Challenges to

innovation

in Graduate Education

Synopsis of the International Conference of
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Canadian Association   Association canadienne
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conference schedule

preface

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Graduate education is directly linked to one of the most significant features of contemporary society, the central role of science and knowledge. Accordingly, our 2006 international conference explored the complex relationship between innovation and graduate studies.

The Conference examined both the influence of discovery on teaching and research, as well as the impact of graduate studies on innovation and the knowledge economy. The gathering gave rise to highly stimulating discussions and identified some of the challenges facing universities to meet the needs of modern society. We are happy to share this summary of the Conference with you and we are convinced that you will find it worth your time and effort.

We would like to express our sincere appreciation to the international experts on higher education who spoke at the Conference and who set the tone at a remarkably high level.

The Conference participants maintained a fruitful dialogue throughout the meeting and are to be commended. We also want to thank members of the

Programme Committee who laid down the broad lines of the Conference, and Dr. Wendy Hough-Eyamie, who worked as a researcher and wrote the synopsis, as well as Jocelyne Vézina-Allard and Dr. Jean-Pierre Gaboury of the national office. Finally, we are extremely grateful to our sponsors: the Canadian Institutes for Health Research, the Natural Sciences and Engineering Research Council of Canada, the Social Sciences and Humanities Research Council of Canada, the Ministry of Training, Colleges, and Universities of Ontario, UMI/ProQuest, the Killam Trusts and the three Toronto universities; Ryerson University, the University of Toronto, and York University. Such broad support is remarkable and allowed us to hold a Conference of such high standing.

challenges to innovation in graduate education:

Wendy Hough-Eyamie, Ph.D.

technological innovations and the transformation to a knowledge-based economy are having a significant impact not only on the practices and policies of educational institutions but also on the very nature of scientific inquiry and research. At the same time, however, directions in graduate education can have an important influence on innovation and the growth of a knowledge society.

There are at least two key elements of this transformation to a knowledge-based economy: innovation and globalization. Innovation refers to the development of new technologies and the expanded application or uses of these technologies. Technological advances have resulted in an unprecedented proliferation of knowledge and an ever-expanding set of tools for its distribution. Implied by the term innovation is an increased commercialization of research – a shift from "pure" research producing advances in knowledge to more "applied" research producing advances in some form of tangible product with a concomitant economic benefit. This shift is also linked to increasing involvement of private investors and industry in the funding of university-based research. These investments have subsequently impacted the research process and researchers by increasing the accountability of the researcher both in terms of outcome and timeliness. Researchers find themselves in the process of shifting from involvement in the "process" of research to the "management" of research. Likewise, the governance of universities has taken a decidedly managerial or corporate shift in response to innovation, for example, many universities have established offices of technology transfer, engage in cost-benefit evaluation of programs and projects, and have incorporated human resource policies that favour contract-based employment of research staff.

The trend toward globalization in research and graduate education has both contributed to and been facilitated by innovation. The production of truly innovative research is enabled by bringing together the best people, resources, and facilities to tackle the question at hand. This has resulted in research collaborations that extend beyond the boundaries of traditional disciplines, institutions, and nations. Networking, collaborations, and partnerships have become commonplace forms of academic inquiry and exchange. Of course, globalization has been facilitated by innovations in communication that make access to information virtually borderless and instantaneous and by the standardization of products and services around the world. This technology has also resulted in enormous potential for global e-education which is yet another front on which the traditional university faces market pressures as it is pulled into competition with for-profit institutions that offer quick and convenient access to higher education through e-learning.

Together, the processes of innovation and globalization prevalent in today's knowledge economy are having a significant impact on the very core of the traditional university and its key functions of research and teaching[1]. This period of transition provided the context for our discussion of Challenges to Innovation in Graduate Education. The 2005 International Conference of the Canadian Association for Graduate

Studies brought together faculty, administrators and graduate students from Canada and around the world to explore the relationship between innovation and graduate education.

This report provides a synopsis of the sub-themes discussed at the conference concentrating on the issues related to the challenges that exist in the development of graduate education that is responsive to the needs and pressures of the knowledge economy. These interconnected sub-themes include:

- International mobility
- Disciplines and transdisciplinarity
- Policies of innovation
- Public-private partnerships
- Ethics and ethical issues
- Graduate education in the global context
- Indigenous peoples and graduate education
- Women in academia

International mobility

The global movement of faculty and students in order to facilitate the sharing of knowledge, resources, and facilities is a hallmark of the knowledge economy. This, however, is also a reflection of national and institutional goals and efforts[ii]. For instance, attracting foreign students can be seen as an export activity with economic returns for the hosting country while for the sending country student mobility is one way of addressing the need for tertiary education particularly for developing countries and economies. Of course, substantial effort is required to ensure the viability of such movement particularly as concerns quality assurance, credit transfer, and degree typologies. This is clearly evidenced in the European context by the ongoing Bologna Process[iii].

Interestingly, international mobility is also tied to another European initiative: the Lisbon Declaration which has as its goal to strengthen the competitiveness of Europe in the fields of innovation and technology. In this case, however, the local interest of competitiveness is actually somewhat at odds with global interests in sharing knowledge and resources – internationalization as opposed to globalization[iv].

Both structural characteristics of the destination country and internationalization policies impact the decisions of prospective students in choosing a host country[v]. Structural characteristics include such variables as language of instruction, geographic and/or cultural proximity, and the existence of historical ties between countries while internationalization policies are related to issues such as quality assurance, recognition of foreign qualifications, immigration policy, tuition fees, and marketing policies.

Disciplines and Transdisciplinarity

The complex nature of the questions facing society at the dawn of the 21st century has provided the impetus for transdisciplinary approaches to research. Reaching beyond traditional discipline-based boundaries allows for the dynamic engagement of multiple perspectives, sources of knowledge, and scientific tools. However, there are a number of barriers to transdisciplinarity many of which reflect the structure and function of universities such as academic hiring and promotion based on departmental identities, budget processes, and limited resources. These are coupled with the often pejorative connotation of transdisciplinarity with applied, non-academic research while discipline-based research is seen more positively as basic and academic[vi]. Transdisciplinary efforts are undermined further by the typical granting mechanisms of the funding agencies[vii].

In the face of these generic barriers to transdisciplinarity the questions remain, then, as to why and how are some institutions, programs, or disciplines more successful than others at moving in this direction[viii]? The answer may lie in the difference between innovation and initiative – many institutions are successful in taking the first steps towards trans-

disciplinarity or taking the "initiative". However, true innovation requires follow-through especially in terms of funding, forward thinking, and flexibility with regard to evaluation of research contribution[ix,x].

Interestingly, from an historical perspective, it appears that much of the discussion about the inherent difficulties in establishing transdisciplinarity may be purely academic. Disciplines are constantly evolving: some are created and some disappear, and some are fused while others are further segmented. Transdisciplinarity is one mechanism involved in this evolutionary process[xi].

The ongoing struggle to foster and develop transdisciplinarity in research extends to graduate education. Students trained in transdisciplinary programs continue to face a number of hurdles including difficulties finding academic employment and devaluation of non-academic career options. Often, supervisors actively discourage students from following in their own transdisciplinary tracks. However, many students are willing to engage in the "risky business" of transdisciplinary research[xii]. The resolve of this new generation of researchers to answer questions they wish to pose by whatever means are necessary will undoubtedly provide the catalyst for continued transdisciplinary efforts.

Policies of Innovation

Policies of innovation have had a significant impact on the nature of the academic enterprise particularly with regard to the role of the university in terms of commercialization, the nature of the social contract between the researcher and the funding agency, and the appropriate training of graduate students[xiii].

The increased importance of commercialization in terms of such measures as patents and start-up companies resulting from university-based research represents a fundamental shift in the traditional

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research paradigm and is one important element of innovation. To a certain extent, commercialization reflects the increased ties of industry and government to university-based research and the attached expectations of return on investment. Examination of trends in commercialization productivity reveals that the amount of technology transferred from universities is a roughly linear function of research expenditure. However, there is wide variation between institutions and regions reflecting the role of institutional culture and commitment to the commercialization agenda[xiv].

Related to policies of innovation, funding relationships, and social accountability are the profound changes currently taking place at the "research-teaching nexus"[xv]. Within the current academic climate there has been a multiplication of tasks for which the researcher is responsible: seeking out sources of funding, optimally managing research projects with regard to budget and timelines, all the while expanding the range of research relationships with new stakeholders in industry and government and/or researchers from across disciplinary domains. While the process of research is becoming more flexible with regard to potential collaborations, teaching remains, for the most part, statically linked to disciplines causing a degree of tension between the two fundamental roles of the university. This tension is furthered

by trends toward increased teaching loads related to the development of mass education in response to the demands of the knowledge economy for a vast number of knowledgeable workers. These changes in both research and teaching roles are coupled with an inadequate salary structure and the movement in university human resource policy toward contract-based employment. The net result of which is that many young researchers are less attracted to academic careers.

This discussion raises a number of questions pertaining to the training of tomorrow's scientists such as what are the requisite skills they have to learn, are universities prepared to train students in non-academic competencies, what is the role of the graduate student within the university, and how should they be socialized[xvi].

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Beyond this practical instruction, there needs to be substantial intellectual processing of ethical issues[xxiii]. There is a need to distinguish between the active consideration of professional norms of ethics in one's field of study and the contemplative consideration of the moral issues associated with undertaking research: "should" and "should?"[xxiv]. However, the development of a true "culture of research" requires an understanding of some of the misconceptions regarding ethics and ethics training such as assuming that the fundamental nature of ethical reasoning is based solely on early socialization; the subjectivity of ethical positions renders their consideration moot; the belief that the existence of regulatory boards will ensure ethical research, and finally, the myth that good ethical research practices are best taught through modeling as opposed to explicit instruction or discussion[xxv].

Public Private Partnerships

Although, overall, universities have been rather slow to make this transformation as administrators have forced the poles between public and private research activities to stay separate[xvii], the emergence of the knowledge economy has resulted in the proliferation of public-private partnerships and the blurring of definitions of public/non-profit/for-profit organizations[xviii].

These partnerships have created a new set of roles for graduate students as inventors, innovators, and entrepreneurs which, in turn, have produced a number of unexpected educational dilemmas surrounding issues of intellectual property ownership and the power relationships, rights and responsibilities of professors, students, and universities. In order for students and universities to participate fully and to mutual benefit in the entrepreneurial process, policies and procedures must be clear and explicit and not part of the "hidden curriculum"[xix].

Ethics and Ethical Issues

Innovative scientific advances have served to highlight the importance and complexity of ethical considerations in research. As an example, human genetics research illustrates the myriad factors that must be considered from an ethical perspective – the right to anonymity for participants and the right-to-know or conversely not-to-know any diagnosis, prognosis, or other relevant health information as it applies to the individual, family, or community[xx]. The global sharing of genetic information will undoubtedly expedite the research process; however, such borderless distribution of data not only produces logistical issues related to harmonizing terminology but also extends the responsibilities of the researcher to include consideration of the ethical standards of the "importing" country. Finally, the open sharing of genetic material and data illustrate a fundamental shift in ethical perspective from investigator or institutional ownership of data toward a more inclusive conception of genetic data as public resources or global public goods.

Education and acculturation in research ethics ought to form a central part of graduate education but, in fact, does not[xxi]. Graduate students should receive formal training in the responsible conduct of research including: regulations concerning the use of animals or human research subjects (where appropriate), responsible data management and publication practices, the fundamentals of managing grants and conflicts of interest, expectations for sharing or protecting information, and obligations associated with the peer review process and reporting misconduct[xxii].

Global Impact of Innovation in Graduate Education

Discussion of the challenges of innovation to graduate study in the global context revealed an interesting continuum of impact related to the stage of development of graduate education in the region. For example, the impact of innovation per se in Central America is overshadowed by recent "catastrophic" histories, both natural and political[xxvi]. Graduate studies in this region are a relatively recent development and are characterized as being highly diversified across countries and institutions, with no standards of excellence in operation, and not linked to research but are more market driven with a focus on professional training. They face considerable developmental problems such as achieving a critical mass of faculty and students, small academic communities, and redundancy[xxvii]. Although innovations such as globalization may ultimately serve to enable the development of graduate studies in Central America, in its existing stage of infancy its impact is relatively negligible.

The current state of graduate studies in India represents an intermediate position on the continuum of innovation impact. The technological advances and forces of innovation associated with the movement toward a knowledge economy have resulted in many of the brightest students being attracted to private sector industry and management schools. Likewise, globalization has resulted in a number of students being drawn to study and research abroad programs. Not only have these forces produced a decline in graduate student intake and output, they have resulted in an acute shortage of faculty[xxviii].

Aimed at both quantitative expansion and qualitative improvement of graduate studies programs, a number of periodic reviews have been commissioned. These reviews produced a number of recommendations regarding how to attract more students to graduate education, necessary modifications to existing programs to ensure that the needs of the industrial and strategic sectors are met, and how to ensure that employment opportunities exist for graduates[xxix]. In general, graduate programs in India are characterized as being in a stage of development in which market forces are pushing the education system to be responsive to its needs and impact.

Examination of graduate studies in Hong Kong exemplifies the extreme position on the continuum of the impact of innovation on graduate studies and research. In the recent past, institutions and researchers in this part of the world were considerably limited in their access to information and equipment. The focus of research was to deal with meeting local needs with little consideration of issues concerning the outside world. As is the case in India, a number of students chose to study abroad because of both academic and economic reasons[xxx]. However, forces of innovation and globalization including the faster and freer flow of products, information, and people have served to bring Hong Kong's institutions and researchers into a competitive position with other regions in international benchmarking exercises, researchers are tackling some of the worlds' most pressing questions, and there has even been a reversal in the flow of graduates back from developed regions[xxxi]. In this case, innovations have served to strengthen educational and research institutions and programs.

The expansion of graduate education into developing regions of the world in which sexual equality has neither been the cultural norm nor priority serves as another important reminder of our social responsibilities in the process of globalization.

movements in indigenous graduate education

The impact of innovation and the emergence of the knowledge economy in many countries with significant Indigenous populations have in many cases highlighted the already existing discrepancies between Indigenous and non-Indigenous populations – a "revolution" in Indigenous education and schooling is a prerequisite to successful participation in the knowledge economy[xxxii]. At the graduate level, there are a number of overriding difficulties particularly, achieving a critical mass of indigenous scholars and students who are willing to assume leadership roles within their communities and within the academy[xxxiii,xxxiv]. Recent developments in Indigenous education serve to address this need as well as to foster the development of Indigenous research and theorizing that is able to meet the "local" needs of the group[xxxv,xxxvi].

A similar picture emerges with regard to Indigenous health issues – significant changes in lifestyle have resulted in alarming rates of some diseases among Indigenous peoples. For example, whereas diabetes did not exist in First Nations peoples living in Canada as recently as the 1940s, its incidence in this group is now epidemic[xxxvii]. The development of graduate student research in Indigenous health issues has focused on meeting the local needs of the Indigenous peoples not only by building Indigenous health research capacity and encouraging the study of specific health issues but through the development of ethics policies and knowledge translation systems that respect Indigenous values and culture[xxxviii]. Although innovation may have served to highlight many growing differences between Indigenous and non-Indigenous peoples in overall welfare and potential for participation in the global knowledge economy, it has also served as a catalyst for positive change in Indigenous graduate education.

women in academia

Although there have been a number of gains in relation to women's access to graduate studies as students in most areas of study, there remain a number of obvious gender inequalities in academia including a lag in female enrollments in graduate studies in the physical sciences and engineering as well as a lower representation of women on faculty even when field is controlled for[xxxix]. This discrepancy also holds in terms of women's representation in university management[xl]. The question, then, becomes what are the factors that account for these discrepancies? Two potential hypotheses have been put forth related to female representation in the professoriate: one relating to differences in the socialization of male and female graduate students and the other to the suggesting that the university is a particularly unappealing workplace for women[xli]. Research into the underlying reasons for these inequalities is crucial if we are to understand the nature of the barriers that exist for women in the academy and if we are to provide graduate training that will serve to remove them.

The expansion of graduate education into developing regions of the world in which sexual equality has neither been the cultural norm nor priority serves as another important reminder of our social responsibilities in the process of globalization. For instance, recent research into the status of women in low-income Commonwealth universities revealed that a number of discriminatory practices, gendered and exclusionary processes[xlii]. However, this research also revealed a number of ways in which gender equity is being promoted including national and institutional policy development for gender equity, staff development and mentoring programs, and perhaps most importantly through international collaborations and networking opportunities[xliii]. These findings have important implications as the knowledge economy provides a driving force behind higher education in many lesser developed parts of the world – there is an opportunity to either enable women globally through internationalization or to turn a blind eye to discriminatory practices[xliv].

conclusions

Policies of innovation, public-private partnerships, and the process of globalization have had significant impacts on the quotidian functioning of universities and the "enterprise" of university-based research. The emerging "corporate" university is characterized by its sensitivity to market pressures such as putting a premium on research agendas that are flexible and responsive to market demands, productive, and well-managed and by its commodity-based view of higher education. Seen in this light, "the institutional goal of the university could be the production of graduates and patents"[xlv]. The enabling of this transition by the institutions themselves is a reflection of the "pro-innovation bias": the assumption that innovations are not only new things but are beneficial if not necessary[xlvi]. However, there are a number of caveats related to this assumption and the evolutionary state in which our educational institutions find themselves presently.

First, we need to objectively evaluate this process of adaptation. We must consider that "the 'critical ability to adapt' to change can mean very different things: it can mean the ability to adjust one's behaviour in order to fit in with changes over which one has no control; or it may, on the contrary, mean the ability to critique and challenge the situation in which one finds oneself. It is important for us to see innovation in terms of critique and challenge, as well as in terms of more conciliatory forms of adaptation"[xlvii]. Responding to innovation without an adequate degree of reflection on the consequences of this responsiveness could result in a situation of "over-adaptation" as exemplified by the unusual sensitivity to external change that has developed in some countries and institutions, reinforcing a constant flow of short-term adjustments that tend to blur the overall direction of the institution's development, thus making it hard to evaluate the full impact of the decisions taken"[xlviii]. The earlier discussion of the changes to the system of graduate education in India could be interpreted as an example of such over-adaptation.

Another over-riding concern relates to the differential impact of innovation and globalization on lesser developed regions or already marginalized social groups: "copyrights and patents protect knowledge and artistic production of industrialized countries while their technological and cultural goods flow onto developing nations, taken as mere consuming markets destined to pay royalties and revenues"[xlix]. This mentality extends to universities and educational institutions that have come to consider higher education as a commodity for export as opposed to a public good[l]. Our discussions of Indigenous peoples and women in academia also served to illustrate that the forces of innovation and globalization can exacerbate already existing forms of social inequalities.

The third issue relates to important contribution of the established disciplinary structure of universities. Notwithstanding the genuine need for interdisciplinary collaboration, it is clear that disciplinary distinctions permit a form "interdisciplinary contestation" that is vital to the academic value of critique[li]. In particular, the distinct roles to be played by the sciences and humanities as universities and researchers grapple with this innovation-based transformation must be recognized and, to a certain extent, fostered. Clearly, the sciences will produce the lion's share of the fodder for innovation in terms of the products and manpower needed for the knowledge economy while the equally invaluable role of the humanities will be the teaching of skills related to "critical reflexivity, the need to understand different cultural identities, and concerns for social justice"[lii] and, perhaps most importantly, the protection of academic freedom itself.

The final proviso relates to the sustainability of the knowledge economy. The growing dependency of universities on predominantly short-term relationships with non-university partners makes long-term programs of research difficult to implement and makes it very difficult to move beyond a focus on the immediate interest[liii]. It has been suggested that we need to look farther than the needs of the knowledge economy toward a more sustainable "knowledge ecology"[liv]. In a similar vein, are warnings of the need to allow for

the exceptional in the research domain – "most innovations have one thing in common, they are neither planned nor predictable"[lv]. While universities and researchers are focused on output, budgetary considerations, and timelines, they may overlook the potential innovations they are so desperate to produce.

Considering both the forces related to innovation on the university research enterprise and the caveats cited above, what, then, is the nature of the educational institution to which we aspire for the future? First and philosophically, we must consider that "as builders of such peculiar historical organizations that never cease to evolve … we are in a privileged position to conceive, propose, build and nurture a renewed university for our societies, one that shall become a tool for social integration instead of an institution for social exclusion as it has been for almost a thousand years"[lvi]. Further, in this process of reinvention we must realize that "academia is not confronted simply with an add-on situation … what is at stake is a qualitative leap that can integrate an expanded spectrum of activities; within the framework for these new conditions, this calls for a redefinition of universities as institutions. New grounding, new blending and new balances are required to re-engineer the academic institution as a social partner of a society in constant flux"[lvii]. Finally, universities must be able to "think globally and act locally"[lviii]. That is to say that our universities must be able to participate in research and teaching activities in the global arena but they must also be able to remain somewhat grounded by the local needs of their particular geographical, political or social context. In fact, the strength gained by the development of local expertise may be a necessary bootstrap toward a more global orientation.

In conclusion, let us return to the goal of our conference which was to explore the relationship between innovation and graduate education. First, what impact has innovation had on the training of graduate students – what skills do they need to successfully, participate in the knowledge economy? This seemingly straightforward question is complicated by the fact that one significant impact of innovation on graduate education is the relatively large number of graduates who chose to pursue non-academic careers.

Perhaps the most obvious impact of innovation is the need for students to have the ability to work with new and developing technologies. Not only have technological advances provided students with access to the rapidly proliferating volume of information, advanced data analysis systems, and more precise research instrumentation, they are having an increasing impact on the nature of university teaching. Movement toward IT-based teaching systems will not only provide universities with the opportunity to meet their need to train an increasing number of students

but may also provide an opportunity to renew the learning process; a task which will most likely fall to the hands of the incoming generation of university professors[lix].

Secondly, graduate education in the contemporary university must foster a sense of flexibility in its students. Flexibility to engage in a wide range of research configurations from individual to team-based research and in a variety of partnerships and collaborations that reach across disciplinary and geographical boundaries with a variety of players from within and outside of academia. Within this context, students will need to learn to balance their efforts and contributions to their individual research and team projects. This flexibility also extends to mobility in general. Both students and researchers find themselves increasingly involved in globalization activities such as networking and exchanges. These activities require a substantial level of cultural sensitivity and linguistic skill on the part of the participants.

Increasingly demanded for successful academic and non-academic careers are managerial skills – abilities such as leadership, time management and budgeting, grantsmanship, and teamwork skills are now part of the repertoire of today's researcher. This skill set is extended to include more entrepreneurial abilities for those students and faculty who find themselves involved in the business of transferring their knowledge via patents or spin-off companies. Finally, a well developed communicative capacity that extends beyond the ability to disseminate findings within one's field of expertise is also essential in order to allow researchers to sell their science to the larger audience of society, potential research partners, and funding agencies.

Finally, perhaps more than ever before researchers need to develop a strong sense of ethical and moral values to guide them as they navigate through increasingly complex issues facing society. Related to this is the need for young academics that have been adequately and appropriately socialized to produce "good science" in their field of study. The rather rapid nature of the changes to the university research enterprise in response to innovation has in some ways undermined the process of socialization. Universities will need to evaluate their current practices regarding ethics training and academic socialization in order to ensure that students develop a healthy foundation on which to build their scientific careers.

It is clear, then, that innovation has had a significant impact on graduate education – or at least what is required for successful graduate education in the context of the knowledge economy. The question remaining is what is the impact of graduate education on innovation? The answer to this question depends upon our success in actively shaping and transforming our universities and providing students with the skills made requisite by innovation itself. If we are

successful in this endeavour, the ultimate impact of graduate education on innovation is unlimited. The inevitable expansion and flow of integrated, borderless information and learning has the potential to lead us to true "consilience", the unity of knowledge[lx]. Let our motivation for engaging actively in this process come from the words of our keynote speaker, **Edward O. Wilson**, taken from his book entitled, Consilience, The Unity of Knowledge[lxi] :

"**Thanks to science and technology, access to factual knowledge of all kinds is rising exponentially while dropping in unit cost. It is destined to become global and democratic. Soon it will be available everywhere on television and computer screens. What then? The answer is clear: synthesis. We are drowning in information, while starving for wisdom. The world henceforth will be run by synthesizers, people able to put together the right information at the right time, think critically about it, and make important choices wisely**"

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