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**CANADIAN ENGINEERING EDUCATION**

An Interactive Qualifying Project

Submitted to the Faculty

Of the

WORCESTER POLYTECHNIC INSTITUTE

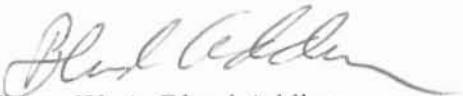
In Partial Fulfillment of the Requirements for the

Degree of Bachelor of Science

By

Aaron M. Jones

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Professor W. A. Bland Addison

## **Abstract**

An exchange program with Ecole Polytechnique and the University of Montreal, both in the city of Montreal, in Quebec, Canada was reinstated to facilitate this project. The purpose of which was to explore, understand, and analyze all aspects of Canadian engineering education that are similar to or different from those of the American system, and more specifically those of WPI. In doing so, I hope to encourage future students to continue the growth of this program.

The report presented here is the culmination of a period of four months of exploration in the great city of Montreal, Canada. Cristiana Cruceanu<sup>1</sup> and I were able to reestablish the virtually dead exchange program with Ecole Polytechnique, the French-Canadian equivalent of WPI in Montreal. Ecole Polytechnique is a minor college that is affiliated with the much larger University of Montreal, which is one of the biggest schools in the province of Quebec. Even though Montreal is the second largest French-speaking city in the world, the University of Montreal is one of the few that maintain an education entirely in French. Other Canadian schools, such as McGill, or Concordia, are exactly like American universities, just placed in a foreign city. We set out to explore, understand, and analyze this and all the other areas in which engineering education in Canada differs from the system here in the United States, and more specifically at WPI. One of the students whom we encountered, Sebastien, was studying biology at the University of Montreal. He was telling us about how he grew up entirely bilingual, having a father who spoke primarily French and a mother who spoke only English, and as a result he was perfectly fluent in both languages. He continued to say that a lot of the time he prefers to take his exams in English, and then informed us that all teachers were required by the University of Montreal to give the students the option to take their exams and complete their homework assignments in English. We later found out, however, that this was not an option at Ecole Polytechnique, even though one of our professors did prepare an exam in English for us to take.

When first arriving in Montreal, we were unsure of what to expect. Of course, we were quite nervous about the culture shock that was sure to come. In fact, our first night in town we made sure to go to the restaurant with the most English sounding name,

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<sup>1</sup> Cristiana accompanied me to Montreal with the intention of partnering on this project, however, while there she decided to transfer to a different Canadian university. Thus portions of this report are drawn from our common experiences.

Mike's, and sure enough they greeted us in English. We became surrounded by information for our project right away, even though we did not know it at the time – we were simply exchange students trying to find our way to classes and orientation sessions. The goal and the direction of the report were not completely formulated in the beginning months of our stay. We simply absorbed the enormous quantity of new concepts and ideas that comprised a culture different from our own. All we had come with was the idea that we wanted to explore the nature of engineering education in Canada and learn a lesson from experiencing a different form of college instruction. Once we began observing the interesting differences in the education system that we were immersed in and, most importantly, became comfortable with these concepts, we were able to see a path, and a purpose for our project.

We saw the task of examining and writing about the education system that our Quebecois classmates took for granted as an opportunity to expand our horizons and possibly bring back some Canadian ideas about engineering education. After all, this system seemed to be working very well in its own way. Perhaps there would be areas where the American system and even WPI needed improvement, while the people at Ecole Polytechnique had already perfected a method to improve the quality of education in areas where Americans were still struggling to find answers. Or, on the contrary, perhaps we would see areas where Ecole Polytechnique was failing its students and we could make suggestions for improvement to our new colleagues and friends north of the border.

Perhaps we could learn to better appreciate our own society by observing another. Either way, we could draw attention to particular needs at both institutions and offer the methods of the other institution as a possible solution.

Learning about the university was not very difficult, due to the fact that we were immersed in it as students. As resources we used any pamphlets that were thrown at us during orientation and along the way, interviewing the staff members that were in charge of guiding us, as well as our classmates and newly acquired friends, and most importantly observing what was happening inside the classroom and out. Teachers were a useful resource, particularly a very nice and devoted French teacher who taught our French Written Communication course, Sylvie Lafleur. She regularly taught French at Marianopolis *Collège*, which was a private CEGEP with English as the language of instruction, but in addition taught one night course per semester at the University of Montreal. Thus, she was particularly understanding of our struggle with the language, as we were two of the few who spoke English as our primary language. She was able to supply us with her own experiences as part of a CEGEP in addition to some literature on the subject in English. In general, everyone was very willing to help even though slightly confused about how to describe a system that they were a part of and thus seldom analyzed and questioned.

In order to better understand the significant differences between education here in the U.S. and in Quebec, we knew it was vital to examine its history and its influences. The history of education in the province is a very interesting one, going hand in hand with the history of the ethnic turmoil present here throughout the years: Catholic vs. Protestant, French vs. English. The major influences on the education system, as far as we could tell, were the French and the American systems with a bit of British influence remaining in the form of the other Canadian provinces. The features that seemed to be most different from our own system were obviously those that originated in the educational philosophy of France. This sort of melting pot of ideas is to be expected, as the most strongly francophone province in all of Canada would naturally try to keep its

French roots while unavoidably receiving a lot of influence from the other, Anglophone part of Canada and of course its closest neighbor, the United States.

It is our greatest wish for the research and writing presented here to be used as a resource for better understanding our neighbor to the north, while also serving as a possible tool in the future for any WPI quests for change and improvements.

## Education in the Province of Quebec

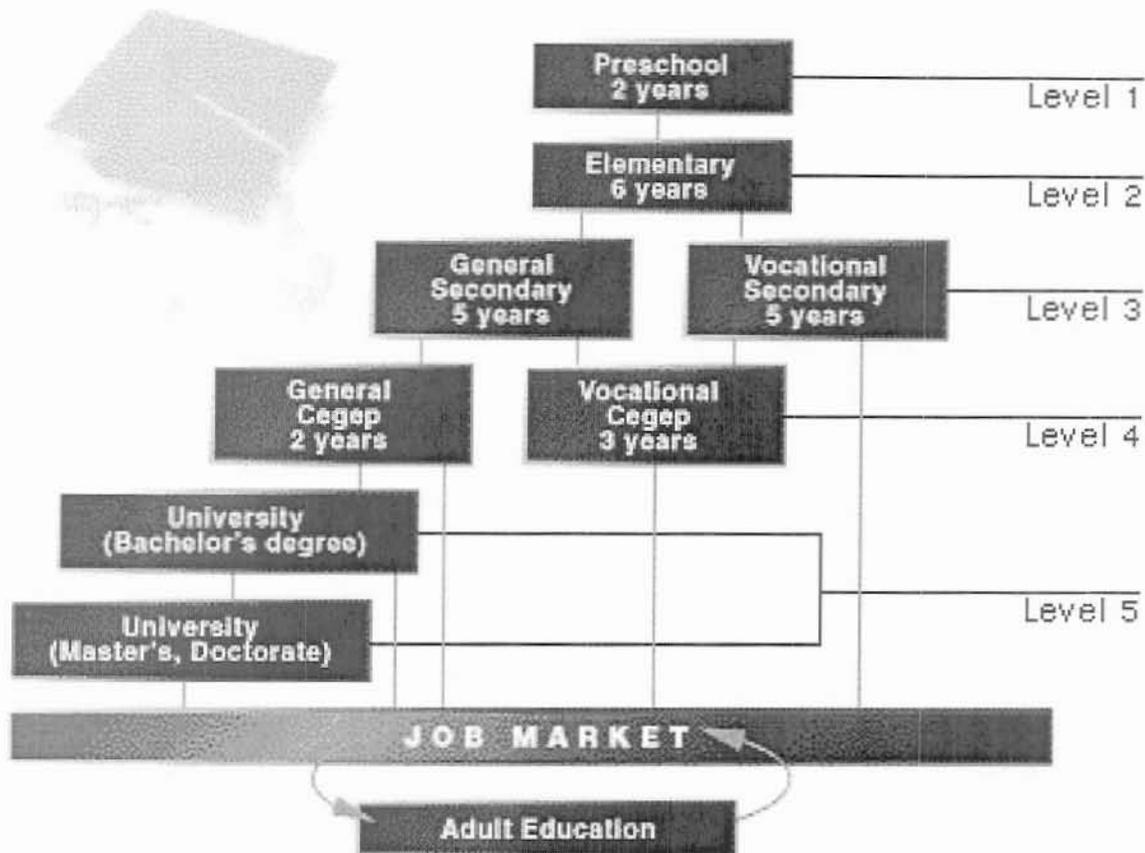


Figure 1: Chart of the system in the province of Quebec.

(Source: <http://www.montrealinternational.com/en/vivre/systeme.aspx>)

Education in Quebec, as seen in Figure 1, is divided into 5 different levels of achievement. Preschool and elementary school are almost equivalent with the United States. Also, in the United States the equivalent of the Quebec General Secondary is Middle School and High School. A great difference is that Quebecers finish after only 11 years whereas American students finish in 12. However, in order to be able to continue to university, they must complete at least an additional 2 years of CEGEP (Collège d'Enseignement Général et Professionnel). This institution is very specific to

Quebec, as it can be found nowhere else in Canada. It will be discussed more in depth later in this report.

Up to and including the fourth level, education is provided free of charge for residents of the province in public institutions. However, parents have the choice of sending their children to privately owned institutions at any level. As in many European countries, the provincial and the federal governments provide a significant amount of funding to any and all educational institutions in an effort to offer every child the opportunity of acquiring the appropriate education level for the career of their choice and ability. As a result, tuition fees for privately owned institutions for citizens and residents of Canada are in the affordable range of 1,500-3,500 Canadian dollars for preschool through college (the term college in Quebec refers only to pre-university institutions such as CEGEPs, unlike the United States where the terms college and university are almost synonymous in terms of the education level). Compulsory education, as decreed by the laws given by the Ministry of Education of Quebec, lasts for ten years, between the ages of 6 and 16.

(Source: <http://www.montrealinternational.com/en/vivre/systeme.aspx>).

At the university level, Quebecers have a choice between private and public institutions, both at affordable prices. There are 14 public and 9 private universities in the province of Quebec. Ten of these institutions are located in the city of Montreal.

(Source: <http://www.univsource.com/qctype.htm>).

## History of Quebec Education

The territory that is now known as the province of Québec was void of a true education system in the 17<sup>th</sup> and 18<sup>th</sup> centuries. Some institutions run by the Catholic clergy in New France provided the only form of education. A map of this area is provided below.

Figure 2: Map of New France in 1691



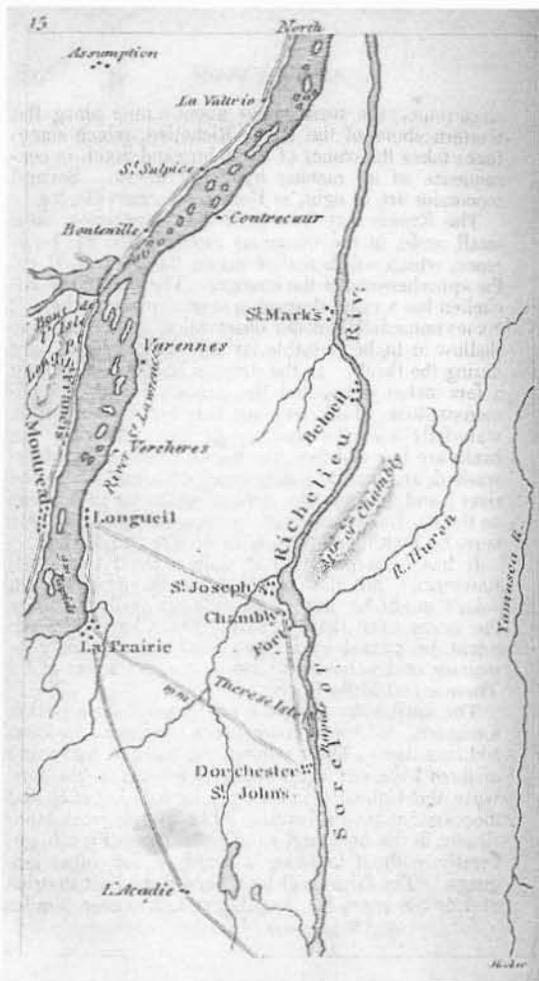
(Source: <http://www.library.upenn.edu/exhibits/rbm/kislak/lands/nfmap.html>).

Examples of such clergy-run institutions are the Ursulines of Québec and the Séminaire of Québec, both historically renowned for their contributions to the establishment of an official educational system. In a spirit of true clerical dominion, education came under the authority of the Bishop of Québec and its main purpose was to serve as a tool for the Catholic Church to spread the Gospel among the common people. However, as their resources were limited, these programs did not reach a large percentage of the population. In fact, as with many other cultures in of the colonial period, education

was almost strictly limited to the urban area. A study done between the years of 1745 and 1754 of the couples marrying in Quebec shows that in the rural parishes only 10% of the people could sign their name, while in the urban parishes 50% could do so (Magnuson, 8). The study assumes that ability to sign one's name is an indication of literacy.

## Lower Canada

Figure 3: Map of Lower Canada in 1830:



(Source: [http://www.lib.utexas.edu/maps/historical/history\\_americas.html](http://www.lib.utexas.edu/maps/historical/history_americas.html)).

In 1760, the British defeated the French in North America and the colony that was known as New France was severed. The region that is now Quebec was named Lower Canada by the British Empire and its boundaries are depicted in the map above. The first piece of

school legislation appeared in the Statutes of Lower Canada no sooner than the year 1801. This law created elementary schools administered by the Royal Institution for the Advancement of Learning, which was a sort of standing committee on education under the authority of the British governor. Since the power on education was no longer in the hands of the clergy, Catholics stayed away from the Royal schools. Another reason was that the language of instruction was English and the religious denomination in these schools was Anglican. Thus, the success of these schools was very limited among Francophones. To deal with this problem, the government adopted the Fabriques Act in 1824. This decreed that the colonial authorities would still control the Royal schools. However, another form of institution would also exist that would essentially serve as parish schools for Francophones run by the vestries or *fabriques*, thus the name of the act. The downside of these schools was that they received no financial assistance from the government, which meant that a very small number of them would be available.

The Syndics Act was another law passed in 1829, allowing the election of commissioners or *syndics*, who would be responsible for running elementary schools in both the Catholic and Protestant parishes. Funding for the building of these schools and the teachers' salaries was provided by the Government. Secondary-level institutions did not appear until the first quarter of the 19th century, when the classical colleges and the first normal school were created. Also around this time, specifically in 1821, McGill University was created, then Quebec's first and only Anglophone University. The first French-language University, Laval, was founded in Quebec in 1852. (Source: Minister of Education of Quebec: <http://www.meq.gouv.qc.ca/rens/brochu/anglais/history.htm>). Ecole Polytechnique was not founded until 1873 (Source: <http://www.polymtl.ca/rensgen/en/toutPoly/enBref/chiffres.php>).

## **United Canada**

From 1840 on, what is commonly known as Modern Canada consisted of modern-day Quebec and Ontario. Around this time, the government authorities adopted a number of measures aimed at promoting education throughout the country. In 1841, a bill was passed decreeing the creation of a network of schools run by elected commissioners under municipal authorities, with a superintendent of instruction in charge of the system in its entirety. In 1845, school boards that were independent of municipal authorities were created and placed under the authority of the superintendent. In order to delimit where the authority of one ended and that of another began, the superintendent used the borders of parishes. Furthermore, schools were still separated according to the religious denomination. As a result, the religious separation in education was maintained and stronger than ever. To aid the formation of new schools, the elected commissioners had the unusual power to levy taxes.

The new changes led to the opening of a few of new schools, but the numbers were not nearly high enough to reach everybody. A number of problems arose aside from the obvious establishment of separate denominational schools. Officials encountered difficulties in recruiting teachers, and even those willing to do the job were often under qualified. Also, as with any new program, there was significant controversy over organizational and financial matters. However, the greatest obstacle was the unwillingness of the people to accept these new ideas of educating their children. Even when children enrolled in a school, there was a very low attendance rate and a large majority of students ended their studies at the very young ages of 10 or 12. (Source: <http://www.meq.gouv.qc.ca/rens/brochu/anglais/history.htm>). The few who went on to attend the secondary level had a choice between model schools, convents, classical

colleges (French), high schools (English) and some specialized schools. Almost all of these institutions were run and staffed by the clergy. (Magnuson 33-37)

### **Quebec after 1867**

The year of 1867 was a very important one in the history of education in Quebec because it was the year when The British North America Act was passed. This Act established the Canadian federation and created a two-tiered government (provincial and federal) as well as giving each province exclusive jurisdiction over all education-related concerns. Since the Church was enthusiastically involved in all political matters, education was one matter they would not release control of. Even though there was strong support for the removing of religion from education, the Protestant community in Quebec, a fairly new minority in the province, strongly advocated the maintenance of the denominational schools in order to ensure the equal rights of people of Protestant faiths. As a result, provisions were introduced to protect the existing rights of religious minorities through denominational schools. (Magnuson, 38-46)

The province of Quebec experienced strong demographic growth in the early 20th century, as well as a strong movement of industrialization and urbanization. Montreal alone tripled in size between 1900 and 1920. Several classical colleges, high schools, advanced schools and even technical schools subsidized by the government were created. It was around this time, specifically in 1920, when the University of Montreal was granted its charter. Not until later did the University of Montreal and Ecole Polytechnique become affiliated.

Even with the improvements in the education system and the creation of new schools, dropout rates were continuously high. Interestingly, the Protestant community flourished and its members were more motivated than their Catholic neighbors. A study

done in the 1946-1958 period found that Catholic Quebec had the highest dropout rate in all of Canada, while Protestant Quebec had the lowest. In an attempt to repair the attendance problem, a law was passed in 1943 making school attendance compulsory for all children between the ages of 6 and 14. However, there was still the problem of finding appropriate teachers to staff the new schools. The solution was to create a teachers' corporation in 1946. However, teachers were underpaid and teaching was still considered a vocation. In 1951, there were as many as 8 780 schools, 70 percent or more of which still had only one classroom, 60 percent of which had no electricity and 40 percent of which had no running water or indoor toilets. Since they were the Catholic majority, the Francophone population remained the more undereducated. As late as the 1950s, only 63 percent of students who started attending elementary school would actually complete the seventh grade. Mainly a cause of the poor funding and organization, the education system in Quebec remained undemocratic, elitist and sexist through the 1950s. (Magnuson, 75-101).

### **The Quiet Revolution: The Reform of the 1960s**

The 1960s were a special time in Quebec history, one commonly referred to as the Quiet Revolution. It was a time when the entire society was reconsidering its values, a revolution of ideas. The "revolution" started when the Liberal Party came to power in 1960 under the leadership of Jean Lesage. Education was one of the systems that were severely modified to better fit the new ideals of the modernized Quebecers. Public education was made a priority, namely making it equally available to residents living in all parts of the province. This goal was achieved through a series of laws collectively referred to as the Magna Carta of Education. Other provisions of these laws were increasing the compulsory school-leaving age from 14 to 15 and the abolition of

secondary school fees for public schools. In 1961, the government created the Royal Commission of Inquiry on Education. The purpose of this commission was to survey and analyze the education situation in the entire province. The recommendations made by the commissioners played a key role in the restructuring of the education system. In 1964, in response to the report created by the Royal Commission of Inquiry on Education, Bill 60 was passed. This bill created the Ministry of Education to control education legislation and to put the power in the hands of legislators rather than the Catholic or Protestant clergy. As a result, this legislation met with some resistance from the Church. However, the school system continued to be denominational. In 1966, the CEGEP concept came to life and a number of such intermediary/vocational institutions were created. In 1968, the first public university, University of Quebec, was established. The new reforms also touched upon the issue of the teacher force. Statistics showed that before the reforms, 90 percent of the Catholic public school teachers and 65 percent of the Protestant public school teachers had thirteen years or less of education. Gradually, an undergraduate degree became the required level of education for new teachers, and by the end of the decade, half of the teachers had fifteen or more years of education. Many changes and reforms were put into place in the education system in the province of Quebec during a short period of time, so the following decades were a time of adjustment (Magnuson, 106-109).

### **The 1970 to Present**

Throughout the 1970s and 80s, a plethora of measures were taken and bills were passed to modify, adjust and ultimately perfect the education system. Among other things, day care and preschool services were identified as an essential part of education and accordingly organized and funded. A strong focus was placed on promoting the

French language and francophone education after statistics showed that the Francophone population was increasing at a much slower rate than the Anglophone one. The issue of denominational schools was also seriously considered. A year worth mentioning is the year of 1988, which is when the Education Act was passed to replace the old legislation with the same name. The new Act changed the compulsory school attendance end age from 15 to 16, where it remains today, and decreed that school boards would be organized on the basis of language rather than denomination.

(<http://www.meq.gouv.qc.ca/rens/brochu/anglais/history.htm#1970>).

During the last twenty years, education in Quebec has been a key aspect of the provincial legislation. Constant evaluations and adjustments of policies in order to improve services offered to students and all others involved have marked this time period. The Minister of Education in 1996 published an important plan entitled A New Direction for Success. The overall goal of the reform was outlined as: “access for as many students as possible to success so that, in 2010, 85 percent of students of a given generation will obtain a secondary school diploma before the age of 20, 60 percent, a college diploma and 30 percent, an undergraduate degree

(<http://www.meq.gouv.qc.ca/REFORME/Reform.htm>)”. Focus was placed on 7 key aspects outlined in the table below:

1.	<b>Providing services for young children</b>
2.	<b>Teaching the essential subjects</b>
3.	<b>Giving more autonomy to schools</b>
4.	<b>Supporting Montréal schools</b>
5.	<b>Intensifying the reform of vocational and technical education</b>
6.	<b>Consolidating and rationalizing postsecondary education</b>

## **7. Providing better access to continuing education**

(<http://www.meq.gouv.qc.ca/REFORME/Reform.htm>).

The result of this ambitious plan is the education system currently in place in the province of Quebec. Presently, as throughout the history described in this section of this report, education is a major concern of the legislators and officials of the province.

Religion and language concerns still raise tumultuous debates and they will continue to do so in the future for as long as people maintain a sense of pride in their origins, beliefs and culture.

## **The CEGEP**

The term CEGEP is an acronym meaning Collège d'Enseignement Général et Professionnel, or, in English, College of General and Professional Teaching. This is a level of education strictly specific to the province of Quebec; all the other Canadian provinces have an education system similar to the American one. CEGEP education lasts for 2 years for the university-bound students and 3 years for those looking to obtain a vocational degree in a specific trade. To some degree, the latter could be compared to a community college degree in the United States or perhaps an associate's degree with the difference that the Quebec-earned diploma can be obtained with one year less of schooling. This type of diploma is called a DEC (Diplôme d'études collégiales) or, in English, Diploma of Collegiate Studies. By following the mathematics of university-bound students, adding 2 years of CEGEP to the 11 years of primary and secondary education, Quebec students will have studied for 13 years before attending a university. To account for that, some institutions in Quebec have 3-year programs or rather offer students the possibility to transfer credits acquired at the CEGEP level as part of their university curriculum. In fact, many universities in the other Canadian provinces take such courses into account. An engineering degree, as awarded by Ecole Polytechnique, however, is considered more demanding and thus requires 4 years at the university level no matter what CEGEP courses have been previously completed.

### **History and Purpose**

The concept for this type of institution came to life in 1967, in the midst of the Quiet Revolution, which overturned the entire education system in the province. The reformist leaders of the Quiet Revolution saw a lack of participation within the general public in education at a level above secondary, or high school. At that time, higher

education was pursued mostly by the wealthy or those desiring to enter the clergy. CEGEPs were seen as an intermediary step of a relatively short duration (2 or 3 years) where people could prepare for university or acquire the skill of a professional trade. The concept was not completely new as there was a relatively large network of technical schools, and nursing schools. The reformist idea consisted of combining these into single units where a number of career paths were offered and thus the students had the time to choose the right one for them. While this restructuring was easy in the French sector of the province's population where a lot of these schools existed, it was more difficult to provide for the English sector where these institutions had to be created from scratch. Twelve French CEGEPs opened in 1967, while the first English one did not open its doors until two years later. The true nature of the CEGEP was a sort of social equalizer in the opportunities available to the Anglophone and the Francophone people. Before the CEGEP, French speakers would have to attend an intermediary college, which would often last four to five years, before going ahead to university. In the English sector, where there were no *collèges*, students went straight to university after completing high school. This meant that students could be as young as 16 years old, immature and often poorly prepared when entering into world of university studies. The change was appreciated by both sectors as the time of education was equalized for all Quebeckers and the age of entering into the university was an appropriate 18-19 years old. (Magnuson, 111-112)

### **Structure**

As mentioned above, the length of CEGEP studies is 2 years for those students that are university-bound and 3 years for those seeking to obtain a professional or technical degree. However, a student completing 3 years of CEGEP can certainly continue on to university if he or she so chooses.

The following is a list of the programs offered by a typical *collège*. This particular list is from Le *Collège* de Champlain in Lennoxville, Quebec.

<u>Pre-University Programs</u>		<u>Career Programs (Technologies)</u>	
200.B0	Science	351.A0	Special Care Counselling
	Health Science profile	410.B0	Accounting and Management Technology
	Pure and Applied profile	420.A0	Computer Information Syst.
300.A0	Social Science		
	General profile	<u>Enrichment Programs</u>	
	Pre-Commerce profile	International Studies	
	Math profile	English Advantage	
	Pre-Psychology profile	<u>Pre-program semester (Session d'accueil)</u>	
500.A1	Creative Arts, Literature and Languages	<u>081.01</u>	
	Creative Arts profile	Preparatory semester for students in need of	
	Languages profile	special academic assistance	
510.A0	Fine Arts		
700.B0	Liberal Arts		

This particular CEGEP offers concentrations in all the different forms of education whereas others may focus on science and engineering only, or humanities only. Students will choose a profile and take the required courses, as outlined below. There is not much room for choices in class selection. The first two years of CEGEP education are meant to provide a foundation for continuing on to university or to another year of CEGEP after which a diploma is available.

The following is a sample of a two-year program with a specialization in sciences from the Champlain College in Lennoxville. A student planning on attending a university program in engineering could follow this type of program.

## 200.B0 SCIENCES

IMPORTANT NOTE: The sequence of courses noted below is intended as a guideline ONLY. Not all students will follow this sequence each semester due to timetable constraints and individual needs.

### Semester 1

Physical Education 109-103/04  
Humanities - World Views 345-102-03  
College English 603-101-04  
French - General 602-107-03

Calculus I 201-NYA-05  
General Chemistry 202-NYA-05  
Mechanics 203-NYA-05

### Semester 2

Physical Education 109-104/03  
Humanities - Knowledge 345-103-04  
English for Science 603-BEF-04  
French - Specific 602-BE?-03

Calculus II 201-NYB-05  
Solutions 202-NYB-05  
Electricity and  
Magnetism 203-NYB-05

### Semester 3

Physical Education 109-105-02  
English Literature 603-102-04  
Complementary course

Linear Algebra [201-NYC-05], General Biology I [101-NYA-05], Wave Motion/Modern Physics [203-NYC-05] and three (3) science option courses are taken in semesters 3 and 4.

The following science option courses are currently available (F=Fall semester only, W=Winter semester only): Human Biology [Science version] (F), General Biology II (W), Organic Chemistry I (F), Organic Chemistry II (W), Calculus III (W), Mathematical Statistics (W), Experimental Physics (W), Astrophysics (F).

### Semester 4

Humanities - Ethics 345-BEF-03  
English Literature 603-103-04  
Complementary course

Total courses: 26 =  
58 2/3 credits

The following is a similar science program at the Champlain College in St.Lambert, Quebec. It has been included because it shows a more specific example of a particular student's entire two-year path.

Semester 1	Semester 2
<ul style="list-style-type: none"> <li>English 101</li> <li>Humanities 103</li> <li>French (Block A)</li> <li>Physical Education 103 or Physical Education 104</li> </ul> 201-NYA-05 Calculus I 202-NYA-05 General Chemistry I 203-NYA-05 Mechanics <b>Total: 7 courses</b>	<ul style="list-style-type: none"> <li>English BJA</li> <li>Humanities 102</li> <li>Complementary</li> <li>Physical Education 103 or Physical Education 104</li> </ul> 201-NYB-05 Calculus II 202-NYB-05 General Chemistry II 203-NYC-05 Waves & Modern Physics <b>Total: 7 courses</b>
Semester 3	Semester 4
<ul style="list-style-type: none"> <li>English 102 or English 103</li> <li>Humanities BJA</li> <li>Complementary</li> </ul> 101-NYA-05 General Biology I 201-NYC-05 Linear Algebra 203-NYB-05 Electricity & Magnetism <b>Total: 6 courses</b>	<ul style="list-style-type: none"> <li>English 102 or English 103</li> <li>French (Block B)</li> <li>Physical Education 105</li> </ul> Three Optional courses  <b>Total: 6 courses</b>
<ul style="list-style-type: none"> <li><b>Total: 26 courses over 4 semesters</b></li> </ul>	

Both programs show the same number of courses required of the students. The reason is that this level of education is overall controlled by the Ministry of Education of Quebec, which ensures that all students complete this level with the same credentials.

### **Engineering/Science Specialization within CEGEP**

The process of specialization begins at the CEGEP level. In addition to the courses listed above, the “Complementary course” requirements would be fulfilled by courses applicable to the student’s future major of choice in the upcoming university years. Students in Quebec must decide at this point at least the general direction that they plan on taking with their degree. An engineering-bound student would follow a science program. However, a student who is not certain what he or she would like for a career still has two years to explore before university; and the classes taken at this level provide a deeper insight into the subject matter than high school classes would in the United States.

Some courses offered at a CEGEP would never be taken at the high school level in the United States. One example is Linear algebra. Another is Calculus III; the course description for this course offered at the Champlain College in Lennoxville is provided below.

**201-BFB-05: Calculus III**  
**2 2/3 cr. (3-2-3) 75 hrs**

This course includes the following topics: Curves in the plane and in space; polar equations and graphs; functions of several variables, partial derivatives, maxima and minima, Lagrange's method; multiple integrals with applications; vector calculus with applications; differential equations. (*Prerequisites: Calculus II, Linear Algebra*)

**NOTES:** Recommended for science or engineering at university. Offered in winter semester only.

In order for universities to ensure that all their students are educated at the same level, a course such as the one above would be accorded transfer credit for a Quebec student, whereas a student coming from outside the province would have to take it since they would not have had the opportunity to take it at the high school level.

Universities in Canada have to take into account that the education systems are different from one province to another. This is why they establish specific requirements for each type of student. In the chart below, the requirements for students from Quebec are outlined according to the major field they plan on entering. Requirements are also described for the CEGEP itself, to ensure that the school is clear on what they should offer their students.

## **QUEBEC UNIVERSITY REQUIREMENTS**

<u>NAME OF PROGRAM</u>	<u>LEADING TO UNIVERSITY STUDY IN:</u>	<u>CEGEP PROGRAM SHOULD INCLUDE:**</u>	<u>DIPLOMA</u>	
<b>200.B0 SCIENCES (Health)</b>	Dentistry Nutrition /Dietetics Medicine Veterinary Medicine Optometry Pharmacy Nursing Phys. & Occ. Therapy Physical Education* etc.	Required science courses plus: General Biology II and Organic Chemistry I, and one other science option course relevant to the planned university program, eg Organic Chemistry II for medicine, etc.	<b>D.E.C. in SCIENCES</b>	
<b>200.B0 SCIENCES (Pure and Applied)</b>	Agriculture Architecture Forestry & Related Pure Sciences, e.g. Biology, Chemistry Physics, Mathematics Earth Sciences Engineering, etc.	Required science courses plus: three courses chosen from Physics and Math options, eg Calculus III for engineering.	<b>D.E.C. in SCIENCES</b>	
<b>300.A0 SOCIAL SCIENCES (General Profile)</b>	Law Geography History Philosophy Education Anthropology	Religion Sociology Social Work Economics Psychology Government etc.	Required Social Science courses plus Social Science courses in relevant disciplines, and Human Biology and Advanced Quantitative Methods for pre-Psychology profile.	<b>D.E.C. in SOCIAL SCIENCES</b>
<b>300.A0 SOCIAL SCIENCES (Pre-Commerce Profile)</b>	Accounting Finance Management	Marketing Production etc.	Social Science required courses plus Calculus I, II, and Linear Algebra, Understanding Business, Microeconomics (recommended), and up to three other business courses.	<b>D.E.C. in SOCIAL SCIENCES</b>
<b>500.A0 CREATIVE ARTS, LITERATURE AND LANGUAGES</b>	Visual Arts Film Study Theatre Communic. Arts Languages Translation	Linguistics Graphics Photography Radio Journalism etc.	FOURTEEN courses, based on requirement for the option, Creative Arts or Languages	<b>D.E.C. in CREATIVE ARTS, LITERATURE AND LANGUAGES</b>
<b>510.A0 FINE ARTS</b>	Visual Arts Graphics	Ceramics etc.	All courses listed in profile for Fine Arts Program	<b>D.E.C. in FINE ARTS</b>
<b>700.B0 LIBERAL ARTS</b>	Law Education	Philosophy etc.	All required courses	<b>D.E.C. in LIBERAL ARTS</b>

\*Some universities, notably McGill University, do not require a Science Diploma for Physical Education Studies.

\*\*In addition to the courses mentioned, the program should also include the other courses required for the Diploma.

A CEGEP education is important in the province of Quebec because it allows students the possibility to become oriented in a career path that is best suited for them.

This step in the education process is meant to be one of specialization and transition between the childhood years and the adulthood years.

## The University

Unlike in the United States, the term university in Quebec refers to an education level separate from *collège*. After completing grade 11 of High School, Quebecers complete 2 years of CEGEP and then enroll in a University if they want to continue their education. Universities in Quebec are structurally more similar to those in the United States than to those in Europe. Most institutions are fairly large and offer concentrations in a variety of areas, from women's studies to nuclear physics. A Bachelor's degree is generally obtained in four years. However, depending on the credits obtained at the CEGEP level, some undergraduate programs can be completed in only three years. In terms of higher education, a Bachelor's Degree is generally followed by a Master's Degree, which is followed by a Ph.D. Our study focuses on studies at the Undergraduate level.

### Engineering schools in Canada and Quebec

There are 36 institutions that offer 236 accredited engineering programs in Canada. More information on what accreditation implies and how it is granted is given below. These programs are offered at universities in all the Canadian provinces, as follows:

University of Alberta	Edmonton	AB
University of British Columbia	Vancouver	BC
University of Calgary	Calgary	AB
Carleton University	Ottawa	ON
<b>Concordia University</b>	<b>Montréal</b>	<b>QC</b>
Dalhousie University/DalTech	Halifax	NS
<b>École de technologie supérieure</b>	<b>Montréal</b>	<b>QC</b>
University of Guelph	Guelph	ON
Lakehead University	Thunder Bay	ON
Laurentian University	Sudbury	ON
<b>Laval University</b>	<b>Québec</b>	<b>QC</b>

University of Manitoba	Winnipeg	MB
<b>McGill University</b>	<b>Montreal</b>	<b>QC</b>
McMaster University	Hamilton	ON
Memorial University of Newfoundland	St. John's	NF
University de Moncton	Moncton	NB
University of New Brunswick	Fredericton	NB
University of Ottawa	Ottawa	ON
<b>École Polytechnique</b>	<b>Montréal</b>	<b>QC</b>
<b>Québec University at Abitibi-Témiscamingue</b>	<b>Rouyn-Noranda</b>	<b>QC</b>
<b>Québec University at Chicoutimi</b>	<b>Chicoutimi</b>	<b>QC</b>
<b>Québec University at Outaouais</b>	<b>Hull</b>	<b>QC</b>
<b>Québec University at Rimouski</b>	<b>Rimouski</b>	<b>QC</b>
<b>Québec University at Trois-Rivières</b>	<b>Trois-Rivières</b>	<b>QC</b>
Queen's University	Kingston	ON
University of Regina	Regina	SK
Royal Military College of Canada	Kingston	ON
Ryerson University	Toronto	ON
University of Saskatchewan	Saskatoon	SK
<b>Sherbrooke University</b>	<b>Sherbrooke</b>	<b>QC</b>
Simon Fraser University	Burnaby	BC
University of Toronto	Toronto	ON
University of Victoria	Victoria	BC
University of Waterloo	Waterloo	ON
University of Western Ontario	London	ON
University of Windsor	Windsor	ON

(Source: [http://www.ccpe.ca/e/acc\\_schools\\_2.cfm](http://www.ccpe.ca/e/acc_schools_2.cfm)).

Of the 36 accredited engineering programs in Canada, 11 are in the province of Quebec, in bold in the list above. Just like in the United States, the quality level differs from one university to another, but all institutions have in common program requirements, material covered, etc.

### Accreditation

Accreditation for engineers is something that is considered necessary in any modern country. Just like in the case of medical professionals, pharmacists and lawyers, the federal government has to control who is allowed to practice the profession because the work of these people affects the lives of many. Since the skill of a professional is a direct reflection of his or her education, the government of any modern country controls

the programs offering degrees in these important fields. Canada is no different, which is why the Canadian Council of Professional Engineers (CCPE) exists. This organization oversees the country's university accreditation system.

In order for a university to be able to grant engineering degrees in Canada, it must be accredited by the Canadian Engineering Accreditation Board (CEAB), an integral part of the CCPE. This group has been in charge of accrediting engineering institutions since 1965 and, in order to keep up to date with technological advancements and other social and cultural issues, their criteria is analyzed and adjusted annually. In order to be accredited, an engineering program has to comply with the most recent criteria outlined by the CEAB. These criteria are designed to qualify only those programs that offer students the necessary academic qualifications for consequently registering as professional engineers in Canada. The Accreditation Board is made up of fifteen distinguished engineers from both the professional and the academic sectors of the field. The Board determines accreditation at the request of a university, and following a visit at the engineering department/school of the particular institution. Accreditation is granted, or in many cases extended for a period of up to 6 years. After the period is completed, the institution must be reevaluated. Of course, accreditation can be denied entirely at any one evaluation, even for a university that has been accredited for many years in the event that the minimum standards of adequate engineering education are not met. Candidate institutions are evaluated only at the program level, and on the following criteria:

- Curriculum content to ensure that the necessary mathematics and basic science education is provided to students,
- Program environment to ensure that the quality of students, faculty and facilities meets the minimum necessity level,

- And other general criteria such as appropriate program name clearly stating the purpose of the degree and obligatorily containing the word engineering.

(Source: [http://www.ccpe.ca/e/files/report\\_ceab.pdf](http://www.ccpe.ca/e/files/report_ceab.pdf)).

However, obtaining a degree from a nationally accredited engineering program does not guarantee a student the right to practice engineering as a professional. Every individual must be individually evaluated by the association of engineers in his or her province of residence in order to determine personal competency. In Quebec, this organization is called the Ordre des Ingenieurs du Quebec (OIQ), or the Order of Engineers of Quebec. This organization has been an intrinsic part of Quebec's engineering system ever since 1920.

The provincial government of Quebec does not demand that every graduate from an engineering program join the Order, but membership is required if one desires to obtain a job or "engage in the practice of engineering" (<http://www.oiq.qc.ca/practice/oiq-member.html>). Someone with an engineering degree can only hold the title of engineer when he or she is a member of the OIQ. What graduates do first is to apply to become a Junior Engineer. Anyone with a degree from an accredited institution is essentially guaranteed Junior Engineer status upon application. The next step is passing a three-hour-long objective professional examination which is meant to determine if the student:

- Is well versed in Quebec's professional law.
- Is familiar with:
  - Principles of professional practices.
  - Concepts of ethics and of professionalism.
  - The roles and obligations of engineers within society.

- The social impact of technology.
- Sustainable development.
- Protection of the environment.
- The obligation to maintain your competency.
- Possesses basic legal knowledge on topics of:
  - Civil liability.
  - Contract law.
  - Intellectual property.
  - General commercial law.
  - Labor law.
  - Construction law.
  - Environmental law.
  - Occupational health and safety law.

(<http://www.oiq.qc.ca/students/studying/becoming/passing-examination.html>).

The Order also deals with complaints and failures in any engineering endeavor. An engineer can be reported by anyone to the Order, whose duty is to investigate the allegations and make a decision. Potentially, the engineer in question could have his or her license withdrawn if it is determined that decisions made as a professional did not comply with the rules and regulations of the Order of Engineers of Quebec. The ability to practice the engineering profession is considered a great honor but at the same time a great responsibility (<http://www.oiq.qc.ca/inshort/protection/syndic.html>).

## Ecole Polytechnique de Montreal

Ecole Polytechnique of Montreal, Poly for short, is one of the most prestigious engineering institutions in Canada, and one renowned internationally for the quality of its students, professors, and overall education. The university is presently affiliated with the much larger University of Montreal and its academic buildings are located on the University of Montreal campus. However, Poly is a university with an administration all its own, ever since its foundation in 1873. The affiliation allows students to take some courses at the U. of M. and vice versa. A full-time student can only take two out of four classes outside of the university where he or she is enrolled. However, since Poly has no humanities or social sciences requirement, students do not usually need to take any courses outside of their institution. Additionally, Poly grants separate degrees from its host university. Thus, even though the schools are affiliated, the relationship is more one of a consortium.

Since its beginnings, Poly has taken pride in its two main focuses: students and research. In terms of funding and research activity, it boasts some of the largest resources in Canada and certainly the largest in Quebec. In terms of the teaching and program style, Poly is considered one of the more theoretically oriented schools. Even though there is a lot of opportunity for research and laboratory work, there are other institutions that offer a more hands-on education.

(<http://www.polymtl.ca/rengen/en/toutPoly/enBref/index.php>).

### Structure

The structure of courses is similar to many major universities in the United States. Poly functions on a semester basis, with two mandatory semesters, Fall and Winter, and

an optional Summer semester that typically offers a limited number of courses from each major at an accelerated pace for those who need to catch up or those who want to get ahead in their studies and finish faster. Class periods are 50-minute long, but typically, two such periods back-to-back with a 10-minute break in between constitute one lecture. Just like many other schools, each course has a lecture component, a conference component called Travaux Pratiques (=Practical Work), and if the case may be, a laboratory component. During one week, courses would meet once or twice for lecture, once for Travaux Pratiques, and once for laboratory, which adds up to anywhere from four to six or seven hours per week for each course. It is no wonder that Poly students spend most of their day on school grounds, doing homework and eating all their meals at one of the many available sitting areas.

Evaluation is done almost entirely through the final and midterm exams. Some classes have one and others have two midterms. Depending on the professor's choice, a few but very extensive homework assignments and/or laboratories can be part of the grade. All classes have a final exam that is taken during the designated exam period at the end of each semester. The students get a couple of free days which are followed by a two-week exam period during which all finals are scheduled by the school officials independent of professors. Exams are scheduled on all days of the week including Saturday and Sunday at three times of the day: Morning (9:30 a.m.), Afternoon (1:30 p.m.), and Evening (6:30 p.m.). Typically, final exams are not cumulative, that is the only include new material introduced since the last midterm, but there is no rule against this practice. Furthermore, professors often allow some or all documentations during the exams along with a scientific calculator. It is school policy that all calculators used are screened in advance by the appropriate office and granted a sticker, which verifies compliance with regulations; programmable calculators are strictly forbidden.

Notation is done on a letter system from A to F. Unlike WPI, Poly does grant grades of F or failure, and it also recognizes intermediate grades such as B- and B+. The scale of grades is somewhat more forgiving than WPI's, in the sense that fifty percent would constitute a passing grade, however, from our experience the method of grading seemed to be much more strict. The tentative grading scale for any course at Poly is shown below:

Description	Letter Grade	0.0 - 4.0 Scale	1 - 100 Scale
Exceptional	A*	4.0	90-100
Excellent	A	4.0	85-89
Very good	B+	3.3	77-79
	B	3.0	73-76
Good	C+	2.3	65-69
	C	2.0	60-64
Passable	D+	1.3	54-56
	D	1.0	50-53
Fail	F	0.0	0-34

The practice of grading on a bell curve is very common here as it is anywhere. Depending on the level of the class, professors will generally set the class average as the limit for passing. However, even if Poly students have failing grades reported on their transcripts, they have the opportunity of retaking courses and replacing an F with a passing grade. The only problem is that most courses are only offered once a year so students have to coordinate their schedules accordingly, especially since most classes have prerequisites, a fact which will be explained in more detail later in the report.

### **The Degree Programs**

Poly offers 11 different engineering programs as follows:

- Chemical Engineering
- Civil Engineering
- Electrical Engineering
- Geological Engineering

Industrial Engineering  
Materials Engineering  
Mechanical Engineering  
Mine Engineering  
Physics Engineering  
Software Engineering  
Computer Science

Within these programs, a variety of concentrations are available. For example, in Mechanical Engineering, the concentrations are: Aeronautical, Fabrication, Biomedical, Steel Engineering, Mechanical-Electronic, and Plastics Engineering. As part of each program, students must complete an internship or CO-OP lasting at the least four months, commonly known as a “stage”. The compulsory integration of this work experience in the curriculum means that each student must complete a summer session or overload. However, with a minimum of four courses for full-time status, it is not uncommon for students to overload by taking five or six courses. The culmination of an engineering degree at Poly is a final project that is meant to give the graduate the most valuable experience he or she will get before entering into the ranks for professional engineers. Throughout the various courses that comprise a particular engineering program, students are expected to practice and perfect their oral and written skills, as well as their ability to work as a part of a team. This education is achieved through project work and presentations. (<http://www.poly.mtl.ca/etudes/bc/index.php>).

### **Course Requirements**

The degree program for any major at Poly is a very specific one, with almost every class having prerequisites. Program descriptions essentially pre-determine which classes are taken at which time during the four years of study. To better illustrate this we include an example of a program of studies in Mechanical Engineering without a specific concentration.

First year classes

<b>Course</b>	<b>Title</b>	<b>Credits</b>
ELE1403	Elements of electro technique and electronics	3
IND2301	Management of technological projects	2
MEC1110	Integrated project I	3
MEC1210	Thermodynamics	3
MEC1310	Informational technology of Mechanical Eng.	2
MEC1410	Statics	2
MEC1420	Resistance of materials I	3
MEC1510	Modelization de mechanical systems	3
MTH1006	Linear Algebra	2
MTH1101	Calculus I	2
MTH1102	Calculus II	2

Mandatory courses for the 2<sup>nd</sup>, 3<sup>rd</sup> and 4<sup>th</sup> years

<b>Course</b>	<b>Title</b>	<b>Credits</b>
GCH1110	Analysis of procedures of durable development	3
INF1005A	Procedural programming	3
MEC2110	Experimental and instrumental methods in ME	2
MEC2200	Fluid Dynamics	3
MEC2405	Materials	3
MEC2415	Resistance of materials II	3
MEC2420	Dynamics of the engineer	3
MEC2430	Vibrations	2
MEC2500	Technological definition of mechanical products	3
MEC2990	Integrated project II	3
MEC3200	Heat Transfer	3
MEC3210	Systems of pumping and ventilation (SPVC)	2

MEC3300	Analysis and order of dynamical systems	2
MEC3310	Elements de CFAO	3
MEC3320	Plastics, elastomeres and composites	2
MEC3355	Hydraulic et pneumatic systems	2
MEC3510	Fabrication	3
MEC3900	Internship/COOP	3
MEC3990	Integrated project III	3
MEC4115	Mechanical Engineering Laboratory I	2
MEC4215	Mechanical Engineering Laboratory II	2
MEC4990	Final integrated project	6
MTH1115	Differential Equations	3
MTH2210C	Numerical Analysis for Engineers	3
MTH2302B	Probability and statistics	3
SSH5201	Economics for engineers	3
SSH5501	Ethics applied to engineering	2

Sociology of technology courses (choice of 3 credits)

<b>Course</b>	<b>Title</b>	<b>Credits</b>
SSH5100A	Sociology of technology	3
SSH5100B	Sociology of technology	3
SSH5100C	Sociology of technology	3

Optional Courses for the Classical Path (choice of 3 credits)

<b>Course</b>	<b>Title</b>	<b>Credits</b>
MEC3230	Finite elements of thermofluids	3
MEC3400	Finite elements of solid mechanics	3

It is advantageous for students to know exactly what to expect from their upcoming four years of college. It is also positive that, through a strict program, it is ensured that they get the proper education in order to become good engineers. The disadvantages of such a program are the lack of room for personal preferences and also the need to successfully complete one course before enrolling in another. Failure in certain key subjects can set students back because they have to wait until the next year when another, higher-level course with prerequisites is offered. This may prevent some from graduating on time. The upside to finishing over a longer time in Canada is that university tuition is so low compared to the United States that almost anybody can afford to pay.

### **Career after Poly**

An effective way to determine the value of a school is to look at the success of its graduates. Ecole Polytechnique offers its students extensive resources to aid them in the search of a job or internship. They have a department called Service de Placement, or, in English, Placement Services. This department guides students through the entire job application process, from resume building to locating an adequate position. This is also where the information of the school's graduates' success rate is found. From their records, the following chart outlines the average salaries for each major when the engineer was employed as a student still attending university – for an internship. The values include salaries obtained during the summer term of the year 2005.

<b>Type of engineering</b>	<b>Number of students included</b>	<b>Average salary per hour (in CDN)</b>
Civil engineering	88	14.75

Mechanical engineering	102	15.51
Electrical engineering	50	16.01
Chemical engineering	38	14.78
Materials engineering	18	14.52
Mines engineering	6	14.75
Geological engineering	12	13.46
Physics engineering	7	14.40
Industrial engineering	45	15.40
Computer Science	56	14.79
Software engineering	68	15.00

These salaries vary as a function of the credits completed by the student, a particular student's previous work experience, and the size of the company employing the student.

The following chart outlines the average salaries for each major when the engineer was employed for the first time as a Bachelor's Degree holder. The information was taken from a survey sent to alumni who had graduated during the Fall of 2004 and the Winter of 2005.

Type of engineering	Number of respondents	Average salary per year (in CDN)
Civil engineering	12	40,000
Mechanical engineering	57	44,000
Electrical engineering	33	43,000
Chemical engineering	21	41,000
Materials engineering	3	43,000
Mines engineering	0	N/A

Geological engineering	6	40,000
Physics engineering	4	44,500
Industrial engineering	24	41,500
Computer Science	37	42,500
Software engineering	2	N/A

In terms of availability of employment, Quebec offers a variety of options, and Poly students are most likely to be considered first for those positions. The reason for that is that Ecole Polytechnique is the highest rated engineering university in the province for French speakers. Due to the strong feelings of local pride that are very apparent, one can assume that Quebec companies would prefer hiring local engineers who will communicate and have studied in French. (<http://www.polymtl.ca/sp/stats/index.php>)

## Analysis

To best compare WPI with Poly, it is important to first acknowledge a few of the many concepts that Poly and WPI have in common.

Poly, the WPI of Canada?

Besides the fact that we barely understood what was being said around us, when we first set foot on the Poly campus, we surprisingly felt right at home. We were surrounded by computer labs and the computer nerds that filled them, classrooms fully equipped laptop plug-ins, and an office specifically designed to help us configure out laptops to the Poly wireless network. We even saw flyers for a weekly movie on campus, a robotics team, and a formula racecar team; all of which are things students enjoy on the WPI campus as well.

Upon further investigation we found even more similarities. For instance both schools offer students a way to atone for his/her classroom mistakes. At Poly, if a student were to receive a grade of F in any course, he/she is allowed the opportunity to take the course again and the F will be replaced on his/her transcript like it never existed. At WPI, the procedure is very similar, except for the fact that the F indeed never does exist, if one does not receive a C or better in any particular course, he/she simply receives no record of ever taking that course. This is quite an uncommon procedure, so to see it at both universities was surprising to say the least. However, something about the engineering community as a whole can perhaps be drawn from this, and that is that it seems to be more practical, in that it understands that in the real world for whatever reason people make mistakes and fail tasks but should be given an opportunity to rectify their errors. Should a student be forever marked with a poor grade, or should he/she be given the chance to learn from and correct his/her mistakes.

Another important similarity is that of providing students with a way to interact with their professors in smaller groups to further work on examples and ask questions. Here at WPI, we call them conferences, and at Poly they are called Travaux Pratiques (TP's), which means practical work in English. These sessions are vital part of learning at the undergraduate level, particularly in engineering. The engineering curriculum typically includes a large number of math and science courses, in which students can encounter concepts or formulas that are at first completely foreign to them. While lectures certainly present students the information they need to know, one-on-one instruction from the professor almost always provides a better understanding of the material. For many students, there can be a large gap between learning the raw material in lectures, and understanding the concepts behind the information given to them. This is why conferences are a necessity in engineering education.

One final key idea that has been instituted at both universities is the concept of a capstone project that is required to complete your degree requirements. Here at WPI, we call this our MQP, or Major Qualifying Project, and it is designed to prepare students for problems they may face in the real world of engineering. This project teaches students to apply what they have learned in class as theory to an everyday issue that they may come across in their future employment. Furthermore, it introduces the concept of teamwork to a student, who up until this point has almost entirely relied on his/herself to complete academic work. Collaborative projects should be an important dimension of contemporary engineering education because it is more and more common nowadays for large companies to assign tasks to teams of engineers rather than individuals. Learning how to successfully contribute in this type of setting is essential.

## Differences

It is quite possible, and in fact probable, that one could differ in opinion about which university's curriculum is best suited for today's students and today's industrial problems. Furthermore, different readers will most certainly form different opinions about which pedagogical techniques better prepare students to meet the needs of the engineering community. That being said, as a student who attended both Poly and WPI, as well as Ohio Wesleyan University, a four year American liberal arts university, I would make the following recommendations.

## Ways for Poly to Improve

- Decrease, but NOT Eliminate Pre-requisites
  - The strictness of the current system of pre-requisites inhibits the students from choosing their own path to their degree requirements. This also sets back those students who are not sure of their desired major field immediately upon entry to the university. While at WPI, there are no specific pre-requisites, and this is sometimes a problem, as it can result in students taking courses they are not adequately prepared for. There needs to be a happy medium.
- Institute a 3-6 Course Humanities Requirement
  - Requiring a student to take a small amount of humanities courses, like at WPI, makes him/her a more well-rounded individual, while taking very little away from his/her engineering education. It also can be a way to encourage travel abroad in the way of exchange programs.

- Implement Intermediary Evaluation Procedures
  - Whether it be regularly assigned homework, periodic quizzes, or projects, there needs to be an evaluative process attached to student throughout the entire semester of the course. I spoke with a number of Poly students, who said that their typical procedure was to only study for exams during the one or two weeks before the test, and do no other work for the course the rest of the semester. This cramming technique not only usually results in lower exam scores, but commonly students are not able to recall the majority of that information after the exam. At WPI, the workload may be heavy, but at least students are evaluatively connected to the course material at all times, thus in general, the material becomes more familiar to them because they are continually asked to review it.

### Ways for WPI to Improve

- Implement Some Pre-requisites
  - While there are recommended pre-requisites listed for every course, there are no actual requirements to take a pre-requisite course before enrolling in the desired class. That is to say, one cannot be denied access to a course because one does not have the pre-requisite. This can often result in students taking courses that they are not at all prepared to take. While the freedom to choose your own path to fulfill your major requirements is an advantage in the WPI system, there still needs to be some limited structure in the progression of courses.

- Require One Summer Internship for Graduation
  - Students at Poly are required to complete one 4-month “*stage*”, or internship. This goes along with the concept of the MQP and capstone project, an internship can only help prepare a student for what the real world will be like after graduation. Students will learn how to face real workplace issues as opposed to solving problems in a textbook. One possible way to implement this would be to allow certain internships to count as fulfilling the IQP or MQP requirement, depending on if they are relevant to the student’s major.
  
- Rework Calendar to Allow for One or Two Free Days Before Final Exams
  - At Poly, students get two days off prior to the final exam period of two weeks. In addition, typically students are only taking four courses per semester and having four exams spread out over fourteen days gives them ample time to prepare for their exams. Of course, at WPI this exact structure is not possible due to our four-term structure. However, it would certainly be feasible to give students a day or two in between the last day of classes and their final exams. The fast pace of WPI has many benefits, but this is certainly one of the disadvantages; students are often swamped with homework/projects right up until the day of their final. Thus they are often ill prepared, and do not get adequate time to review the large amount of material that was presented to them in such a short time.

## Conclusion

After being a part of both these institutions, I came to realize that the majority of the differences between WPI and Poly were only superficial. The difference between English and French, semesters and quarters, homework and no homework, B's and B+'s, one hour lectures and two hour lectures; these things are some major differences between the two institutions but they are only secondary to the common purpose of preparing engineers to work in today's complex global environment. For any particular student, issues concerning grades, curricula, or classroom format might have a small effect upon the success or failure in the learning process, but overall both universities have a set of core values and ideas that make them extraordinarily successful in educating their students. Such as, the opportunity to rectify a poor grade in a course, the concept of conferences, or TP's, that result in more one-on-one time with professors, and the idea of a required project that introduces students to the types of problems they may face in the workplace. In that, they are far more similar then they seem to be at first glance.