are variations – in Germany for example formal coursework and examinations are found where the PhD is entered directly after a B-degree, but not when entering with a Master's (which is the more typical scenario). It was suggested in our group that the coursework model may be related to the type of Master's degree offered in a particular system and that the introduction of formal coursework would be unnecessary in cases where the Master's degree represented an adequate disciplinary foundation for independent research. The traditional South African PhD, which is based on the UK model, also has no credit bearing coursework, although very recently a new variant of "Professional doctorate" has been approved, which allows for up to 40% of credits awarded for examined coursework or workplace learning. Japan also distinguishes between two kinds of doctorate – "Course-work doctorates" and "Paper doctorates", the latter also a pure research degree. However, the Japanese government has strongly recommended that doctoral education should introduce rigid course work in order to ensure completion of the doctoral degrees in three years. Kazakhstan has recently adopted the Anglo-American model of PhD programmes with 1-year coursework requirements and two years of PhD research to enhance the quality of their doctorates. Due to a lack of capacity in the system, however, many of the current courses are of low quality or irrelevant to research, especially in humanities and social sciences: almost nothing is said about big data, digital tools, new research methods.

Extra-curricular courses and skills training

A distinction was made between coursework that is a formal requirement of the candidature and those that could be regarded as "extra-curricular" and aim to supplement or support a "pure research" degree. An increase in the latter type of coursework was reported in our group. These types of courses were most often offered by recently established institutional units situated outside of disciplinary structures (Kazakhstan,

Japan, Germany, Australia, South Africa) and thus tended to offer generic courses common to all PhD candidates, such as research ethics, teamwork, communicating complex ideas, grant writing and time management (Nerad, 2010b, 2010a). Acknowledging that many PhD graduates do not stay in academia, these units also offer workplace and so called "transferable skills." In Japan, PhD candidates were also encouraged to enrol in undergraduate courses in disciplines outside their own field of study (especially liberal arts courses) in order to develop their interdisciplinarity and employability. This echoes to Nerad's suggestion that interdisciplinarity could be stimulated by offering epistemology courses to make transparent how knowledge is generated and legitimated and how these may differ across disciplines (Nerad, 2010a). In South Africa, generic courses are often focused on basic research skills, academic writing and language skills in order to ensure that all students can cope with the demands of the research degree (given that research universities are wanting to ensure equitable access to the doctorate within a system that still delivers highly unequal education right up to tertiary level).

Points for further discussion: extracurricular skills training

A question raised in our group related to whether "transferable" workplace skills were something separate from the attributes already developed through completing the research degree and whether they should or could be taught. Perhaps what PhD graduates rather needed was the ability to *name and reflect on the attributes* that they have developed through the PhD and consider how they can *translate or contribute* to a variety of contexts.

A second issue relates to the notion of decontextualized skills training offered through central support and development units for doctoral education. In the South African context skills training is seen as a way to prepare (some) candidates for the demands of the research degree. Gee's point that academic literacy cannot be taught but must be acquired through practice in context is relevant here (Gee, 1990 in Boughey & McKenna, 2015). Also, the individualised interpretation of doctoral learning tends to "unproductively assign blame to students for what may be structural issues… [by] suggesting a normative assumption representing supervisory resources and structures as adequate for all students, they thus make invisible structural and systemic problems that may exist" (McAlpine, Paulson, Gonsalves, & Jazvac-Martek, 2012:512).

A third issue is the concern that "skills" training reinforces the often narrow and instrumental views on doctoral education found in the growing number of policies concerned with efficiency and relevance of doctoral education. Platow (2012) distinguishes between models of graduate attributes that focus on what *should be produced* (in the form of skills, competencies or attributes) through doctoral education; and those that are based on empirical research that seek to identify what *has been produced* through doctoral education. It is especially the former type that could be seen to "limit and constrain what doctoral education is for" (Boud & Lee, 2009:14). Green (2009) also sounds a cautionary note in this regard. Drawing on the work of Pinar (2004, 2006), he argues that the process of doctoral curriculum inquiry should include more open-ended research in order to *understand* educational phenomena. Curriculum inquiry into doctoral education, like 'basic' research in the natural sciences, "wherein destinations are not necessarily known in advance" should go beyond questions related to "the utilitarian, the pragmatic, the narrowly relevant" (Green, 2009:329). Following Hainge (2004), Green asks what may be lost in recent moves by governments to reframe the doctorate purely instrumentally within "the supra-logic of productivity" (Green, 2009:330).

In the Canadian context, the **Public Scholars Initiative** attempts to move beyond generic skills training and extracurricular experience, and to find ways of developing complex scholarly attributes through the broadening of doctoral research and the dissertation. New kinds of scholarly attributes require learning that entails experience, diverse human interaction and collaboration, trans-disciplinarity, disorienting dilemmas (involving cognitive dissonance), and learning how to learn, ideally in the context of the student's deepest engagement in research. This has implications for the kinds of scholarly product deemed acceptable and the Canadian Association of Graduate Studies are investigating ways of expanding the dissertation (purpose, content, structure, assessment).

Research work and Supervision

Despite the presence and perhaps increase in doctoral coursework, the dominant model of research education in many universities remains an apprenticeship "learning-by-doing" model, characterised by an "individualised and personal" dyadic relationship between the supervisor and the research student (ASSAf, 2010:65 Lee and Green (2009:616). The appropriateness of this model has been called into question from various quarters, but there is not necessarily agreement on whether or how changes should be introduced. Concerns centre around the reliance on a single primary supervisor, the lone scholar working on an individual research project and the degree of structuring of the research project.

Group, team and joint supervision

Most candidates rely heavily on a single primary advisor or mentor, even in the US "supervisory committees", which is made up of collaborators and additional mentors to complement the guidance offered by the primary supervisor, and other members who ensure quality assurance for the overall educational experience (e.g., on behalf of the central graduate school). In other systems too, it is not uncommon to find co-supervisors that play this supplementary role, although these arrangements are not necessarily formally prescribed. In the South African context, arguments have been made that "the traditional approach – being based on the availability of suitably qualified supervisors – serves a relatively small number of students and may not be an efficient model for rapidly increasing PhD production" (ASSAf 2010:65). There is also concern about the shortage of experienced supervisors and newly graduated and inexperienced supervisors that are unprepared for full supervisory responsibility (Manathunga, 2005; Manathunga & Goozée, 2007). This is worrying, especially since Delamont et al. (1997) argue that the inter-generational transmission of disciplinary knowledge and skills between supervisors and students creates pedagogic continuity.

Others suggest exploring alternative models of supervision in order to "open out and make transparent the largely private relationship" (Samuel and Vithal, 2011:83). This sentiment is also reflected in the recent recommendation of the National Academies and the Council of Graduate Schools in the US that trainees should benefit from a multiple mentor structure. Advantages given include that candidates would be freed from the power dynamics of a single mentor relationship; get guidance from multiple perspectives; get knowledge of and access to multiple career options; benefit from institution-supported training of mentors; benefit from increased accountability from funding agencies (the belief is that if universities respond to increased oversight from funders such as the NIH and NSF best-practices will extend across the university). In Kazakhstan a new requirement is that all candidates must be co supervised by an international co-supervisor. This move is an attempt by the government to raise the quality of the degree and align it with international standards. In practice however, this brings about multiple challenges.

Point for further Discussion: **the primary supervisor role**

Not everyone in our group agreed with the need to expand the number of different roles involved in doctoral education. Some felt that the relationship with the supervisor should be primary, with other roles in support of and supplementary to this relationship, rather than creating new institutional structures, roles and regulations. Perhaps this concern is linked to the introduction of monitoring and mentoring by new institutional role players who are not always familiar with the realities of disciplinary knowledge building?

Cohorts and Research Teams

A group of PhD researchers working together on a research project is quite common in the natural sciences. In the Humanities and Social Sciences however, doctoral work can be very isolated. Cohorts are said to improve completion rates, remedy a sense of isolation felt by many students, decrease pressure on students, supervisors, administrators and academics to meet expectations timeously (Govender & Dhunpath, 2011). Structured cohort programmes have traditionally been associated with US-based doctoral programmes

(Nerad, 2011), because coursework lends itself to the structuring of cohorts. In South Africa, establishing cohorts is made very difficult because most PhD scholars are non-resident, part-time students. Also, there is a lack of sufficient sustained funding to support long-term, large research programmes. Nevertheless, there are examples of some of the features and benefits of cohorts being introduced into more loosely structured programmes, such as the use of research seminars to create collaborative knowledge sharing environments (Malfroy, 2005) or scheduled residential "doctoral weeks" (McKenna, 2016).

Structure and programming

Because of its disciplinary focus, most of the decision-making around doctoral education has traditionally taken place at the disciplinary level. Processes such as selection procedures, final selection of candidates, supervisory relationships and selection of research topics, are still mostly embedded at the disciplinary level, where individual supervisors make many or most of these decisions, with some oversight by the department, e.g. rules and guidelines; or the faculty, e.g. quality control, final approval of proposals, examiner selection. However, there has been a surge in the creation of institutional schools/research schools that develop overall guidelines for the doctoral education process in an institution, codes of practice related to doctoral education (Nerad, 2010a, 2010b). In some cases, they are involved in evaluation surveys to assess student experiences of their supervision and doctoral programmes. They can also offer incentives and rewards for good mentoring. Increasingly, such units also offer supervisory training, as well as training for doctoral students, as discussed above. In line with this there is a general move away from a *laissez faire* style of doctoral supervision towards a more structured and directed process (Gatfield, 2005; Mouton, 2011). Admission processes have become more defined and competitive, there is stricter monitoring of progress throughout the doctoral process as well as at the end of the process, for example the wider introduction of an oral defence (Mouton, 2011; Nerad, 2010b).

Our group expressed some concerns about the role of such central institutional units. It was felt that these units do not always understand the complexity of doctoral work and the fact that research is essentially non-programmatic, unpredictable and relational. The focus on planning and monitoring is especially problematic in some disciplines, where the epistemic structure of the science itself prevents early formulation of research topic and questions for example. Another concern is that the monitoring of doctoral outputs and throughput rates interferes with the autonomy of academics and threatens the academic decision-making power. At their best, such central units should be able to work in partnership with supervisors. For this to happen, however, the structural divide between support staff and academics needs to be challenged, by developing such support staff as scholars in the field. It will also require the maintenance or improvement of trust between institutional units and the disciplines, which in turn means that such central units should avoid managerialism and an over-emphasis on policy and regulation.

New Settings

Pearson et al. (2016) argue that doctoral education is not only migrating beyond disciplinary boundaries but also beyond traditional teaching and research structures. In an analysis of PhD programmes in Australia (2006 – 2009) they describe the fluid and complex arrangements forming the 'experienced environments' for doctoral candidates", including a range of research sites, agencies, entities, facilities/infrastructure within or external to any one institution; collaborative programmes and structures among related and dispersed disciplinary academics; research sites hosting inter-institutional groups of candidates; and candidates with strong or tenuous connection to their academic units of official enrolment. Similar examples given by Nerad (2011) include the German *Graduiertenkolleges*, involving academics from several universities, and often having an international orientation and US programmes introduced in 1997, to train doctoral students by working within multi-disciplinary teams on topic-driven research, in addition to acquiring traditional disciplinary research training. Clearly such new forms of doctoral education have implications for the management, supervision and examination of doctoral work. An increase in structured,

interdisciplinary, theme-oriented doctoral programmes. Pearson et al. (2016) emphasise the importance of more empirical research to capture the diversity of doctoral education practices, settings and agencies.

4. How is doctoral education examined?

Both outcomes of doctoral education – the scholarly product and the skilled person – have traditionally been assessed through presenting a written research report to qualified scholars in the relevant disciplinary field, who would evaluate the level of scholarship reflected in it and contribution it offers to disciplinary knowledge. (While the USA and Canada and some other systems also have formal examination of coursework in the earlier phases, the final examination of the PhD is based on the research report). Some systems, or individual institutions within systems, end the evaluation phase with an oral defence by the candidate, but different systems give different weighting to the viva[6]. The selection of examiners is a key quality measure and institutional regulations will often require internal as well as external examiners (often international).

Recent developments have brought about new varieties in the form of the final research report. The traditional dissertation in a single monograph, developing one theme or thesis over a series of chapters, is still widely used, especially in the humanities, to a lesser extent in the social science. The natural sciences however now mostly follow the format of a series of journal articles, linked together by an introduction and conclusion. As publishing becomes a central feature of academic work this format is becoming increasingly popular across all disciplines. In the creative arts, creative outputs (for example, music composition, performance, a novel, paintings) together with a scholarly analysis, can make up the dissertation. While many national doctoral systems now acknowledge and allow these variations, institutional policies and practices may lag behind, as Mason (2018) reports in the Australian context. This means that candidates may not be aware of the options available to them, they may not receive the support specific to their approach, and they may struggle with issues that are left unresolved, e.g. how many and what type of publications they should include, issues of authorship and contribution, dealing with lengthy publication turnaround times, etc. (Jackson, 2013; Merga, 2015; Mason, 2018).

As has been reported above, the Public Scholar Initiative in Canada are encouraging broader approaches to scholarship and innovative forms of scholarly product and investigating ways in which new forms of knowledge can be made rigorous, assessed, and valued as integral components of the work required for its highest degree. Related to this the Canadian Association of Graduate Studies are looking at expanded notions of the dissertation – its purpose, structure, content and assessment. One of the recommendations made was to keep a repository of resources and non-traditional dissertations. This has been started at: https://cags.ca/rethinkingphd-dissertation/

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[6] In some cases, it is key to providing a final result and can overturn or confirm examiner's initial evaluation of the written report. In others it is closer to a formality, giving the successful candidate an opportunity to be welcomed into the disciplinary peer group through a public presentation of the research

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