

## **COLLEGE MATHEMATICS PROJECT 2008**

### **CMP 2008 Forum Backgrounder**

#### **Part 1: Introduction**

The College Mathematics Project (CMP) is based on the need for general improvement in first year college mathematics achievement. Past studies have shown that too many students fail or barely pass first semester mathematics in college. And since mathematics is a critical foundation of most programs in business and technology, poor achievement in mathematics can lead to drop-out with negative consequences for students, colleges and the Ontario economy. It is therefore the aim of the CMP to conduct research and deliberations leading to increased student success in mathematics.

In 2008, CMP has expanded to include 11 colleges and the 34 district school boards in the areas of those colleges<sup>1</sup>. Its goals are basically unchanged from previous studies:

- To analyse the mathematics achievement of first-semester college students, particularly in relation to their secondary school mathematics backgrounds;
- To deliberate with members of both college and school communities about ways to increase student success in college mathematics.

The methodology used for the College Mathematics Project is called “Deliberative Inquiry”. It is a cyclical methodology designed for integrating research with deliberations about future courses of action. The questions for research are derived from deliberations about the problems of practice and the deliberations are based on questions emerging from the research and so the cycle of research and deliberation continues. Further information about the methodology and its application to the College Mathematics Project can be found on the CMP web site<sup>2</sup>.

This Forum Backgrounder represents a mid point in the deliberative inquiry cycle, when the data has been collected and enough research has been completed to

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<sup>1</sup> CMP 2008 includes Algonquin, Centennial, Confederation, Durham, George Brown, Georgian, Humber, Mohawk, Niagara, Seneca and Sheridan colleges. The project is supported financially by the Ministry of Education and the Ministry of Training, Colleges and Universities and led by a project team from the York/Seneca Institute for Mathematics, Science and Technology Education (YSIMSTE) based at Seneca College.

<sup>2</sup> <http://collegemathproject.senecac.on.ca>

raise significant questions for deliberation. The research will continue as deliberations suggest additional ways to analyse the data. During the coming months, deliberative forums will take place in several regions of the province bringing together representatives of colleges, schools and government, mathematics specialists, student support and guidance professionals and administrators, to share experiences from their own institutions and to respond to the questions raised by the research.

The document itself is in two parts: this introductory text and a set of data tables and figures. At this point, both parts should be regarded as confidential as the data analyses are preliminary and subject to review and updating.

### **Research Questions**

The following research questions were approved by the CMP Steering Committee at its first meeting in March 2008. Not all questions have been answered at this stage of the research.

#### **A. PARTICIPATION**

*Note 1: For operational definitions, see the “Key Research Information” section below)*

A1. What are the numbers of students in our sample, by college, gender, and program cluster?

A2. What are the numbers of Recent Ontario Graduates (ROGs) by college, gender, and program cluster?

A3. What are the numbers of students (both ROGs and non-ROGS) enrolled in all math courses, in college-level math courses, and in preparatory math courses, by college, gender and program cluster?

#### **B. COLLEGE MATH ACHIEVEMENT**

*Note 1: This only applies to students taking mathematics courses (as described in A3)*

*Note 2: These questions apply to all math courses, college-level math courses, and preparatory math courses and these are shown separately.*

B1. What is the mathematics grade distribution for ROGs and non-ROGs, by college, gender, and program cluster?

B2. What are the % of students achieving a “good passing grade” (A, B, C) for ROGs and non-ROGs by college, gender, and program cluster?

B3. What is the % of students “at risk” (D, F, and WD) for ROGs and non-ROGs, by college, gender, and program cluster?

B4. How do students’ college English marks (A, B, C, D, F) compare with their college mathematics marks (good grades, at risk)

### C. SECONDARY SCHOOL MATHEMATICS BACKGROUNDS

*Note 1: This only applies to ROGs (as described in A3)*

*Note 2: These questions apply to all math courses, college-level math courses, and preparatory math courses and these are shown separately.*

C1. What are the numbers of students taking each secondary school mathematics pathway and what % of those taking each pathway achieve good grades or are at risk in college.

C2. For students following a pathway culminating in MCT4C, MAP4C, or a 12U course, how do students’ Grade 12 math marks (50-60, 60-70, 70-80, over 80) compare with their college math marks (good grades, at risk)?

### D. COLLEGE ACHIEVEMENTS BY SCHOOL BOARD AND SCHOOL

*Note 1: This only applies to ROGs (as described in A3)*

*Note 2: These questions apply to all math courses, college-level math courses, and preparatory math courses and these are shown separately.*

D1. What are the % of students with a “good passing grade” (A, B, C) and “at risk” (D, F and WD) from each of the partner school boards in the project?

D2. What are the % of students enrolled in college-level courses and preparatory courses from each of the partner school boards in the project?

D3. What are the % of students with a “good passing grade” (A, B, C) and “at risk” (D, F and WD) from secondary schools in each of the partner school boards in the project?

**Key Research Information**

*Students*

Students whose data is included in this study are those who were enrolled at CMP participating colleges in the Fall Semester 2007, in all postsecondary programs *except* applied degree programs, apprenticeship programs, and post-graduate certificate programs.

This CMP student population is extremely diverse and includes students of all ages (post-secondary), and from a wide variety of origins. Since aspects of CMP relate to mathematics in Ontario secondary schools, we have found it useful to subdivide the overall CMP student population into “recent Ontario graduates” (ROGs) and others (non-ROGs), whose secondary school mathematics was either a long time ago or took place in another jurisdiction. ROGs are defined as being under the age of 23 (as of December 31 2007) and having an Ontario Secondary School Diploma (OSSD).

*Programs*

The postsecondary programs included in the College Mathematics Project are designated by each college independently with names and codes for local use. However, they are also based on a common system of MTCU program codes and CMP uses these MTCU codes as the basis for grouping similar programs from different colleges together, regardless of their local names or faculty affiliation. Over the past several years, CMP has developed the following system of major clusters and sub-clusters to organize the programs.

Major Clusters	<b>AA</b>	Applied Arts
	<b>B</b>	Business
	<b>G</b>	General
	<b>T</b>	Technology
Sub-Clusters	AA	<b>Arts</b> e.g. graphic design, journalism
		<b>Human</b> e.g. recreation, children & youth
		<b>Health</b> e.g. nursing, paramedic
		<b>Hospitality/Tourism</b> e.g. travel, culinary
	B	<b>Finance</b> e.g. accounting
		<b>Admin</b> e.g. marketing, human resources
		<b>Office</b> e.g. office administration
	G	<b>A &amp; S</b> e.g. Arts & Science programs
		<b>Health</b> e.g. pre-Health programs
		<b>Technology</b> e.g. pre-Technology programs
	T	<b>Applied Science</b> e.g. chemical, biotechnology

**Computer** e.g. programming, systems  
**Construction** e.g. architectural, civil, HVAC  
**Electrical** e.g. electronics, electrical  
**Mechanical** e.g. manufacturing, fire protection

A complete list of all CMP College programs with their MTCU codes, clusters and sub-clusters will be made available on the CMP web site. This year with 11 colleges participating, CMP has data relating to over 1000 programs as outlined in the following table. It is notable that over half of these programs include a Mathematics course in the first semester and nearly 85% include an English course<sup>3</sup>.

Major Clusters	Programs	1st semester		Sub-Clusters	Programs	1st semester	
		Math	English			Math	English
<b>Applied Arts</b>	426	39	373	<b>Arts</b>	152	8	126
				<b>Health Services</b>	71	7	64
				<b>Hospitality &amp; Tourism</b>	53	20	50
				<b>Human Services</b>	150	4	133
<b>Business</b>	208	155	189	<b>Administration</b>	128	93	119
				<b>Finance</b>	47	45	40
				<b>Office</b>	33	17	30
<b>General</b>	99	53	83	<b>Arts &amp; Science</b>	84	40	70
				<b>Pre-Health</b>	10	9	9
				<b>Pre-Technology</b>	5	4	4
<b>Technology</b>	369	310	283	<b>Applied Science</b>	69	53	58
				<b>Computer</b>	77	59	58
				<b>Construction</b>	55	54	43
				<b>Electrical</b>	45	41	36
				<b>Mechanical</b>	123	103	88
<b>TOTAL</b>	<b>1102</b>	<b>557</b>	<b>928</b>		<b>1102</b>	<b>557</b>	<b>928</b>

*Mathematics Courses*

The programs included in the College Mathematics Project all have mathematics scheduled in the first semester of the curriculum. However some colleges require or encourage students to take a mathematics assessment and on the basis of their results assign them either to the regularly scheduled mathematics course or to a preparatory (or remedial) mathematics course. If students' achievement in mathematics in first semester is to be compared, then it is important to distinguish these two types of course.

Therefore in the CMP database, there are three parallel sets of data view:

<sup>3</sup> While CMP is only concerned with mathematics, a parallel study on English achievement is being conducted under the direction of the Colleges' Heads of English and CMP extracts data for both studies.

All math: students' achievement in all types of math courses  
Preparatory math: students' achievement in preparatory math courses only  
College math: students' achievement in college level mathematics courses

Unless otherwise specified in this report, data analyses are based on data from "all math" courses. Later analyses will examine achievement in preparatory and college-level mathematics.

*Grades*

Since all colleges have their own individual grading systems, the College Mathematics project has had to develop its own simplified system to which grades from all college data sets are transformed. These are also grouped together for analysis purposes into two groups, as follows.

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**Good Grades**

A	(includes A+ and A-)	80% - 100%
B	(includes B+ and B-)	70% - 79%
C	(includes C+ and C-)	60% - 69%
P	(used for courses with Pass/Fail grades)	

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**At Risk**

D	(includes D+ and D-)	50% - 59%
F		under 50%
W		withdrawal

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Many of the tables in the data section show achievement in terms of "good grades" and "at risk".

*Confidential Data*

Much of the data provided by colleges for the College Mathematics Project is confidential. CMP ensures student confidentiality by replacing all personal identifiers in the data set provided by the college with its own student number and then erasing the original student ID.

College and school board confidentiality is ensured by masking the actual names of colleges and school boards in displays of comparative data and by providing the key to each college and school board in relation to its own data.

This confidentiality procedure is based on the CMP Policy on Confidential Data, which was agreed by participating colleges and school boards; it is available on the CMP web site.

### **Research Highlights**

This section refers to the the companion document, *CMP 2008 Forum Backgrounder: Data Tables and Figures*. Data analyses reported there are not repeated here. Rather, this document comprises a brief commentary on the highlights of the data analyses contained in the tables and figures. It is divided into four sections corresponding to the research questions:

- Participation
- Mathematics Achievement in College
- Secondary School Mathematics Backgrounds
- School Boards and Schools

#### ***Participation***<sup>4</sup>

- Over 50,000 students' records were reviewed as part of CMP2008.
- Almost exactly equal numbers of males and females were included in the overall CMP sample; more females than males in Applied Arts, more males than females in Technology, and more equal numbers in Business and General clusters.
- Nearly 20,000 (38.8% of all students) take mathematics in first semester, over  $\frac{3}{4}$  of technology students and  $\frac{2}{3}$  of business students take math.
- Close to  $\frac{2}{3}$  of all students taking mathematics are Recent Ontario Graduates (ROGs).
- 7 of the 11 CMP colleges offer preparatory mathematics courses to some or all students; 2,659 students (13.5%) take such courses; 77.1% of these are ROGs.

#### ***Mathematics Achievement in College***<sup>5</sup>

- Distribution is bimodal (peaks at A and F).
- Non-ROG's achievement is significantly better than ROG's.
- Overall, 64.6% achieve "good grades" in mathematics and 35.4% are "at risk."
- Except for in Applied Arts, there s little variation in achievement across program clusters.

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<sup>4</sup> Tables 1 – 5, Figures 1 – 3

<sup>5</sup> Figures 4 – 9

- Achievement varies little between college-level and preparatory mathematics courses.
- There are significant differences among colleges in mathematics achievement with the percentage of students achieving good grades varying from 49.1% to 76.5%.
- These inter-college differences become even more pronounced when ROGs and non-ROGs are compared within both Business and Technology program clusters.

### **Secondary School Mathematics Backgrounds<sup>6</sup>**

- 560 distinct pathways are followed by ROGs through secondary school mathematics but over 400 of these are followed by fewer than 10 students. The analysis is based on the 123 pathways followed by over 80% of students that are based on *The Common Curriculum (2000)*.<sup>7</sup>
- Achievement of students who took “academic” mathematics courses in both Grades 9 and 10 is significantly better than those taking “applied” courses especially among students in the Technology program cluster.
- Approximately 10 times as many students took MAP4C in Grade 12 than MCT4C but only 55% achieved good grades, compared with 64% of those taking MCT4C.
- The choice of Grade 11 mathematics course is also significant with students taking MCF3M or MCR3U achieving significantly better in college mathematics.

### **School Boards and Schools<sup>8</sup>**

- Analysis of achievement based on all school boards from which students graduated is presented in the CMP database. Selections from this for each of the four regions where CMP Forums are being held are presented in this Backgrounder.
- Average achievement of the 8,432 graduates of 14 GTA school boards is very similar to that of the province as a whole, but there is significant difference among boards, with the percentage achieving good grades varying from 49.0% to 68.2%.
- Average achievement of the 2,174 graduates of 8 boards in the Golden Horseshoe region is very slightly lower than that of the province as a whole; percentages of students achieving good grades vary from 49.0% to 65.7%
- Average achievement of the 1,007 graduates of 8 boards in the Eastern Ontario region is very slightly lower than that of the province as a whole; percentages of students achieving good grades vary from 51.4% to 70.4%.

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<sup>6</sup> Table 6 and Figures 10 – 12

<sup>7</sup> Students whose records are included in CMP2008 had completed secondary school before the current mathematics curriculum was fully implemented. CMP2009 will be the first in which graduates of the recently revised curriculum can be compared with those of the previous one.

<sup>8</sup> Figures 13 – 16

- Average achievement of the 340 graduates of 6 boards in the Northwestern Ontario region is significantly better than that of the province as a whole; percentages of students achieving good grades vary from 61.9% to 81.1%.

### **Questions for Deliberation**

The research data themselves cannot lead directly to prescriptions for action and the deliberative forums to be held in the coming weeks are where that will be the focus. Nonetheless the research can suggest questions for the deliberations and the CMP project team proposes the following. They are divided into four sections corresponding to the four planned forum discussion groups.

#### ***Curriculum Group***

1. Which outcomes from the study have the greatest impact for you? Why?
2. What are the implications of the CMP results for the college mathematics curriculum content in:
  - a. applied arts programs
  - b. business programs
  - c. general programs
  - d. technology programs?
3. What are the implications of the CMP results for the design of an assessment tool? Assessment for placement? (i.e., What is the key content? What are the key processes?)
4. What is the evidence that placement testing and preparatory courses in mathematics are beneficial?
5. What strategies/initiatives can help students be better prepared for college mathematics?
6. What modifications to content and pedagogy could help smooth transitions between secondary school and college?
7. Are there strategies that could be put into place between secondary schools and colleges which could provide the seamless transition for students as proposed by the study? What would these look like? How can these strategies be implemented? Measured?
8. What recommendations would we like to make based on the results of this study?

***At-Risk / Student Success Strategies Group***

1. What do we mean by “at-risk” in the context of this study?
  - for secondary students:
  - for college students:
2. What is the profile of a college bound student? What should it be?
3. What do the CMP results (to date) mean for students who are entering College programs?
4. Which college strategies have been shown to be most successful at increasing student success in mathematics? How should these be measured?
5. Specifically, what are the costs and benefits of placement tests and mandatory remedial math courses?
6. What recommendations would we like to make based on the results of this study?

***Career-Guidance Discussion Group***

1. How do we ensure that students are made aware of the best choices for them?
2. How do we ensure that the courses most critical for student success are offered?
3. To what extent do students choose courses based on their expected postsecondary destination? What other factors are involved?
4. To what extent is any of the guidance for course selection supported by empirical data of any kind?
5. How well do you feel you are informed about careers that colleges prepare their grads for?
6. What additional information do guidance teachers need in order to be able to assist students headed for college programs?
7. What recommendations would we like to make based on the results of this study?

***Provincial, Boards and Colleges Discussion Group***

1. What are the advantages/disadvantages of having a wide diversity across the Colleges in the following areas:
  - Admissions policies
  - Placement testing (in mathematics)
  - Preparatory (remedial) courses (in mathematics)
  - Grading policies
  - Content and structure of first semester mathematics courses
  - Support systems for at-risk students
2. CMP is able to provide systematic feedback to high schools concerning the success of their graduates in postsecondary education. How helpful is this to schools and to what extent should it be expanded?
3. What responsibilities, if any, do the Ministries of Education and Training Colleges and Universities have to increase student success at College.
4. In what areas are inter-college or inter-school board comparisons (a) helpful and (b) counter-productive? How do these answers differ if the comparisons are also made public?
5. What information arising from this study do students and their parents most need to have access to?
6. What are the lessons you take back from this Forum to your own institution?
7. What recommendations would we like to make based on the results of this study?