Anticipating Tomorrow: The Future of Higher Education in a Turbulent World

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Gracias. Thank you.

It’s such a great pleasure to join you for the annual Canadian Chamber of Commerce Day.

The University of Toronto enjoys close ties to Mexico, through our alumni community here, and our partnership with leading Mexican institutions of advanced research and higher education.

In addition, our Chancellor – the Honourable Michael Wilson – is a great champion of collaboration between Canada and Mexico. He very much regrets that he is not able to join us here today.

As the title of my talk today indicates, I want to address ‘The Future of Higher Education’ – and to discuss the turbulent, disruptive nature of change in the economy and what it means for universities.

The Education Dividend

More than 75 years ago, the Austrian-American economist Joseph Schumpeter published a book – *Capitalism, Socialism and Democracy* (1942) – a volume that would become a landmark work in the literature on technological change and its social and economic implications. In this book, he coined the phrase ‘creative destruction’ to describe the fundamentally disruptive nature of innovation. The central idea was the observation that economic change is propelled by entrepreneurs who introduce fundamentally new products and new ways of making things. As these entrepreneurial innovations are introduced and take hold, they displace older, inferior technologies and – in many cases – spell the end for established firms and causing wider economic dislocation for workers and communities.

Schumpeter’s key insight was to show how the demise of the old and the rise of the new are intimately connected – two sides of the same coin. It is a useful starting point for our discussion of higher education in the face of turbulent economic change. Indeed, looking back over recent history, it’s clear that education has offered the best protection from the ‘gales of creative destruction’ that Schumpeter so perceptively described. When technological change has made certain occupations – or even entire industries – obsolete, advanced education has always been the most effective way of ensuring survival and prosperity.

For example, in 1975, Statistics Canada reported that stenographers (a fancy word for secretaries and typists) were the most in-demand category of white-collar workers, representing nearly 20% of all white-collar job vacancies that year.¹

¹ Statistics Canada, Vacancies for Full-Time Jobs in Selected White-Collar Occupational Groups. ‘Clerical and related’ represented 17% of the total. ‘Stenographic and typing’ represented 40% of ‘Clerical and related’, the largest subgroup of the category.
But 1975 was significant for another reason. It was in that year that Bill Gates and Paul Allen established Microsoft. And the next year, Steve Jobs and Steve Wozniak founded a company called Apple. Within a decade, demand for stenographers and typists had plummeted, while the employment opportunities for workers in electronics fabricating, assembling, installing, and repairing skyrocketed. So too did demand for computer programmers. And these new jobs typically required post-secondary education.

The digital revolution, like major economic transformations before it, propelled greater educational attainment in the labour market. In 1975, nearly three quarters\(^2\) of all jobs in the United States were held by workers with no postsecondary qualifications. By 1992, that number had fallen to 44 percent. By 2010, according to the Georgetown Center on Education and the Workforce, “[a]bout 90 percent of the jobs…[the]…fastest growing occupational clusters require[d] postsecondary education.”\(^3\)

Canadian data are similar. According to a recent report by the CD Howe Institute, non-routine cognitive jobs – typically high-wage, high-education occupations – grew by 91% from 1987 to 2015. In contrast, routine occupations – those more susceptible to automation – grew by only 27% over the same period, falling from 66% of the Canadian labour force in 1987 to only 58% of the labour force in 2015.

Across North America, the demand for an increasingly educated workforce has risen steadily, as innovations in technology and productivity enhancements have reshaped the economy. For decades, employment rates and median earnings have increased with educational attainment – a statistical association that has proven to be very robust in multiple studies.

**Reasons to Worry?**

But are there good reasons to think that all of this might be coming to an end? After all, much-publicized advances in robotics, artificial intelligence, and machine learning are on the verge of disrupting our economies yet again. Robots already assemble our cars, and soon they will be ‘driven’ by AI-based guidance systems. Robotics and AI are on the verge of taking over certain forms of basic surgery, disease diagnosis, and drug discovery, as well as some surprisingly high-order service functions such as expert legal and financial advising.

In fact, scholars and students at my own university are helping to propel this revolution. Here are four examples:

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\(^2\) 72%

\(^3\) GCEW Healthcare Professional and Technical Occupations, STEM Occupations, Community Services, and Arts Occupations and Education Occupations
DeepGenomics is deploying an AI-driven platform to analyze 69 billion molecules with the goal of identifying compounds that can be used to manipulate cell biology and design therapies.

Cyclica is using biophysics, chemo-informatics and artificial intelligence to help pharmaceutical companies assess the safety and efficacy of drugs.

BlueJ Legal can now predict the strength of tax positions by using machine learning tools to analyze judicial tax decisions.

Clearly, this goes way beyond teaching machines to play chess, Go, and Jeopardy! Technology will disrupt medicine, law, finance and other fields that already require advanced levels of education.

The question for us is: what are the implications for higher education in this emerging and turbulent world?

A Paradox in Canada

To answer this question, let me first highlight something of a paradox in Canada. Incidentally, the United States has its own version of this paradox and I suspect Mexico does as well.

Headlines in our popular media frequently complain about a ‘skills gap’ in Canada. Many commentators point to skills shortages in the so-called STEM disciplines (science, technology, engineering, and math) as the source of this gap. Recent headlines make the case:

“America Desperately Needs More STEM Students”, and

“Canada needs more STEM jobs to compete”.

I agree that literacy in math and science must be a top priority for Canadian schools – perhaps especially for our youngest students. But I am skeptical that a massive boost in the numbers of Canadian scientists, engineers, mathematicians, and doctors alone will lead to a massive boost in Canadian productivity, prosperity, and competitiveness.

Indeed, if we ask our business leaders what kinds of skills and abilities new employees should have to position themselves for success, the picture looks a bit different. According to a survey by the Business Council of Canada, employers identify the following top 10 skills, in order, as most important:

- Collaboration and teamwork skills
- Communication skills
- Functional knowledge
- Problem-solving skills
• People skills
• Customer service
• Analytical capabilities
• Creative thinking
• Industry-specific knowledge and experience
• Technological literacy

The National Association of Colleges and Employers in the United States reports similar results. Their top five is:

• Problem-solving skills
• Ability to work in a team
• Communication skills
• Leadership abilities
• Work ethic

This is not to say that the technical qualifications for any job are not important. Of course, they are. (Functional knowledge is third on the Canadian list; industry knowledge and experience is ninth.)

But I think what we can learn from these surveys is that technical qualifications are not enough by themselves. I am sure this will not be news to those of you in this room who are employers. But it is striking how poorly understood this point is amongst the media, governments – and parents.

Re-imagining undergraduate education

Let me also suggest that these fundamental competencies that are so often identified by our business leaders – collaboration, communication, problem solving, leadership, creative and critical thinking, and inter-personal effectiveness and empathy – are more likely to be robot-proof, to adopt a phrase used by Joseph Aoun in his recent book\(^4\).

Technological change may have made stenography obsolete – but it didn’t make communication obsolete. Similarly, machine learning and robotics may dramatically reshape the 21st century global economy, thereby changing specific technical qualifications for future jobs. But technology won’t eliminate the need for problem solving, creative thinking, and the ability to work effectively with other talented, creative minds. These competencies form part of our ‘mental architecture’ in Professor Aoun’s memorable phrase, as distinct from specific technical skills, our ‘mental furniture’.

My larger point is that helping our society prepare for the next wave of technological disruption arising from advances in fields like artificial intelligence and robotics will require more than just teaching students advanced functional skills and knowledge. It will require us to help students acquire the fundamental competencies that will prepare

them for life-long success in any career – or any series of careers, even those not yet invented.

That phrase ‘life-long’ is important here. Recent studies have suggested that today’s young workers are more likely to have multiple careers – perhaps in multiple geographic locations – than their older peers.⁵ Such ‘career mobility’ points to the importance of resilience and life-long learning. Employees are increasingly returning to school to upgrade their skills and competencies. This is especially true (but by no means uniquely true) in industries threatened by increasing automation. Similarly, employees are relying on their fundamental competencies to be transferable, complementing, extending, and enhancing their industry-specific knowledge whatever their industry might be. And the capacity to learn is itself revealed as a core competency we need to instill in our students.

A recent op-ed coauthored by my U of T colleague Greg Evans, put it this way:

“the world is shifting from a ‘knowledge-based’ society to a ‘learning-based’ society. Students no longer graduate with a knowledge base that will serve them throughout their career…Students can now expect to learn continuously, both individually and from others, throughout their careers – this makes the processes of learning and teaching key competencies in and of themselves.”⁶

These ideas about the value of fundamental competencies have strong intuitive appeal – and, I am happy to report, they are gradually gaining greater traction. Just last month, the Royal Bank of Canada issued a report called Humans Wanted: How Canadian youth can thrive in the age of disruption.

The Bank’s analysis echoes many of the points I have been making today. They report that “more than 25% of Canadian jobs will be heavily disrupted by technology in the coming decade”. Moreover, their survey of 300 occupations and 2.4 million expected job openings found an increasing demand for “critical thinking, co-ordination, social perspectives, active listening, and complex problem solving” – exactly the sort of fundamental competencies I have been talking about today.

The RBC report also mentions the growing importance of “global competencies” like “cultural awareness, language, and adaptability”. This is a vital point – and one that is often overlooked. It is striking that the Business Council of Canada’s survey (and ones


like it) did not identify global competency as an important skill for tomorrow’s workforce. My own view, as you will see, is that global fluency *has never been so important.*

So, even if exact definitions differ, there is growing recognition of the fundamental competencies that will determine our future individual and our collective prosperity.

But how do we put these ideas into practice, when it comes to higher education? Let me focus on three of the most important and promising areas for educators

**Competencies in the curriculum.**

First, cultivating fundamental competencies must a critical part of post-secondary education. Of course, students can acquire some of these competencies as a by-product of their traditional university and college education. Writing an essay may help develop communications skills; studying math helps develop quantitative reasoning. And so on. But such cases are too often regarded as a happy side-effect of a student’s studies rather than an intentional and explicit goal.

It is not sufficient to hope that students will learn collaboration, communication, problem solving and so on as by-products of their curriculum. These competencies should be explicitly incorporated into courses, measured, and integrated into the evaluation of students’ performance.

I am pleased to report that we have been making progress towards these goals at the University of Toronto. For example, our Faculty of Arts & Science has explicitly defined the fundamental competencies *all* students should graduate with. They are:

- quantitative reasoning
- critical thinking
- effective writing and communications
- problem-solving, and
- ethical and social reasoning.

On that last point, it is worth noting that ethical and social reasoning in an age of artificial intelligence and social media has emerged as a critically important issue. Automation and machine judgement in an age of big data are areas fraught with complex moral challenges. As the recent problems at Facebook have demonstrated, unprecedented technological capabilities unchecked by strong ethical frameworks can undermine the very foundations of long-run competitive success. Taking ethical positions, arguing for them, and communicating them to others are uniquely human abilities. The University of Toronto is helping its students develop and hone these abilities.

We have also been experimenting with innovative ideas in teaching and learning that cultivate fundamental competencies while enriching traditional course material. One promising example is the inverted classroom. In an inverted classroom, students are
first introduced to new material outside of regular classroom time through online video lectures or screencasts. Students then achieve a deeper understanding of the material in the classroom setting, where they engage in problem solving, discussions, and active learning, in small groups, and with the active participation of professors and teaching assistants.

Researchers in our Department of Computer Science studied such new pedagogies in real time. They have observed important differences in learning methods and outcomes between students in traditional computer science classes and those in inverted classes covering the same material. The inverted classroom model seems to be superior to the traditional approach in developing competency in collaboration, communication, time management, problem-solving, and judgement. Students still learn the course content, but they also strengthen their fundamental competencies.

The University of Toronto is also aiming to develop students’ fundamental competencies by going beyond the classroom.

**Experiential Learning**

And this brings me to my second principle, recognizing the value of *experiential or work-integrated learning*. Universities can help foster the development of our students’ capacity for lifelong success by harnessing the opportunities outside the academy, locally and globally. Experience-based, work-integrated, and service learning are now recognized as critical elements of post-secondary education. Examples include co-op programs, internships, and research and teaching conducted jointly with local community or business partners.

Universities situated in major urban regions, like U of T or UNAM, are able to take advantage of such opportunities because they are literally on their doorstep. Working with local partners represents a tremendous opportunity for both students and their sponsoring organizations.

Experience-based learning challenges students to apply their knowledge from the classroom, library, or laboratory in practical, hands-on settings. As everyone in this room knows, studying microeconomic theory is one thing; first-hand experience running a business is another. Such experiences also reinforce the importance of teamwork, leadership, communication, creative thinking, problem solving and much more.

In fact, opportunities for experiential learning often help students better understand the theoretical concepts they learned in the classroom. And, though they might not always like to admit it, business veterans sometimes learn from the interns they hire. Increasingly, business leaders actively embrace this kind of ‘reverse mentorship’. This is perhaps especially true in the digital economy, where ‘digital natives’ have much to teach the rest of us about the digital world and how to live in it.
The quintessential experiential learning opportunity might be the start-up. Students and faculty are starting their own companies to commercialize university discoveries and inventions at ever-increasing rates. The kinds of competencies one develops in a start-up – from creativity and entrepreneurship to problem-solving, resiliency and work ethic – are invaluable, whether the startup succeeds or fails.

This is one reason why we are so keen to encourage innovation and entrepreneurship. The University of Toronto, like many of the world’s great research-intensive institutions, is driving a huge surge in start-up activity. In fact, since 2013, the University of Toronto community has created more startup companies than any single institution in North America.

As I mentioned earlier, many of our start-ups are leveraging cutting-edge technologies to reshape traditional industries. It is only appropriate that they also help teach our students how to navigate such turbulent waters.

Toronto’s innovation ecosystem is now thriving – and the University of Toronto, with its nine incubators and accelerators, along with the MaRS Discovery District and our affiliated research hospitals right next door – is attracting increasing attention from venture capitalists and many of the world’s leading knowledge-based firms.

Global Fluency

This brings me to my third principle, the importance of global fluency.

Global fluency is both a valuable competency in its own right, and an indispensable means of enriching other fundamental competencies. It is also a capacity that universities are uniquely well positioned to develop.

As a 2016 McKinsey report on ‘digital globalization’ makes clear, the global community is more intertwined and interdependent that at any other time in human history. In addition to the global reach of popular culture, sports, and entertainment, consider that international exports of merchandise have grown by more than 2.5 times since 1990. In 2014 alone, the latest year for which we have reliable information, cross-border flows of goods contributed $2.7T USD to global GDP. Strikingly, cross-border flows of digital data added some $2.3T to global GDP that year. If international data traffic were a country, it would have been the 7th largest economy in the world in 2014.

Plainly, global positions and opportunities are significant considerations for a huge and growing range of industries. And in such industries, globally fluent employees are indispensable, mission-critical assets. I suspect that global fluency will soon join the list

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8 Cross-border bandwidth grew from fewer than 5 gigabits per second in 2005 to 211 gigabits per second in 2014 – that’s roughly equivalent to sending 240 copies of the entire Library of Congress between countries every day.
of fundamental competencies in high demand by employers. In the meantime, how can universities help with global fluency? Let me suggest two ways.

First, universities are gateways to an expansive international academic community. Over the past 25 years, growth in international research co-publication has exploded. While the total number of research publications has more than doubled since 1990, the number of research publications featuring international collaboration has increased more than tenfold. A vast, shared knowledge network now crisscrosses the globe. Hundreds of thousands of university researchers and students, from virtually every country on earth, are working together to solve challenges that do not respect international borders – climate change, health epidemics, international migration and refugee flows, cyber security, poverty, and more.

International collaboration also fosters global fluency, as individuals from different countries work together on a shared challenge. Such partnerships must overcome differences in language, custom, culture, perspective, and many other diverse considerations – with obvious implications for teamwork, communications, leadership, and so on. But once they do, this diversity in the composition of research networks and teams often leads to breakthrough insights. In the past two years, to their enormous benefit, University of Toronto students and scholars authored more than 18,000 peer-reviewed publications with colleagues from 170 countries – second only to Harvard in the world. By the way, this number includes more than 300 publications with colleagues in Mexico, in such fields as rheumatology, astrophysics, oncology, environmental sciences, electrical engineering, and economics.

Furthermore, in the same way that international collaboration fosters global fluency, local internationalization also fosters global fluency. Attracting international students and scholars to our institutions – as well as our companies and communities – sparks a kind of “international collaboration at home”. Students and scholars from around the world join us in our classrooms, libraries, laboratories, playing fields, and residences. And, together with our domestic students, they encounter new ideas, perspectives, and approaches that, in turn, inspire mutual understanding, and stimulate knowledge. This is the very essence of global fluency.

I would also suggest that, as global fluency takes its place among the other fundamental competencies, it enriches them. Working with diverse teams of students from different socio-economic, cultural, linguistic, racial, and religious backgrounds is fertile ground for developing skills in communication, collaboration, problem solving, and leadership.

There are nearly 20,000 international students at the University of Toronto from 168 countries, including a growing number from Mexico. In fact, we have just lowered our tuition for international PhD students to attract more of the best and brightest to our campuses. This was a symbolic as much as financial decision. In addition, the Canadian government has recently made it easier for students to stay in Canada and work after graduation, and eventually to apply for permanent residency. While other countries build walls, we want to build bridges.
Our efforts at the University of Toronto are meeting with some success. I hope I will be forgiven if I engage in a little bit of un-Canadian bragging for a moment. I would like to share with you the results of the most recent annual survey by the London-based Times Higher Education group, in which they poll the opinions of some 6,000 recruiters and human resource professionals around the world, asking them to rank the graduates of the world’s universities in terms of their *employability*. They ranked the University of Toronto 13th overall, and 5th among the world’s public universities, ahead of Oxford, UCLA, Berkeley, Michigan and many other great public universities.

**Conclusion**

Let me conclude by drawing some of these threads together.

In a turbulent world, increasingly apprehensive about a future disrupted by artificial intelligence, machine learning, robotics, and other advances in technology, society must look to universities to help prepare the citizens and leaders of tomorrow.

I have concentrated on technological disruption. But it is worth emphasizing that the same considerations apply for social and political disruption. And our world today is undeniably turbulent in these ways, as well. Our communities will navigate this turbulence by relying heavily on the fundamental competencies we learn in our schools, colleges, and universities. Yes, science, technology, engineering, and math, along with law, medicine, and management will all play a part. But we won’t invent our way out of intolerance, nativism, or inequality. It will take communication, collaboration, teamwork, creative and critical thinking, people skills, problem solving – and not least, ethical reasoning and global fluency.

All of these considerations suggest that universities need to broaden their focus. They must demonstrate more clearly how the education they provide prepares their graduates for a lifetime of success, while also contributing to the economic, social and political success of their host regions and the wider world.

Technological, social, and political disruption present opportunities as well as challenges. Our universities must seize those opportunities and continue their long tradition of helping make the world a better place.

Thank you for your kind attention.