An Impact Brief
April 2019

Entrepreneurship and Innovation Education at Canadian Universities

An analysis of 40 programs and 281 courses across 21 universities

IMPACT CENTRE
SCIENCE TO SOCIETY

UNIVERSITY OF TORONTO

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Exhibit 1

Overview of Entrepreneurship and Innovation Education Across 21 Universities and the Contrast Between the Demographics of University Student Population and Educational Backgrounds of Canadian Tech Founders.

Demographics

21 Universities

Students

- 16.3% *business students*
- 15.3% *engineering students*
- 38.4% *humanities and social science students*
- 30.0% *science students*

Founders

- 14.7% *of tech founders have a business degree*
- 33.3% *of tech founders have an engineering degree*
- 13.6% *of tech founders have a humanities and social science degree*
- 33.7% *of tech founders have a science degree*

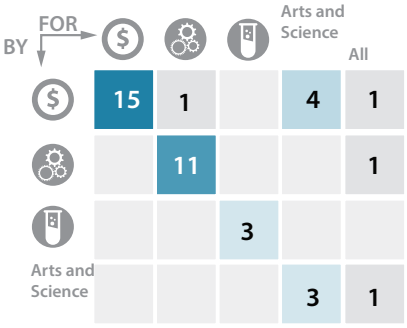
585 Founders

Entrepreneurship & Innovation Education

40 Programs

37.5 %

of all programs are minors, 37.5% are concentrations, 12.5% are majors, and 12.5% are certificates



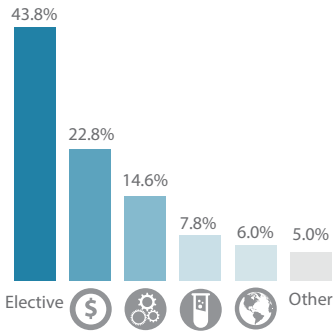
52.5%

of all entrepreneurship programs are offered by business faculties and 30% by engineering faculties

281 Courses

50.9%

of all undergraduate entrepreneurship/innovation courses are taught by business faculties



43.8%

of all entrepreneurship and innovation courses are either electives or electives with prerequisites

Business | Engineering | Humanities & Social Science | Science

Summary

"Delivery of entrepreneurship and innovation education within universities is skewed toward business disciplines, leaving science students with limited educational opportunities, despite their eventual success as tech entrepreneurs."

Higher education institutions have always played a major role in discussions on R&D and knowledge creation activities that are thought to contribute to a country's competitive advantage on a global scale. While scientific entrepreneurship and related technology transfer have been practiced on campus in Canada and elsewhere for decades, the extent to which on-campus entrepreneurship and the "entrepreneurial spirit" have been emphasized among students has increased dramatically in the last decade. In response, the interest in the field of entrepreneurship education has also undergone a rapid expansion, with a proliferation of programs and activities. But how far has the implementation of programs come?

Optimization of the educational framework aimed at harvesting the best talent and realizing the country's innovation potential strongly depends on understanding the landscape of the educational opportunities in entrepreneurship and innovation at Canada's top universities. Plenty of studies have proven that education certainly plays an essential role in forming attitudes, skills, and most importantly an entrepreneurial mindset (Küttim et al., 2014; Wilson, 2008). But what is the strategy behind the current academic structure aimed at encouraging entrepreneurship and innovation education across specific fields? Which students are exposed to entrepreneurship education at the undergraduate level? Which departments or faculties tend to provide entrepreneurship programs, or teach courses on topics of innovation? From which perspectives is entrepreneurship and innovation education delivered to students? Is there a systematic framework under which curricula and programs devoted to entrepreneurship and innovation education are developed?

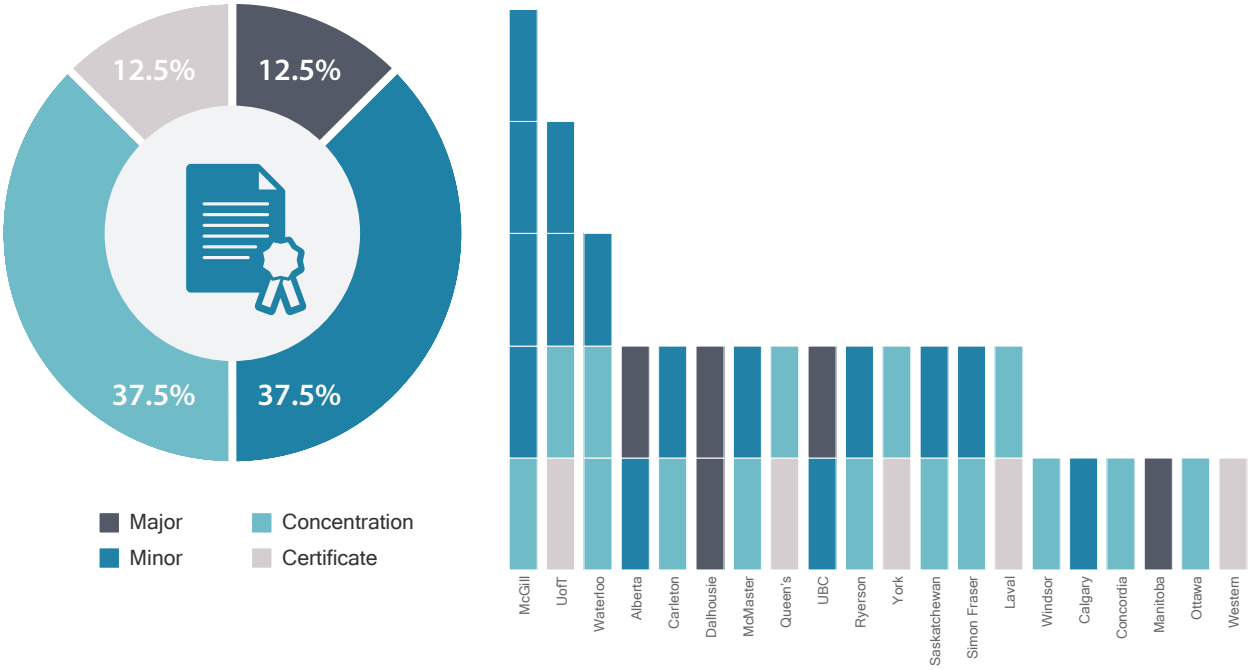
To answer some of these questions, we analyzed the present state of entrepreneurship and innovation education in Canada. Overall, our work identified 40 programs and 281 courses at 21 Canadian universities at the undergraduate level, with the results illustrated in Exhibit 1. This work builds on the findings presented in the first part of this investigation in which we analyzed the educational and demographic portraits of 585 founders of Canada's fastest growing tech startups (refer to our report entitled Tech Founder Education, released in March 2019). This link helped us examine if indeed the students that are accessing entrepreneurship education are also the same students that start successful tech companies.

Our findings at a glance

Our findings indicate that entrepreneurship and innovation education is predominantly offered to business students and presented through the lens of the business faculty. Taking into account the number of students across different faculties, as well as the educational background of successful tech founders, it is evident that the delivery of entrepreneurship and innovation education within universities is skewed toward business disciplines, leaving science students with limited educational opportunities, despite their eventual success as tech entrepreneurs.

- Of the 40 programs identified: 15 are minors; 15 are concentrations; 5 are majors; and 5 are delivered as certificates.
- The majority of the programs are taught by business faculty to business students (15 programs), or engineering faculty to engineering students (11 programs).
- Out of the 281 entrepreneurship and innovation courses offered, 50.9% are taught by business faculty.
- 43.8% of courses are either electives, or electives with pre-requisites.
- Course offerings by science departments are typically limited to students only from those departments, rather than the whole science student population.
- The ratio of the number of entrepreneurship and innovation courses taught by a faculty vs. the number of students in that faculty, highlights that business students have 3.3 times more opportunity than engineers, 7.6 times more than humanities and social science students, and 8.5 times more than science students to be introduced to entrepreneurship in their specialization.
- Our previous findings on the undergraduate education of tech founders were used to determine the index of the number of courses offered by faculty/department vs. the number of tech founders specialized in that field. The results indicate that that index for business majors is 3 times higher than for humanities and social science, 6.7 times higher than for science majors, and 7.9 times higher than for engineers.

Exhibit 2
Entrepreneurship and Innovation Undergraduate Programs
(40 in total across 21 universities)



Undergraduate Entrepreneurship and Innovation Programs

Exhibit 2 details the number of entrepreneurship and innovation programs offered to undergraduate students at universities across Canada. The programs have been subdivided into majors, minors, concentrations, and certificates.

- McGill University, University of Toronto, and University of Waterloo lead with five, four and three programs each, while other universities have one to two programs that focus on entrepreneurship.
- The majority of programs are minors (37.5%) and concentrations (37.5%), while majors and certificates amount to 12.5% each.
- Major programs are only offered by the business faculty (Exhibit 3).

The programs were also grouped into categories based on the type of faculty/department offering them and the student group allowed to take them. The matrix of faculty/department (i.e. who teaches it, or "BY") and student group (i.e. who it is for, or "FOR") summarizes those results in Exhibit 4.

- A more structured framework for entrepreneurship and innovation education is evident in the faculties of business and engineering, who offer 15 and 11 programs, respectively, to their own students. (The business lens is also preserved in another six programs that are offered to other faculties by business schools.)
- Arts and Science faculties offer a total of four programs open to all Arts and Science students.
- There are three programs that are offered by science departments specifically to students in those departments. For example, one of those has been designed for students specializing in agriculture.

Exhibit 3
Programs by Faculty/Department and Level of Program

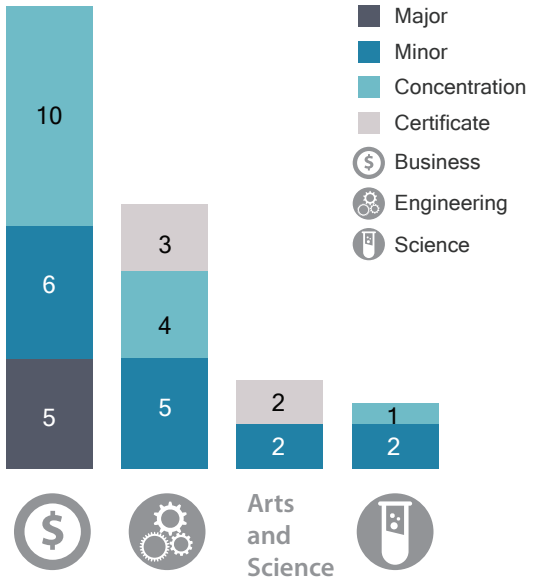
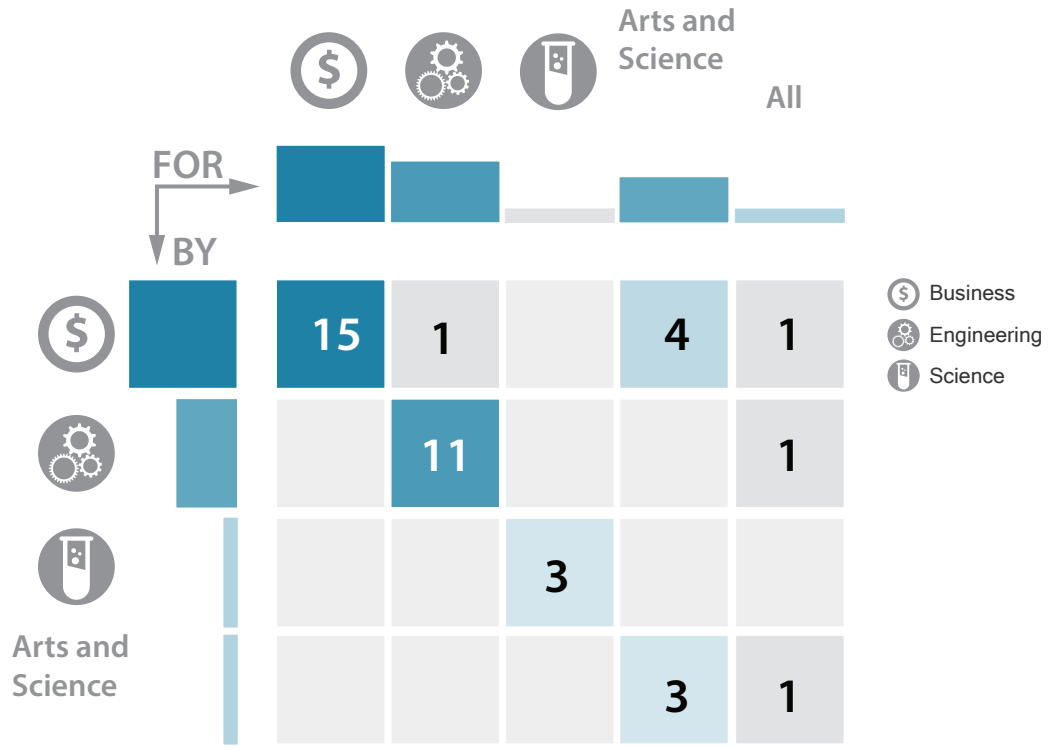


Exhibit 4

Entrepreneurship and Innovation Undergraduate Program Matrix – Programs by / for

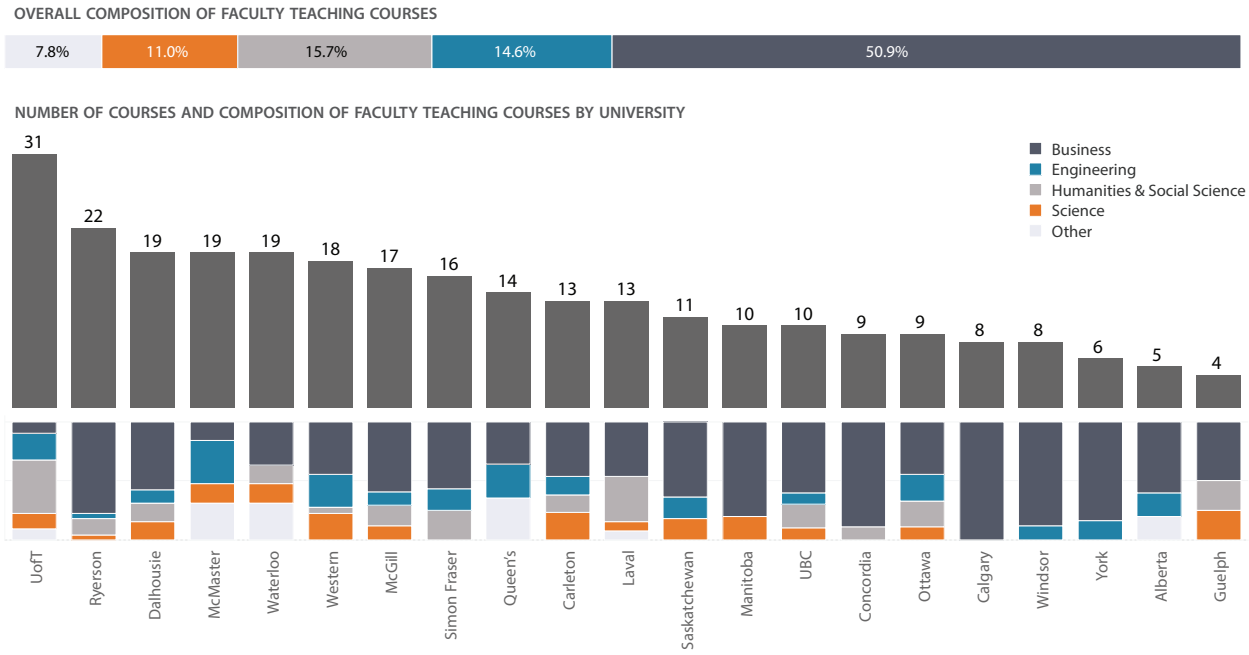


Undergraduate Entrepreneurship and Innovation Courses

Across 21 Canadian universities, we have identified and analyzed 281 entrepreneurship and innovation courses at the undergraduate level. On some occasions, courses were integral to entrepreneurship and innovation programs, but most were standalone courses. The analysis was driven by two main questions. First, we wanted to see from which perspectives entrepreneurship and innovation education was delivered; and to do this, we investigated the type of faculties/departments offering the courses (Exhibit 5). Second, the courses were also grouped by the type of student population they were intended for, or which students had access to take those courses based on their undergraduate specialization (Exhibit 6).

Exhibit 5

Entrepreneurship and Innovation Undergraduate Courses Taught by:



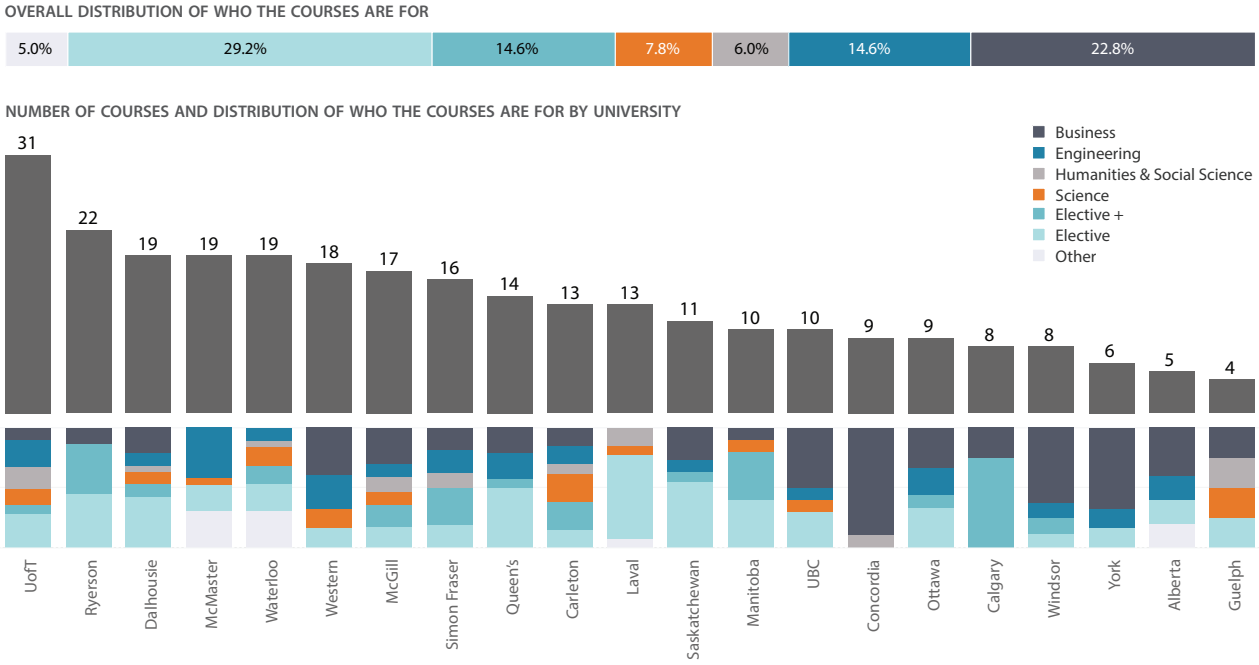
The perspectives of course delivery are summarized in Exhibit 5:

- An overwhelming 50.9% of all courses are taught by the faculty of business.
- Science, humanities and social science, and engineering all offer 10-15% of the courses.
- University of Toronto (UofT), at 31, offers the most courses that delve into concepts of entrepreneurship and innovation.
- The bottom stacked bar graph illustrates the proportions from which perspectives the courses at each of the universities was delivered. For example at Ryerson, Concordia, Calgary, Manitoba, Windsor and York over 80% of the courses are delivered by business faculties. On the other hand, at UofT and Laval, a considerable proportion of courses were taught by faculty from the humanities and social sciences.
- Here, under "Other", we have considered courses offered by nursing, architecture, various entrepreneurship and innovation centres, and a couple individual programs that only offer courses to students in those programs, such as "Health and Engineering Science", and "Science and Business".

Access to entrepreneurship and innovation courses for students from different disciplines is illustrated in Exhibit 6. In addition to courses that were designed for students from specific faculties/departments, courses that were accessible to students from multiple departments/ faculties were designated as "electives". Elective courses that required prerequisites to be completed that either amounted to more courses or even more specialized courses have been designated as "elective+", as a wide selection of students still had the option of taking them.

Exhibit 6

Entrepreneurship and Innovation Undergraduate Courses Offered to Students Specializing in:

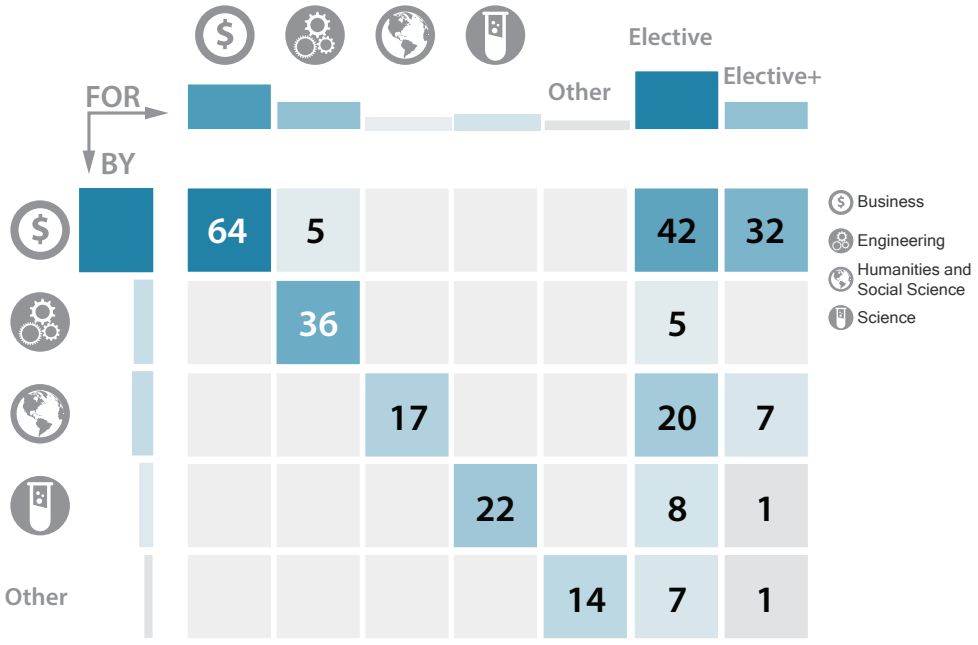


- A total of 43.8% of all courses belong to the "elective" or "elective+" category (29.2% of courses are electives, and 14.6% are elective+).
- Courses designated only for business students amount to 22.8%, while those for engineers are at 14.6% of all the courses offered.
- Students typically belonging to Arts and Science, have fewer courses specifically designed for them: only 7.8% of courses were specific to science and only 6.0% of courses were specific to humanities and social science students.
- The stacked bar graph at the bottom of Exhibit 6 indicates the distribution of students who are allowed to take the courses by university. Some universities, such as Ryerson, Laval and Manitoba have very high fractions of courses that are electives; some institutions are more segmented such as UofT, Western and McGill, whereas Concordia, Windsor and York have courses that are predominantly accessible only to business students.

In order to understand the nature of entrepreneurship and innovation education and the perspectives from which it is delivered across different sub-disciplines at the undergraduate level, we have constructed a matrix illustrating which departments/faculties offer courses to which student (Exhibit 7).

Exhibit 7

Entrepreneurship and Innovation Undergraduate Course Matrix – Courses by / for

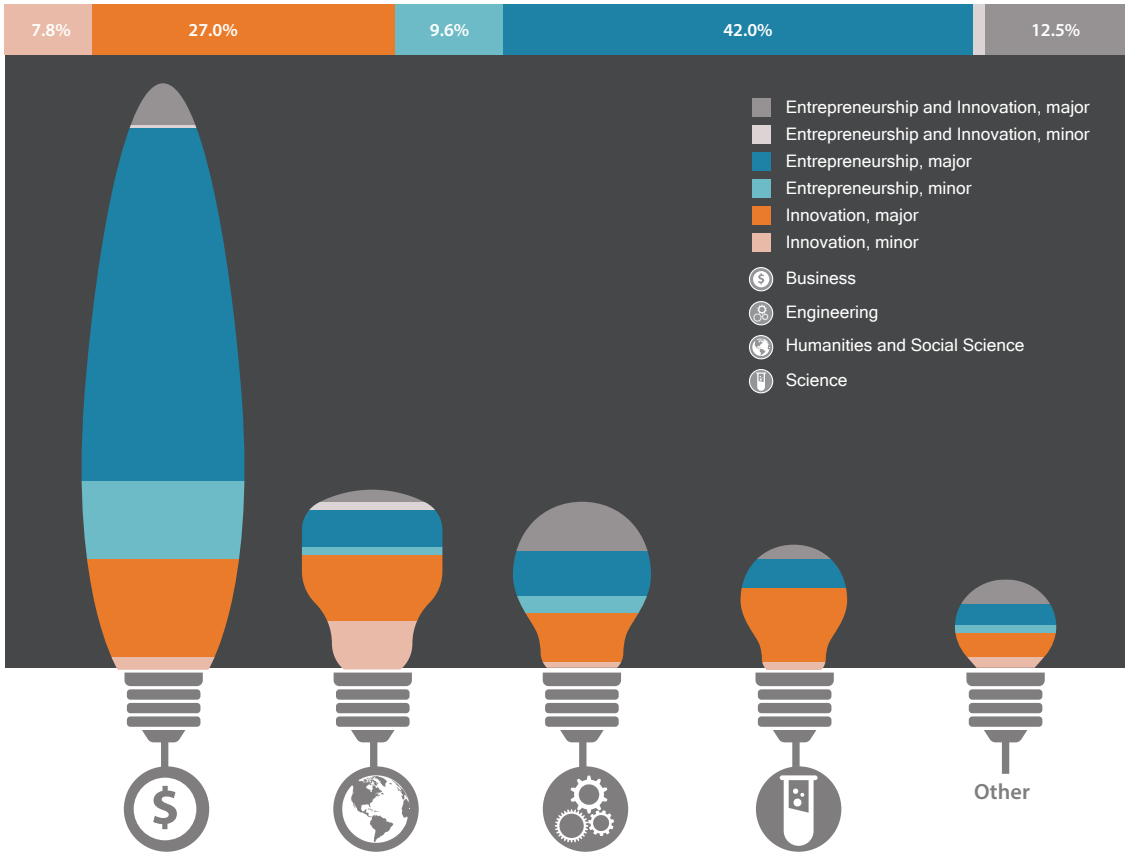


- The vast majority of elective courses are offered by the faculty of business.
- Compared to their total number of courses offered, courses offered by humanities and social science are also over 60% electives.
- Students in business get three times more courses delivered by their faculty, specifically designed for them, compared to the humanities and social science, and science students.
- Engineering primarily delivers courses to their own students.
- The elective courses offered by "Other" departments/faculties are typically offered by entrepreneurship and innovation centres at various universities, whereas specific courses offered to "Other" students are offered by specialized programs such as "Health and Engineering Science", and "Science and Business". Those courses are not accessible to students outside of those programs.

Distribution of Topics: Who Teaches Entrepreneurship and Who Teaches Innovation?

Exhibit 8

Distribution of Topics Taught in Courses: Entrepreneurship vs. Innovation



Further analysis of the courses delved into the concentration of topics. Based on course descriptions, the courses were subdivided into categories depending on their focus: entrepreneurship or innovation, or both. Additionally, the focus of those topics was assessed as either minor or major, resulting in a total of six categories as illustrated above in Exhibit 8.

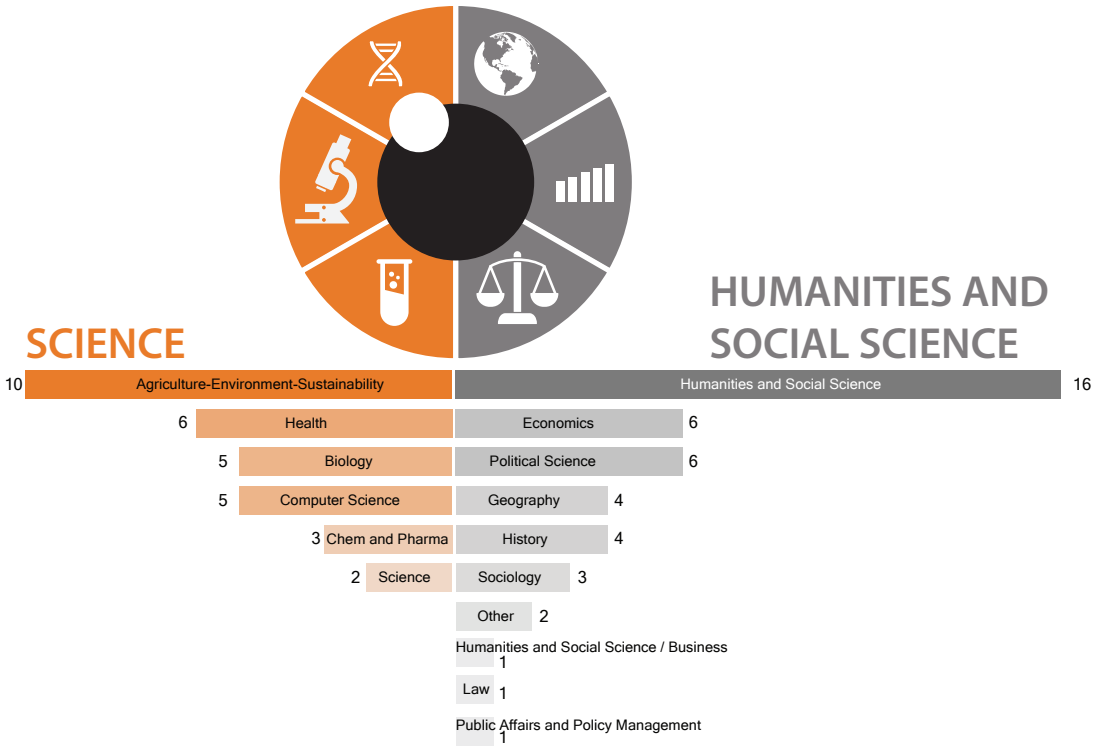
- Overall, 42% of all courses surveyed focused on entrepreneurship as the main topic. If we also include courses that focus on entrepreneurship as a secondary theme, then 51.6% of all courses encompass some entrepreneurship (vs. 34.8% of courses that focus on innovation as a major or minor theme).
- When topics are compared across disciplines that offer the courses, business faculties tend to overwhelmingly offer courses that introduce entrepreneurship – almost 75% of all the courses they offer.
- Engineering has a more balanced delivery of the topics, with about 30% of its courses looking at both entrepreneurship and innovation in depth.
- Humanities and social science, as well as science courses tend to focus on innovation over entrepreneurship.

Focus on Arts and Science

We wanted to shed light on a key distinction between the business schools, faculties of engineering, and the departments within the faculties of Arts and Science. While for the most part, courses within business schools, or engineering faculties appear to be easily accessible to the students belonging to that faculty, Arts and Science appears to be much more fragmented. On the highest hierarchical level, courses belonging to Arts and Science departments have been grouped either under science, or humanities and social science for the purpose of this study. In practice, those courses often originate from departments that do not have particular overlaps, and only students specializing in that specific field have access to those courses. The fragmentation is illustrated in Exhibit 9.

Departments specializing in agriculture or the environment had 10 courses on entrepreneurship and innovation in our study, the largest group among science courses. At the same time, those courses are either partially inaccessible or do not play any significant relevance to the field of study of students who are specializing in other Arts and Science programs like e.g. physics or computer science. Under the humanities and social science group, a large fraction of courses were designed for a wider student population, but a substantial number was only relevant to students within the department offering the courses. For example, courses offered by economics, political science, geography, and history are typically only taken by students within each department. Moreover, this fragmentation indicates that Arts in Science in general lacks a more systematic framework approach for delivering entrepreneurship and innovation education across different departments.

Exhibit 9
Fragmentation of Arts and Science Courses

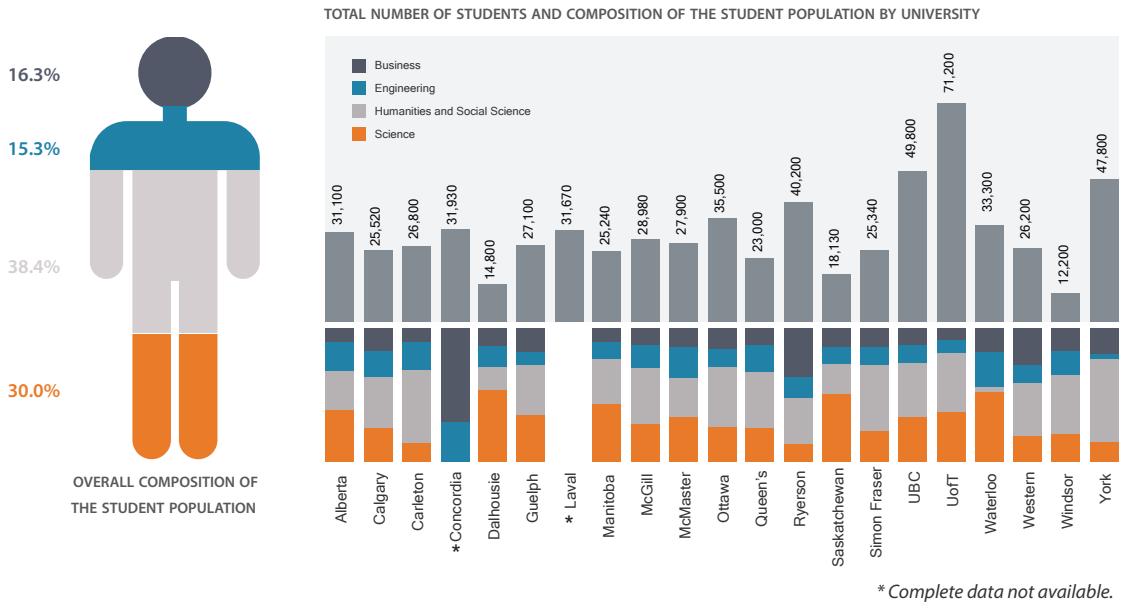


Student Population

In order to paint a complete picture about the access to and reach of entrepreneurship and innovation education, in addition to courses and programs, one has to also analyze the undergraduate student population. We have compiled the total number of students at each university (based on Universities Canada data) and have summarized the results in Exhibit 10 (bar graph, top panel). Our secondary analysis of the student population aimed at classifying students according to the four categories: business, engineering, humanities and social science, and science. It was challenging to obtain a complete set of data for all the universities (e.g. Concordia and Laval), and additional difficulties were encountered in some classifications as they may also vary by institution. With the available data (list of websites in the bibliography), we constructed the average student composition across all universities (Exhibit 10, left panel), and have depicted the student population grouping for individual universities (Exhibit 10, bar graph, bottom panel).

Exhibit 10

Demographics of Student Population by Degree Specialization.



** Complete data not available.*

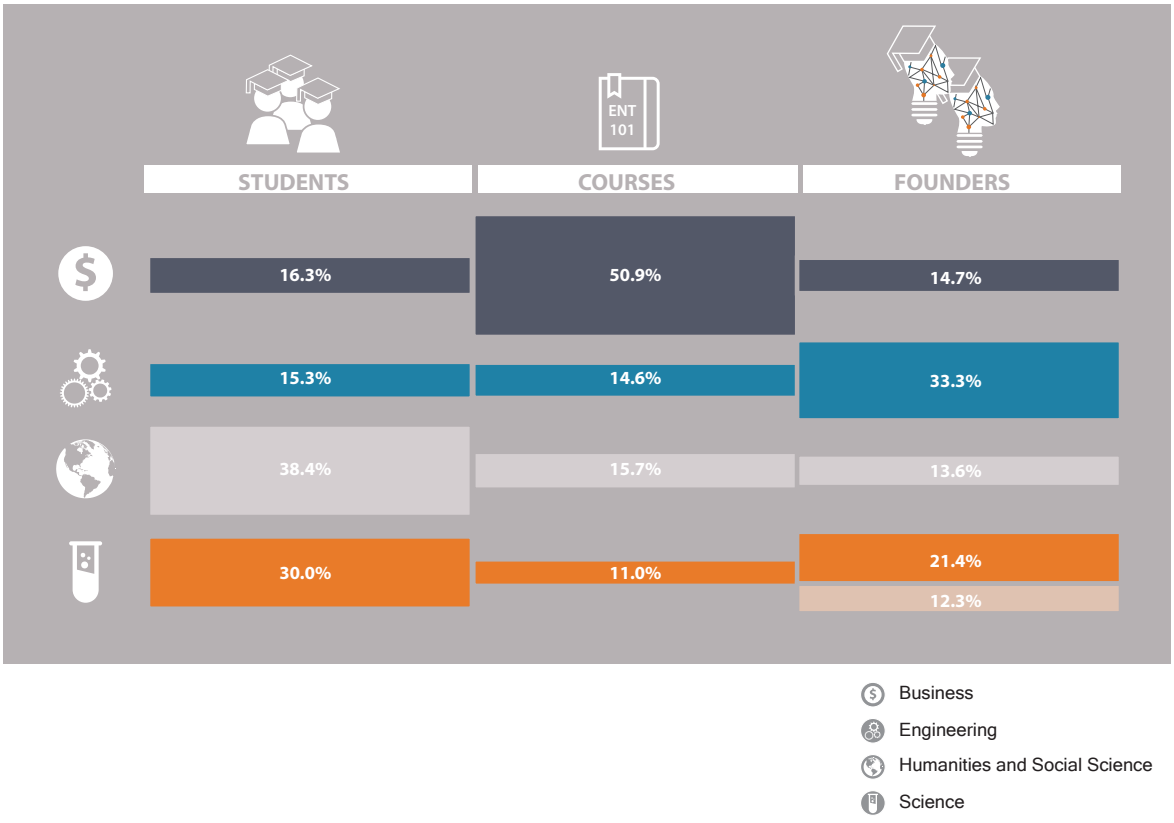
- The average composition across all universities puts the humanities and social science group as the most populous, at 38.4%, followed by science at 30.0%, and business and engineering at 16.3% and 15.3%, respectively.
- For the most part, across the individual universities, the compositions are similar, at least in the ranking of each specialization (i.e. humanities and social science followed by science, business, and engineering). However, there are exceptions: some institutions like Waterloo, with a very small fraction of the entire student population made up of humanities and social science students, or York, on the opposite side of the spectrum with the largest fraction of humanities and social science students, tend to deviate from the average picture.
- Overall, UofT has the largest total student population at over 71,000, while University of Windsor is the smallest at 12,200.

Are we Teaching the "Right" Students About Entrepreneurship and Innovation?

The data analyzed in this study, together with the conclusions of our previous report that focused on the educational demographics of founders of some of Canada's leading tech startups, will serve as the basis for assessing if entrepreneurship and innovation education is indeed accessible to students who eventually become tech entrepreneurs. Exhibit 11 illustrates the summary of the data, by providing a "pipeline" that takes us through the comparison of the student population across all 21 universities, the courses taught by the various faculties, and the resulting percentage of tech founders that were educated by those faculties. The contrasting shapes of the pipelines across the different faculties sends a compelling message and merits the need for a discussion on the optimization of entrepreneurship and innovation education.

Exhibit 11

From Student to Tech Founder – Efficiency Pipeline



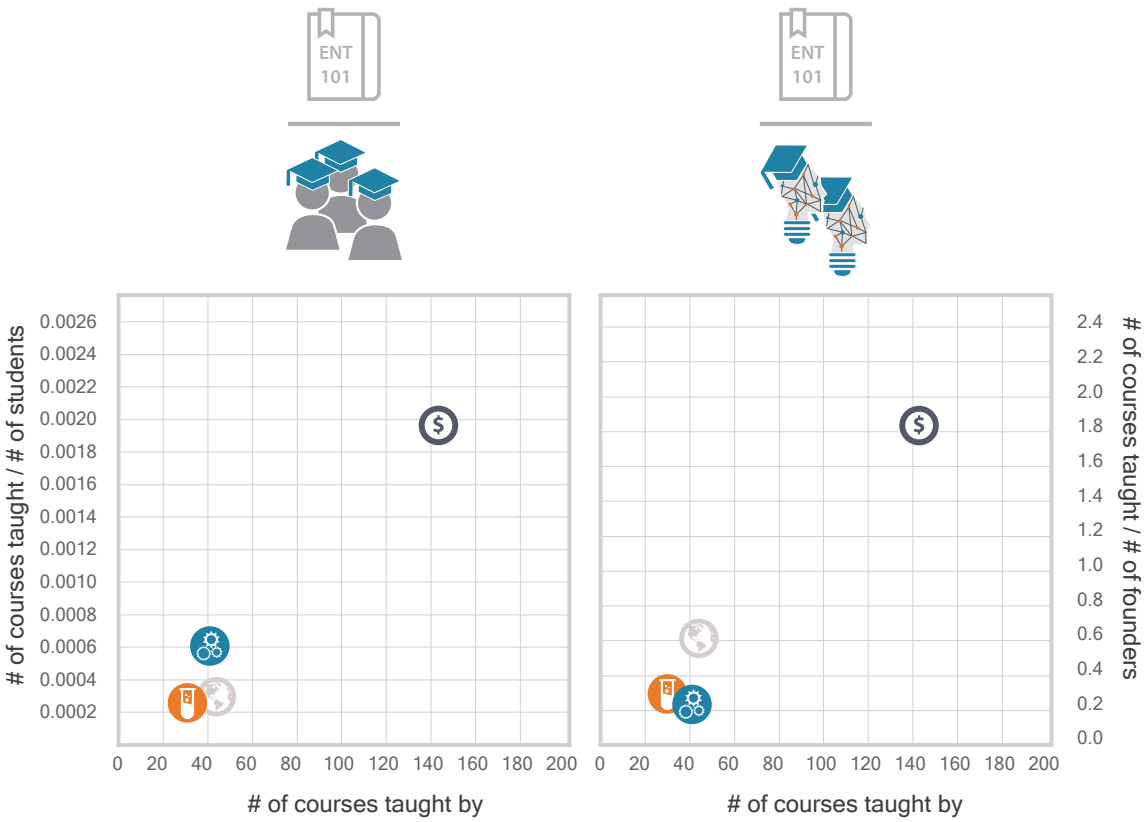
- Most of the entrepreneurship and innovation education (50.9%) is delivered through courses from business faculties, but their student population amounts to only 16.3% across all the universities. Investment in entrepreneurship and innovation education currently largely flows into business students and the dominant perspective of business faculty. However, the effectiveness of this pipeline may need to be improved because only 14.7% of tech founders in Canada's fastest growing startups had a business education at the undergraduate level.
- The investment into entrepreneurship and innovation activities for engineering students may have paid off, as the fraction of tech founders that are engineers doubles compared to their fraction in the student population.
- Humanities and social science departments offer 15.7% of all the entrepreneurship and innovation courses across Canada's top universities. Although this is minimal compared to the large fraction of their student population (38.4% of all students), their conversion to startup founders is in line with the percentage of education delivered.
- Science faculties have the second-largest student population at 30%, deliver only 11.0% of the entrepreneurship and innovation education, but are able to generate 33.7% of tech founders, of which 12.3% had a computer science degree.

We have performed a secondary analysis by calculating the ratio of the number of courses offered by a certain faculty and the number of students in that faculty (Exhibit 12, left panel). This parameter illustrates how dominant the perspective of a particular department/ faculty is compared to the size of their student population. A similar comparison was also performed for the number of courses offered by the faculty vs. the number of tech founders with that particular undergraduate education (Exhibit 12, right panel). The two pictures are very consistent in the story that they are illustrating.

- Comparing the number of courses taught vs. the number of students in that faculty, business outperforms engineering, humanities and social science, and science by a factor of 3.3, 7.6, and 8.5, respectively (Exhibit 12, left panel).
- When comparing how investment into entrepreneurship and innovation education fares with the outcome of the creation of tech founders, business enjoyed an investment that was higher than that for humanities and social science, science and engineering, by a factor of 3.0, 6.7, and 7.9, respectively (Exhibit 12, right panel).
- The two panels illustrate that business faculty was investing the most into entrepreneurship and innovation education, but whether that decision leads to the optimization of the educational frameworks is questionable, as undergraduates with a business degree were not disproportionally represented in the pool of successful tech founders.

Exhibit 12

Normalized Perspective: Number of Entrepreneurship and Innovation Courses Taught Compared to the Number of Students in that Faculty, and by the Number of Tech Founders Educated by that Faculty

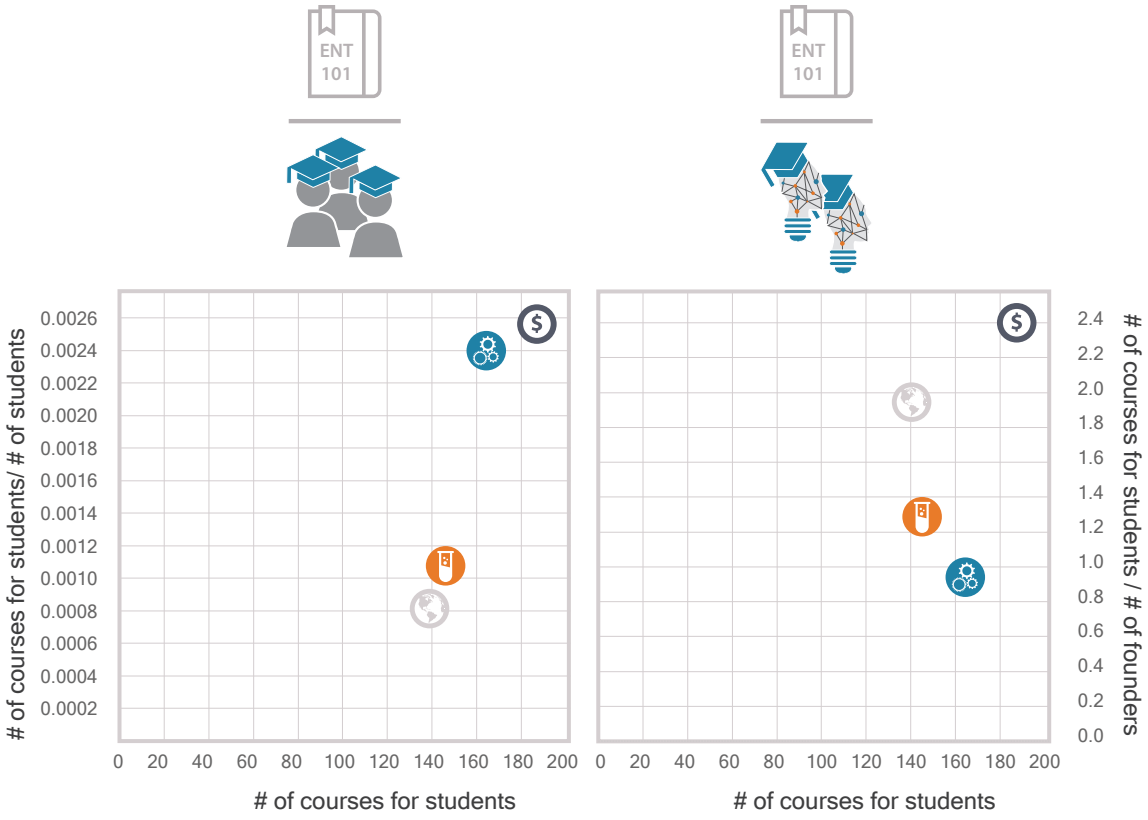


As a large fraction of offered courses are electives, we have chosen to contrast the number of courses offered to a student population to the size of the student population belonging to a certain faculty, as well as the number of tech founders that obtained an undergraduate degree from a certain faculty (Exhibit 13). Despite the large fraction of elective courses (Exhibit 6), the advantages that are built into the educational framework persist in this analysis as well.

- When comparing the number of courses available per student population, business students fare better than engineering, science and humanities and social science students, by a factor of 1.1, 2.4, and 3.1, respectively (Exhibit 13, left panel).
- In the comparison of the number of courses available to the number of tech founders educated through that faculty, the conversion from student to founder within all the different faculties can be better understood. Here, business still leads the ratio compared to humanities and social science, science, and engineering, by a factor of 1.2, 1.9, and 2.6 respectively. In this case, a higher ratio indicates a lower conversion rate of student to tech founder. This value accentuates the higher conversion of engineers and scientists to tech founders, as compared to the amount of entrepreneurship and innovation education that they have access to during their undergraduate degrees.

Exhibit 13

Normalized Availability of Entrepreneurship and Innovation Education: Courses Available Compared to the Number of Students in Faculty, and to the Number of Tech Founders



Conclusions

Our analysis of undergraduate entrepreneurship and innovation education across Canada yielded results that warrant examination of the current educational framework and the balance of investments across the different disciplines.
Findings strongly suggests that science students in particular are underserved within the current educational framework. From the present report, it is evident that very few structured programs in entrepreneurship and innovation have been designed specifically for science students, and the few courses offered to science students from science departments tend to be for students from a niche specialization, rather than for a wider science student population.

Despite those obstacles, our initial report on the educational demographics of founders has indicated that science graduates still make up the largest fraction of tech founders at 33.7% (21.4% science and 12.3% computer science). Results from our first report showed that 85% of founders with a science undergraduate degree also attained graduate degrees, while 41.5% of computer science undergrads and 19.2% of business students obtained a second degree.

Those observations indicate that while science students have a high potential for entrepreneurship and innovation activities, they typically realize it later in their careers and after more schooling. Investment into structured programs at the undergraduate level specifically developed for science students could potentially increase the number of science entrepreneurs even straight out of undergraduate studies, in addition to increasing the conversion rate of more specialized researchers to entrepreneurs following graduate school.

Without more data from other types of startups, it is difficult to gauge if business and humanities and social science students are starting companies in other sectors, and are thus underrepresented among tech founders. If that is the case, then the disproportionate educational input by business departments might be justified. However, from the perspective of the tech industry in particular, redistribution of resources for entrepreneurship and innovation education from business to science disciplines might lead to a more optimized pipeline for the generation of tech founders in the future.

Methodology

Methods

Programs and courses focusing on entrepreneurship and innovation across 21 Canadian universities were compiled from university websites. Depending on the information available across the different universities, the information was either extracted through keyword searches of databases, or through manual checks of websites of different faculties and departments. Detailed information of individual courses and programs is available on the Tableau Story that was designed to accompany this report (https://public.tableau.com/views/EntrepreneurshipandInnovationEducationinCanada/Story1?:embed=y&:display_count=yes).

The student population data for the total number of students was mostly collected from the Universities Canada website https://www.univcan.ca/universities/facts-and-stats/enrolment-by-university/. The information for the construction of the demographic breakdown across the different universities came from university websites, but further analysis and streamlining of the information was required in order to achieve coherent grouping necessary for this comparative study.

UNIVERSITY	INFO
Alberta	https://idw-bi.ualberta.ca/t/Production/views/UofAStudent/UofAStudentFallHeadcount?:embed=y&:showShareOptions=true&:display_count=no&:showVizHome=no
Calgary	https://oia.ucalgary.ca/files/oia/2017-18fb-2-2-sum-x-faculty.pdf
Carleton	http://oirp.carleton.ca/cudo/htmlSectionA.html
Concordia	https://www.concordia.ca/about/fast-facts.html
Dalhousie	https://cdn.dal.ca/content/dam/dalhousie/pdf/dept/oiar/Public_Reports_and_Data/Enrollment/2017/Faculty_2017.pdf
Guelph	https://www.uoguelph.ca/iar/cudo/general
Laval	no information
Manitoba	https://umanitoba.ca/admin/oia/media/student_enrol_W18.pdf
McGill	https://www.mcgill.ca/es/files/es/fall_2017_-_total_ft_and_pt_enrolments_by_level_and_by_faculty.pdf
McMaster	https://ira.mcmaster.ca/enrolment/
Ottawa	https://www.uottawa.ca/institutional-research-planning/resources/facts-figures/quick-facts
Queens	https://www.queensu.ca/planningandbudget/sites/webpublish.queensu.ca.pbwww/files/files/IRP/Queens%20CUDO%202017%20FINAL.pdf
Ryerson	https://www.ryerson.ca/about/data/a-general/#degrees
Saskatchewan	https://www.usask.ca/isa/statistics/students/headcount-demographics.php Used to break up Scince and Arts https://www.usask.ca/isa/statistics/students/headcount-demographics.php
Simon Fraser	https://www.sfu.ca/content/dam/sfu/irp/enrollment/EnrollmentDashboard/documents/ug.enrol.report.2017.2018.pdf
UBC	http://www.calendar.ubc.ca/vancouver/index.cfm?page=appendix1
UofT	http://www.provost.utoronto.ca/Assets/Provost+Digital+Assets/Enrolment+Report+2016-17+-+Final.pdf
Waterloo	https://uwaterloo.ca/institutional-analysis-planning/university-data-and-statistics/student-data/student-headcounts
Western	http://www.ipb.uwo.ca/documents/cudo2017.pdf
Windsor	http://www.uwindsor.ca/common-university-data-ontario/310/general-information-2017
York	http://cudo.info.yorku.ca/report/2017-a-general-information/

Hierarchical Classification

The analysis of the data was aided by the introduction of classification and hierarchy schemes for some of the parameters used in this comparative study. In order to ensure consistency in the classification process and to aid in the reduction of the complexity of the data sets, the data was organized using the following parameters: (1) departments/faculties that offered programs (programs by), (2) students for whom the programs were intended (programs for), (3) departments/faculties that offered courses (courses by), (4) students for whom the courses were intended (courses for), (5) student undergraduate specialization, and (6) founders' undergraduate education based on data from our previous report.

Classification Subcategories

Business: referring to the faculty of business, or business schools
Engineering: referring to the faculty of engineering
Science: referring to science departments typically within the faculty of Arts and Science
Humanities and Social Science: referring to humanities and social science departments typically within the faculty of Arts and Science
Arts and Science: This subcategory was only used in the case of programs if programs didn't originate from one specific department, and were designed for all Arts and Science students.

	PARAMETER	CLASSIFICATION SUBCATEGORIES
1	Programs by	• Business • Engineering • Science • Arts and Science
2	Programs for	• Business • Engineering • Science • Arts and Science • All
3	Courses by	• Business • Engineering • Humanities and Social Science • Science • Other
4	Courses for	• Business • Engineering • Humanities and Social Science • Science • Elective • Elective + • Other
5	Student population	• Business • Engineering • Humanities and Social Science • Science
6	Founder undergraduate education	• Business • Engineering • Humanities and Social Science • Science • Computer Science*

* In parameters 1-5, computer science was grouped under science, while in parameter 6, it was assessed individually. For the comparative analysis in this report, even in parameter 6, computer science was grouped under science.

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