YSIMSTE

York - Seneca Institute for Mathematics, Science and Technology Education

COLLEGE MATHEMATICS PROJECT 2008

FINAL REPORT

For the

Ontario Ministry of Education

and the

Ontario Ministry of Training, Colleges and Universities

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Executive Summary

The College Mathematics Project (CMP) is a collaborative program of research and deliberation concerning mathematics achievement of first-year college students in Ontario. Its goals are:

- 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.

Funded by the Ministry of Education and the Ministry of Training, Colleges and Universities, and led by a team of researchers from the York-Seneca Institute for Mathematics, Science and Technology Education (YSIMSTE) based at Seneca College, CMP 2008 included 11 colleges and many district school boards in four regions of the province.

The CMP employs the overall methodology of deliberative inquiry, in which research into the current situation is linked to deliberations among stakeholders over appropriate courses of future action. The CMP 2008 research analysed the secondary school and college records of over 50,000 students who enrolled in all program areas of the 11 colleges in fall 2007. Of these, nearly 20,000 took a first-semester mathematics course and the research focused on their achievement in these courses, relating this to a variety of factors, including the choice of mathematics courses taken at secondary school.

Highlights of the research include the following:

- Only 65% of students achieved "good grades" (A, B or C) in first-semester mathematics in college, while 35% received grades of D or F or withdrew from the course, placing them at risk of not completing their chosen program.
- Recent Ontario graduates (students under the age of 23 on December 31, 2007 *and* who graduated from an Ontario secondary school) formed 68% of first-semester mathematics students.
- Only 62% of recent Ontario graduates (ROGs) achieved good grades, compared with 71% of older students or those from outside Ontario.
- While males outnumber females in first-semester mathematics by almost 2:1, females out-perform males in both ROGs and non-ROGs.
- Achievement patterns in college mathematics are very similar to those of college English.
- Choices of school mathematics courses and achievement in the chosen courses have a major impact on first-semester college achievement. For example:

  - Over 70% of students with Grades 9 and 10 Academic Mathematics achieved good grades but fewer than 50% of those with Grades 9 and 10 Applied Mathematics did so;
  - Nearly 50% of students taking the most common sequence of college preparation mathematics courses (MBF3C at Grade 11 and MAP4C at Grade 12) were found to be "at risk" when they reached the college level – this rose to over 50% for students enrolled in Technology programs;
  - 75% of students with high achievement (over 80%) in MAP4C were successful in college mathematics;
  - Only 525 students out of 14,676 students (3.6%) took MCT4C in Grade 12 but 63.6% of these achieved good grades in college mathematics;
  - Course selection for Grade 11 mathematics was at least as important as that for Grade 12.
- CMP results also provided systematic feedback to all participating school boards and all secondary schools within those boards about the success of their graduates in first-semester college mathematics.

Following completion of the research, the CMP held four deliberative forums (in the Greater Toronto Area, Ottawa, Hamilton, and Thunder Bay), in which representatives of participating colleges and school boards, along with provincial organizations, received reports of the CMP research and listened to panels of students describing their own mathematics experiences at school and college. They also discussed ways of improving student achievement, and examined a range of initiatives that had been implemented by the institutions. From these deliberations, the CMP team concludes that there is a consensus:

- That student achievement in first-semester mathematics in Ontario colleges needs to be significantly improved;

- That the achievement of this goal requires concrete action by all stakeholders, including students and parents, school boards, schools and teachers, colleges and faculty, and the Government of Ontario.

The report of CMP 2008 concludes with a discussion of four themes that emerged from these deliberative Forums:

- Accountability for Learning
  Students' becoming accountable for their own learning and demonstrating appropriate skills and attitudes is key to their success in college and beyond. Yet in school, such "Learning Skills" are often perceived as less important than the achievement of the formal expectations of the curriculum.

- Talking Together about Mathematics Teaching and Learning

Teachers in secondary school and college often have little knowledge or experience of each others' classroom situations. It is as if they lack a common "language" to support a useful discourse about each others' curriculum and pedagogy.

- Pathways to Success in College Programs
  Parents, students and teachers are confused about the expectations colleges have for their students and the appropriate mathematics pathways leading to the wide variety of college programs.

- Focus on the School/College Interface
  A K-16 vision of student success in policies and programs (i.e. one that spans the secondary/ postsecondary interface) is required to achieve the goals of student success of the Government of Ontario.

Within each of these four themes, recommendations are made for students and their parents, secondary schools and teachers, colleges and college faculty, and the Government of Ontario.

Chapter 1: Introduction to CMP

Mathematics is a critically important foundation for many occupations, particularly those in the business, and technology fields. For this reason, courses in mathematics are found in the first semester curriculum of most business and technology programs at Ontario Colleges of Applied Arts and Technology. However, the College Mathematics Project has found that one-third of all students in these programs are either failing or barely passing mathematics.[1] These students are at risk of not completing their chosen programs, an outcome with negative consequences not only for the students, but also for colleges, taxpayers, and the Ontario economy.

The College Mathematics Project (CMP) was set up at Seneca College in 2005 because of a general awareness within the colleges of this problem. Following two pilot projects in which data collection methods were developed and refined, the first full-scale CMP was mounted in 2007 involving 20,000 students at 6 colleges in the Greater Toronto Area.[2] Researchers from the York/Seneca Institute for Mathematics, Science, and Technology Education (YSIMSTE) based at Seneca College conducted the research, and representatives from both colleges and school boards in the GTA participated in deliberations that led to the project's first published set of conclusions and recommendations.

In 2008, the project has expanded once again, this time to include 50,000 students at 11 colleges in various parts of the province and the district school boards in the immediate areas of these colleges[3]. Following data collection and analysis, four regional forums were held at which over 300 participants discussed the implications of the CMP research and were informed by shared best practices and students' perspectives on the issues raised. Participants then spent time in deliberating how to improve student success in college. This report is the culmination of this process.

CMP Goals and Methodology

The goals of the College Mathematics Project are unchanged from previous years:

- To analyse the mathematics achievement of first-semester college students, particularly in relation to their secondary school mathematics backgrounds;

[1] Laurel Schollen *et al*. *College Mathematics Project 2007: Final Report* (Toronto: Seneca College, 2008). The report can be downloaded from the CMP web site: http://collegemathproject.senecac.on.ca

[2] CMP 2007 and the second pilot study were supported by the Connecting GTA Teachers regional planning team of the School/College/Work Initiative.

[3] 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.

- To deliberate with members of both college and school communities about ways to increase student success in college mathematics.

The methodology used for the CMP is called "Deliberative Inquiry"[4]. It is a cyclical methodology (see Figure 1) designed for integrating research with deliberations about future courses of action. The questions for inquiry (2) are derived from deliberations about the problems of practice (1) and deliberations are based on questions (5) emerging from the research. The cycle of inquiry and deliberation continues, drawing ideas from existing theory (3), generating recommendations for practice (6), and contributing further ideas to theory (4).

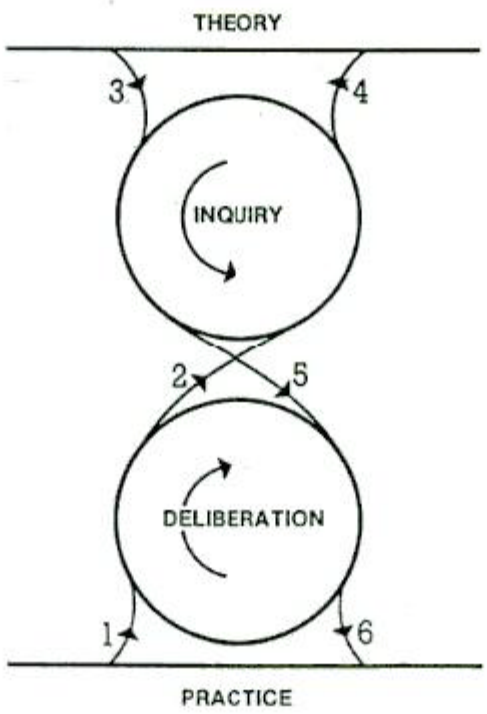


Figure 1. **Deliberative Inquiry - the CMP Methodology**

In the case of the CMP, each year the project continues, new suggestions for research emerge from the previous year's deliberations and from new theoretical perspectives. At the same time, the recommendations from one year contribute to changes of practice in the next. Research enables practice to evaluate the efficacy of interventions so that progress can be measured year over year. And so the cycle continues.

[4] Graham Orpwood, Laurel Schollen and Margaret Sinclair. "Deliberative Inquiry into College Mathematics". *Journal of Applied Research in Learning*, submitted for publication, 2008.

The CMP is directed by a steering committee made up of representatives of participating colleges and school boards, supporting Ministries, and related provincial organisations. This committee met three times during 2008: its first meeting in March approved the research questions for the CMP to address this year; the second (in June) planned the Deliberative Forums to take place in the Fall; and the final meeting (in September) reviewed the preliminary results of the CMP research prior to their being sent to Forum participants.

Data Collection and Analysis

All data used in the CMP is obtained from participating colleges. The principal data sources include students' secondary school transcripts as provided to colleges from the Ontario College Application Services (OCAS) and students' first semester grades in mathematics courses. These files are combined and student identifiers are then removed in order to ensure student anonymity[5]. Finally, the data is validated by each college prior to its being mounted on a web-based database, from which more specific analyses can be made.

CMP 2008 Research Questions

The research questions addressed by the CMP this year addressed and further developed the same four areas of interest used in CMP 2007 – information about the participants, distribution of marks in first semester college math, relationship between college achievement and secondary school mathematics background, and relationship between a student's first semester math achievement and the secondary school from which he/she came. The questions were:

A. ***PARTICIPATION***

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

A2. What are the numbers of students under the age of 23 (December 31, 2007) and who are recent graduates of Ontario secondary schools (ROGs) by college, gender, and program cluster?

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

[5] CMP has a policy on data confidentiality available on its web site (http://collegemathproject.senecac.on.ca) and the research methodology has been given ethics reviews by participating colleges.

B. COLLEGE MATHEMATICS ACHIEVEMENT

Note 1: These apply to all students taking mathematics courses (as shown in A3)

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

B3. What is the % of students "at risk" (D, F, and W) for ROGs and non-ROGs, by course type, college, gender, and program cluster?

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

C. SECONDARY SCHOOL MATHEMATICS BACKGROUNDS

Note 1: These apply to ROGs taking mathematics only (as shown in A3)

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 (50-59, 60-69, 70-79, 80 and over) compare with their college math marks (good grades, at risk)?

D. COLLEGE ACHIEVEMENT BY SCHOOL BOARD AND SCHOOL

Note 1: These apply to ROGs taking mathematics only (as shown in A3)

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

Analysis of the CMP data has been based on these questions and is documented in Chapter 2 of this report.

College Programs and Policies

Academic programs and policies in Ontario's Colleges of Applied Arts & Technology have developed relatively independently of each other over the 40 years since the colleges were founded. However all policies and procedures must adhere to the overall framework, directives and policies established by the Ministry of Training, Colleges and Universities, which has ultimate accountability for the Ontario college system. Research that collects data across the college system must therefore document programs from each college separately to establish comparability. In addition, grading policies differ across the system as does the provision of remedial or preparatory courses in mathematics, both of which require college by college analysis in order that aggregation of data can be carried out in a meaningful way. The sections that follow describe the systems of program clustering and grade equivalency that have been developed for use in the CMP as well as an overview of college admissions and placement policies.

Program Clusters

The Ministry of Training, Colleges and Universities has a system of 5-digit codes to identify college programs and to link them to published program standards (where these exist). These codes also enable the CMP to compare programs from different colleges regardless of the program names used locally. The CMP clusters all programs from participating colleges into four major clusters, each of which is subdivided into sub-clusters, as shown in Table 1. This clustering ensures comparability of the aggregate analysis across colleges and also affords researchers opportunities to "drill down" further into the data to investigate achievement at the sub-cluster and program level.

Table 1.

CMP System of Program Clusters

Major Cluster	Sub-clusters
Applied Arts (AA)	Applied Arts
	Human Services
	Health Services
	Hospitality & Tourism
Business (B)	Accounting & Finance
	Business Administration & Management
	Office Administration
General (G)	General Arts & Science
	Pre-Health
	Pre-Technology
Technology (T)	Applied Science
	Computer
	Construction
	Electrical
	Mechanical

It should be noted that the CMP major clusters are consistent with those published on the MTCU website, with the exception of the Applied Arts cluster. In this case we have grouped the MTCU clusters "Applied Arts, Human Services, Health Services and Hospitality & Tourism" together to form the Applied Arts major cluster.

Admissions and Placement Policies

All colleges must comply with Ministry of Training, Colleges and Universities Binding Policy Directives. The directive concerning admissions criteria provides a clear and consistent method that colleges must use when considering applicants to all college programs. These general criteria are outlined in the *Ontario Colleges of Applied Arts and Technology Act, 2002*[6].

The basic requirement for consideration for admission to post secondary programs in the Ontario college system is the Ontario Secondary School Diploma (OSSD) or equivalent. The OSSD requires that students have one senior (Grade 11 or 12) mathematics course for graduation however colleges may stipulate a requirement for Grade 12.

Colleges may admit a student under a *Mature Adult Admission* provision when the student lacks a secondary school diploma or equivalent, and is 19 years of age or more on or before the start of classes. Students admitted under mature status must demonstrate proficiency in meeting specific program admission requirements. Depending on the college, this may be accomplished through equivalency testing, academic upgrading courses or if the student obtained the necessary academic credits during their secondary schooling.

Colleges may also publish additional admission and selection criteria if the program has particular academic focus (for example, the requirement for a senior level chemistry and biology credit for a biotechnology program), is in a specialized field (for example, the requirement for a medical examination, police reference check), or is over subscribed. Students may be required to submit a portfolio, résumé, or complete a questionnaire. The ministry requires that program specific criteria be relevant to the program of study and be measurable.

In all cases the ministry requires that college admission practices be objective and transparent. Colleges are not allowed to include university preparation courses or Ontario Academic Courses with the exception of applied degree and integrated collaborative degree programs as part of their admission requirements[7], however a university preparation (or university/college preparation) course may be accepted in lieu of a college preparation course. The CMP2007

[6] Ontario Colleges of Applied Arts and Technology Act, 2002 Ontario Regulation 34/03 http://www.e-laws.gov.on.ca/html/regs/english/elaws_regs_030034_e.htm

[7] Ontario Ministry of Training, Colleges and Universities. Colleges of Applied Arts and Technology Policy Framework 3.0. Programs Admissions Criteria - Minister's Binding Policy Directive.

study found this practice takes place to a great extent - a large percentage of first semester college students had taken U level mathematics courses.

Consistent with our findings, the "2007 College Applicant Survey – Final Report" found that 25% of direct entry, 13% of delayed entry, 26% of post secondary education transfer students, and 21% of applicants with previous post secondary education had taken university preparation mathematics courses, however applicants are more likely to have taken college level mathematics than university level[8]. Given the patterns of enrolment shown in our research, these courses are most likely to be MBF3C and MAP4C.

The report also noted that while 71% of applicants applied only to an Ontario College about 1 in 6 also apply to a university in Ontario or in another Canadian province.[9] Colleges are competing with universities for this group of students and are losing ground. King and Warren, noted in their 2006 report "Transition to College: Perspectives of Secondary School Students" that "the expansion of the universities to accommodate the "double cohort" in combination with an increase in the proportion of students meeting university admission had the effect of increasing the proportion of students attending university..."[10] King and Warren also observe "Since it is unlikely that the universities' share of the age cohort will decline, if the colleges are to expand to meet the identified needs of Ontario's economy then (1) secondary school graduation rates must increase substantially, (2) a greater proportion of students must choose to attend college, and (3) more young people who have left secondary school without graduating must re-enter the educational system."[11] Capacity exists in the university system at the same time the demographic of the direct from secondary school age group is predicted to decline. King has noted that universities typically set program targets and adhere to them regardless of variation in applicant numbers. This means that grade cut offs "float" from year to year; it can be speculated that in years where applicant numbers are higher than expected that grade cut offs may be higher. In such cases, students applying to both college and university may not be accepted to university and therefore would be expected to attend college (depending on their grades). Similarly in years where applicant numbers are decreased, the cut off may be adjusted accordingly and students who have applied to both college and university may be accepted at university and will elect to attend university. For this reason one cannot look at college admissions independent of universities.

The binding policy directive also speaks to the practice of weighting courses: "To ensure consistency and to adhere to the destination-based objective of the new secondary school

[8] *2007 College Applicant Survey™ Final Report* by the Academica Group. Report to Colleges Ontario
[9] Ibid.
[10] King, A.J.C. and Warren, W.K.."Transition to College: Perspectives of Secondary School Students" *Full Report Colleges Ontario, 2006.*
[11] Ibid.

curriculum, the practice of weighting between university (U) and university/college (U/C) and college (C) courses in the new curriculum is not appropriate when making admissions decisions."[12] This last point is germane to our discussion of secondary school pathways, and achievement in first semester college mathematics.

The programs selected for detailed study in the CMP all have mathematics scheduled in the first semester of the curriculum[13]. The mathematics courses themselves vary both across colleges and across programs within a college. Some aspects of this variety were the subject of detailed CMP study in 2006 and 2007 but with the overall growth of CMP this aspect of the research has had to be curtailed.

Furthermore, some colleges require or encourage new students to take a post-admission mathematics assessment test and, on the basis of their results, place them either in the regularly scheduled mathematics course or in a preparatory (or remedial) mathematics course. For comparability purposes, therefore, the CMP distinguishes between these types of courses and the CMP database contains three parallel sets of data view:

- All Math: students' achievement in both 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, analyses are based on the combined data from all types of mathematics course.

Grading Policies

We have noted in earlier reports that, since all colleges have their own grading systems, the College Mathematics project has – for the purposes of aggregating achievement data across multiple colleges – developed its own simplified system of grades, to which grades from all college data sets are transformed. The final report of the CMP 2007 study contained a full discussion of this issue[14] and this is not repeated here. The CMP grading system is shown in

[12] Ontario Ministry of Training, Colleges and Universities Colleges of Applied Arts and Technology Policy Framework 3.0 Programs Admissions Criteria Minister's Binding Policy Directive.

[13] In a few colleges, some programs have the first mathematics course scheduled in the second semester curriculum. However, since the CMP only collects data following first semester, we are unable to include these programs in our analyses.

[14] Laurel Schollen et al. *College Mathematics Project 2007: Final Report*. (Toronto: Seneca College of Applied Arts & Technology, 2008), pp 10-13.

Table 2 and the detailed comparison of this system with that of each participating college is available on the CMP web site[15].

In addition, CMP has found from earlier studies that a D grade in first semester mathematics is often followed by a student dropping out or changing programs. We therefore classify D grades along with F and W as evidence that students are "at risk" of not completing their chosen program.

Table 2.
CMP Grading System

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

The CMP 2008 Student Cohort

The student cohort that has been studied this year entered college in the fall of 2007. The CMP Data Collection Protocol called for the records of all students in postsecondary programs including Ontario College Diploma, Ontario College Advanced Diploma and Ontario College Certificate programs. The study did not include students enrolled in applied degree, Ontario graduate certificate or apprenticeship programs (as these programs have different admission and curriculum standards). This section of the report contains a description of this cohort in terms of program cluster, gender, participation in first semester mathematics courses, and secondary school background.

Enrolment by Program Cluster and Gender

The eleven colleges participating in the CMP 2008 offer a total of 1102 postsecondary programs[16] in which over 50,000 students are enrolled – approximately equal numbers of

[15] http://collegemathproject.senecac.on.ca
[16] CMP investigates all postsecondary diploma and certificate programs except applied degree, post diploma and apprenticeship programs.

males and females – as shown in Table 3[17]. As noted earlier, not all college programs contain a mathematics course in first semester. Of the 1,102 programs reported by the participating colleges, 557 included a mathematics course in first semester, as shown in Table 4. Nearly 20,000 students are enrolled in these mathematics courses and it is their records of achievement that are the focus of study in the CMP.

Table 3.

Programs and Enrolments by Program Cluster

Cluster	Programs	Enrolment	Males	Females	% M	% F
Applied Arts	426	25,566	9,179	16,387	35.9%	64.1%
Business	208	9,602	5,096	4,506	53.1%	46.9%
General	99	4,842	1,951	2,891	40.3%	59.7%
Technology	369	10,576	8,922	1,654	84.4%	15.6%
TOTAL	**1,102**	**50,586**	**25,148**	**25,438**	**49.7%**	**50.3%**

Table 4.

Programs with 1st Semester Mathematics

Cluster	Programs	Enrolment	Males	Females	% M	% F
Applied Arts	39	2,292	903	1,376	39.4%	60.6%
Business	155	6,460	3,492	2,953	54.1%	45.9%
General	53	2,725	1,010	1,714	37.1%	62.9%
Technology	310	8,493	7,422	1,057	87.4%	12.6%
TOTAL	**557**	**19,970**	**12,827**	**7,100**	**64.2%**	**35.8%**

Comparison of Tables 3 and 4 also shows that while male and female enrollments in college are almost identical, male enrolment in programs containing mathematics is much higher than female enrolment, since the programs most favoured by females (such as Applied Arts major cluster which includes programs in hospitality and tourism, health and human services and applied arts) are much less likely to contain mathematics than programs chosen more often by male students (such as Technology).

Enrolment by Secondary School Background

The CMP is interested in analyzing mathematics achievement in light of students' secondary school backgrounds. For this purpose, we distinguish between students aged 23 or under (as of December 31, 2007) who have graduated with an Ontario Secondary School Diploma (OSSD)

[17] The combined number of males and females is less than the total because gender was not identified on some records.

from those who are either older or who have graduated from secondary schools in other jurisdictions. The former group are designated Recent Ontario Graduates (ROGs) and the latter non-ROGs in the analyses contained in this report. ROGs represent slightly more than two-thirds of overall college mathematics enrolment (see Table 5). Gender representation within the ROG group is very similar to that of the overall mathematics enrolment.

Table 5.

Mathematics Enrolment: Recent Ontario Graduates (ROGs)

Cluster	Overall	ROGs	Males	Females	% M	%F
Applied Arts	2,292	1,576	651	919	41.3%	58.7%
Business	6,460	4,510	2,538	1,964	56.3%	43.7%
General	2,725	1,853	690	1,162	37.2%	62.8%
Technology	8,493	5,712	5,105	659	89.4%	10.6%
TOTAL	**19,970**	**13,651**	**8,984**	**4,704**	**65.8%**	**34.2%**

Enrolment by Type of Mathematics Course

As noted earlier, preparatory or remedial mathematics courses are available to some students in some programs at some colleges. Of the eleven CMP colleges, four do not have remedial mathematics courses in any programs, six offer preparatory courses in some program areas but not others, and only one offers preparatory mathematics courses to students in all programs. As Table 6 shows, 13.3% of all students taking first-semester mathematics are taking a preparatory course, the proportion being somewhat higher for ROGs than for non-ROGs.

Table 6.

Preparatory (Remedial) Course Enrolments

Cluster	*All Ss*	*Remedial*	*% of All Ss*	*ROGs*	*% of all ROGs*
Applied Arts	2,292	181	7.9%	77	4.9%
Business	6,460	1,193	18.5%	1,005	22.3%
General	2,725	487	17.9%	358	19.3%
Technology	8,493	803	9.5%	613	10.7%
TOTAL	**19,970**	**2,664**	**13.3%**	**2,053**	**15.0%**

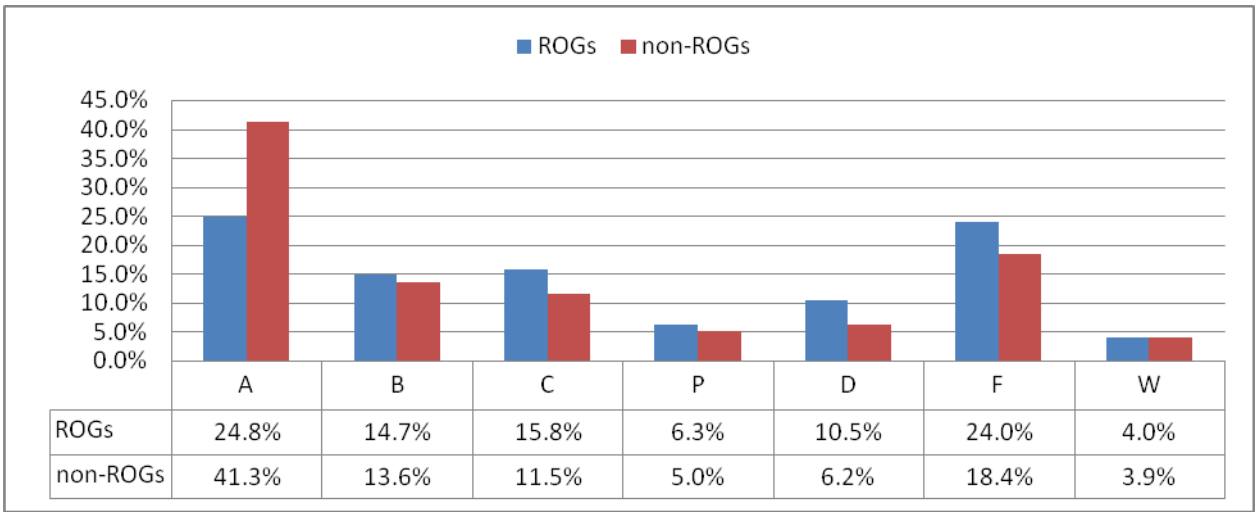
The largest proportion of students taking preparatory mathematics is in the Business program cluster, where four of the eleven CMP colleges offering remedial math. In those colleges, an average of 34.9% of first semester Business students (41.1% in the case of ROGs) takes remedial mathematics. In the Technology program cluster, seven colleges offer remedial mathematics, with an average of 17.1% of Technology students enrolled (17.8% in the case of ROGs)[18].

[18] These percentages are based on the enrolments on colleges offering preparatory mathematics courses only.

Chapter 2: Research Results

Mathematics Achievement at College

When all students' grades in first semester college mathematics courses are analysed (as in Figure 2), two features become immediately evident. First, the distribution is found to be bi-modal; there are two peaks, one at the A grade level and one at the F level. Second, those who are *not* Recent Ontario Graduates (non-ROGs) show a systematically higher level of achievement (e.g., more A grades and fewer Failing grades) than ROGs. This pattern is almost identical to the corresponding pattern shown in CMP 2007 and grade distributions for each Program Cluster follow the same pattern also.



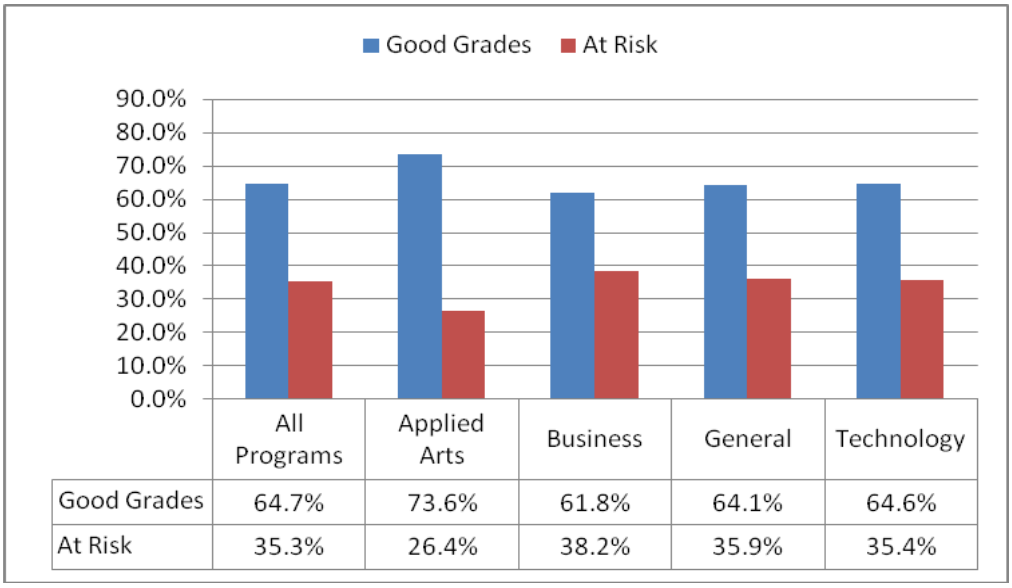
	A	B	C	P	D	F	W
ROGs	24.8%	14.7%	15.8%	6.3%	10.5%	24.0%	4.0%
non-ROGs	41.3%	13.6%	11.5%	5.0%	6.2%	18.4%	3.9%

***Figure 2*. Grade Distribution, ROGs and non-ROGs (n=19,970)**

As in our previous research reports, the CMP refers to achievement at the A, B, & C grade levels as "Good Grades" and describes achievement at the D, F and W levels as placing students "At Risk". When the grade distribution shown in Figure 2 is condensed to these categories we find that 64.7% of all CMP 2008 students received good grades, while 35.3% were found to be at risk.

Achievement by Program Cluster

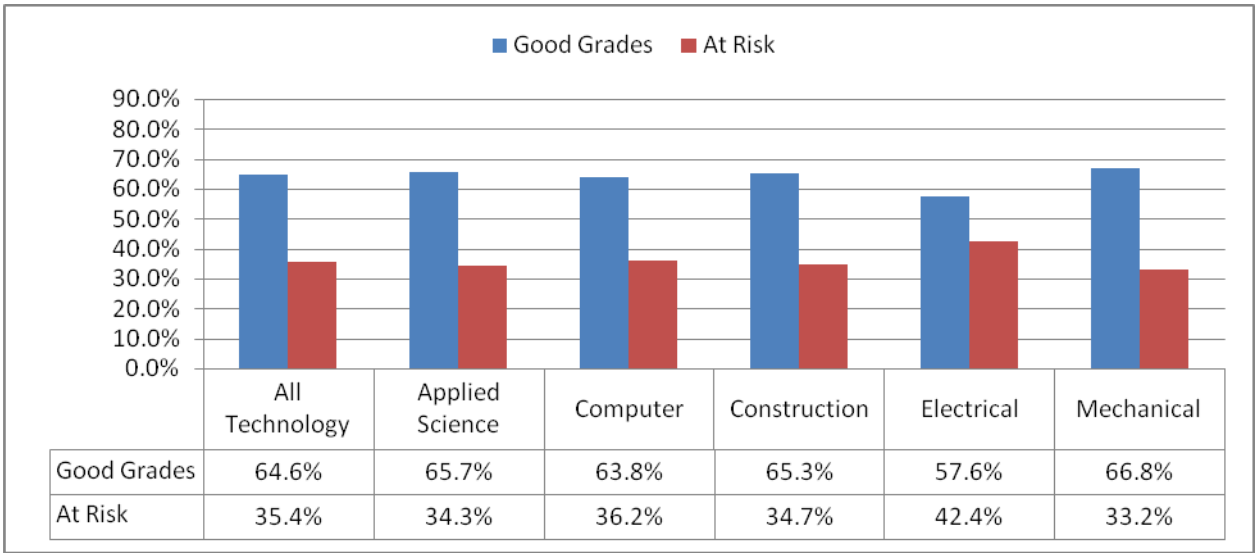
Figure 3 shows this analysis for all Programs and for each of the four Program Clusters. Except for Applied Arts programs, the pattern of mathematics achievement across program clusters appears very similar.



	All Programs	Applied Arts	Business	General	Technology
Good Grades	64.7%	73.6%	61.8%	64.1%	64.6%
At Risk	35.3%	26.4%	38.2%	35.9%	35.4%

Figure 3. **Achievement by Program Cluster**

However, drilling down into the program clusters can sometimes show significant variations among sub-clusters and at the individual program level. For example, when the five Technology sub-clusters are compared (as in Figure 4), lower levels of mathematics achievement can be seen in the electrical sub-cluster. The implications of these variations for mathematics course development would be an interesting topic for further research.

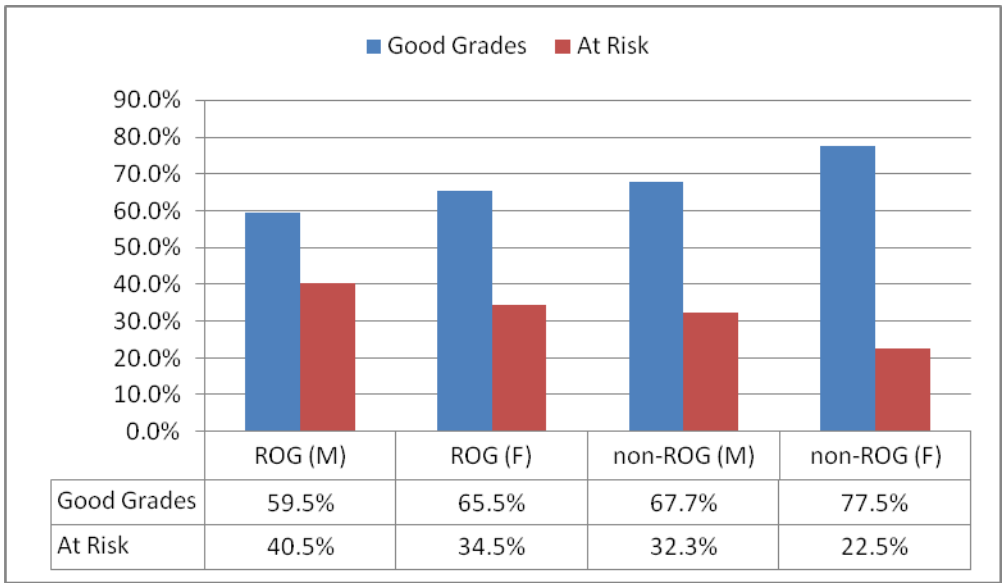


	All Technology	Applied Science	Computer	Construction	Electrical	Mechanical
Good Grades	64.6%	65.7%	63.8%	65.3%	57.6%	66.8%
At Risk	35.4%	34.3%	36.2%	34.7%	42.4%	33.2%

Figure 4. **Achievement by Technology Sub-Cluster**

Achievement by Gender and Student Type

The CMP data allows for comparison of achievement by the all the variables identified earlier: gender, student type (ROG/non-ROG), course type (preparatory/college-level), and college. Figure 5 provides an analysis of achievement by gender and student type.



	ROG (M)	ROG (F)	non-ROG (M)	non-ROG (F)
Good Grades	59.5%	65.5%	67.7%	77.5%
At Risk	40.5%	34.5%	32.3%	22.5%

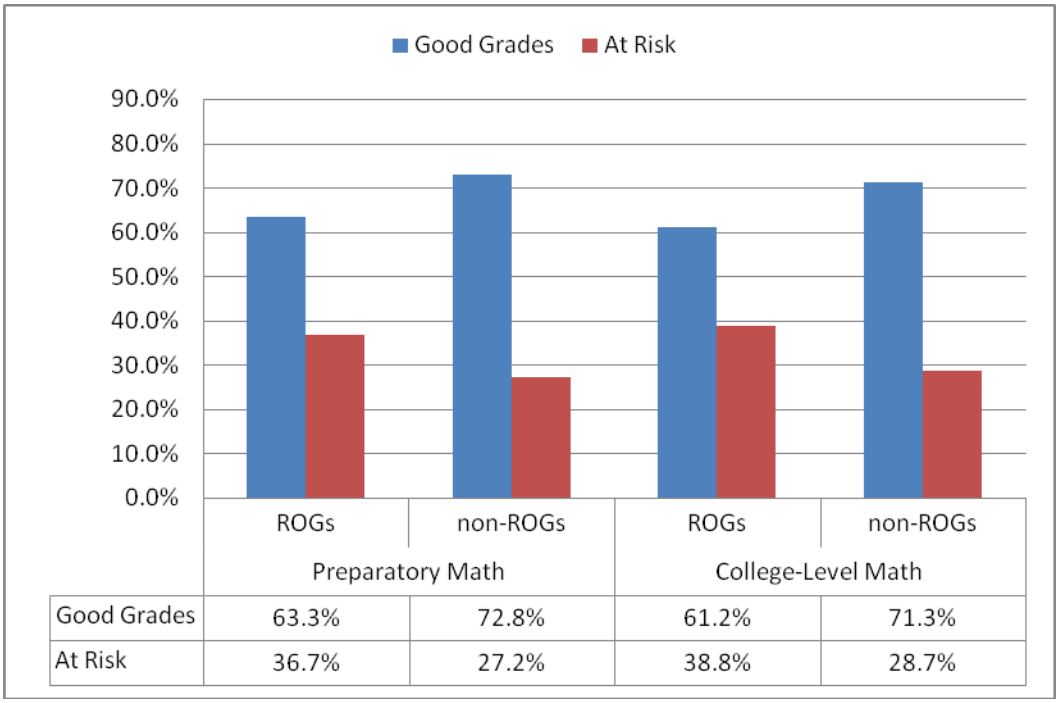
Figure 5. **Achievement by Student Type and Gender**

It is interesting to note that achievement by females surpasses that of males both among ROGs and non-ROGs. We have already seen that non-ROGs out-perform ROGs in first semester mathematics. Readers should note that the "non-ROG" group contains two overlapping sub-groups: students over the age of 23; and students from secondary schools outside Ontario. This makes interpretation of the differences in achievement between ROGs and non-ROGs difficult. An extension of this analysis that could be explored in future years would be the further analysis of the non-ROG group to examine achievement of each of the two sub-groups.

Similarly, gender-based differences are hard to interpret. It is not unusual that females outperform males, even in mathematics. It is interesting to note that the gender difference with non-ROGs is greater than it is with ROGs, reflecting (in the view of some Forum participants) the sacrifice made by mature females returning to the workforce. Further study of these sub-groups would be interesting although additional data would be required to obtain answers to some of these intriguing questions.

Achievement by Course and Student Type

Figure 6 shows achievement analysed by the type of mathematics course (Preparatory v. Regular College-level) and student type (ROG v. Non-ROG).



	Preparatory Math		College-Level Math	
	ROGs	non-ROGs	ROGs	non-ROGs
Good Grades	63.3%	72.8%	61.2%	71.3%
At Risk	36.7%	27.2%	38.8%	28.7%

Figure 6. **Achievement by Course and Student Type**

While, in principle, it makes sense to treat achievement in preparatory (remedial) mathematics courses quite separately from achievement in college-level courses, we find in practice that achievement is relatively similar in both types of course. Offering preparatory courses for students whose mathematics preparation does not appear to be adequate to meet the standards of college-level courses is a strategy employed by only some colleges and more specifically, by some program areas within those colleges. Thus, CMP analysis of preparatory course achievement separately gives a picture that is not generally representative of the broader CMP cohort. Individual colleges are of course able to use their own CMP data to conduct these analyses.

In particular, the question to which everyone would appreciate a definitive answer is: Are preparatory courses effective at enabling students to meet the requirements of their chosen programs? And this question cannot be answered through the CMP's current data collection methods since second-semester data for those students taking a preparatory course in first semester would also be needed.

Achievement by College

Figure 7 shows the variation in achievement across participating colleges for all programs and for Business, and Technology Programs. While there is significant variation across the college system, the mix of programs and students at each college in the system makes interpretation of this variation very problematic.

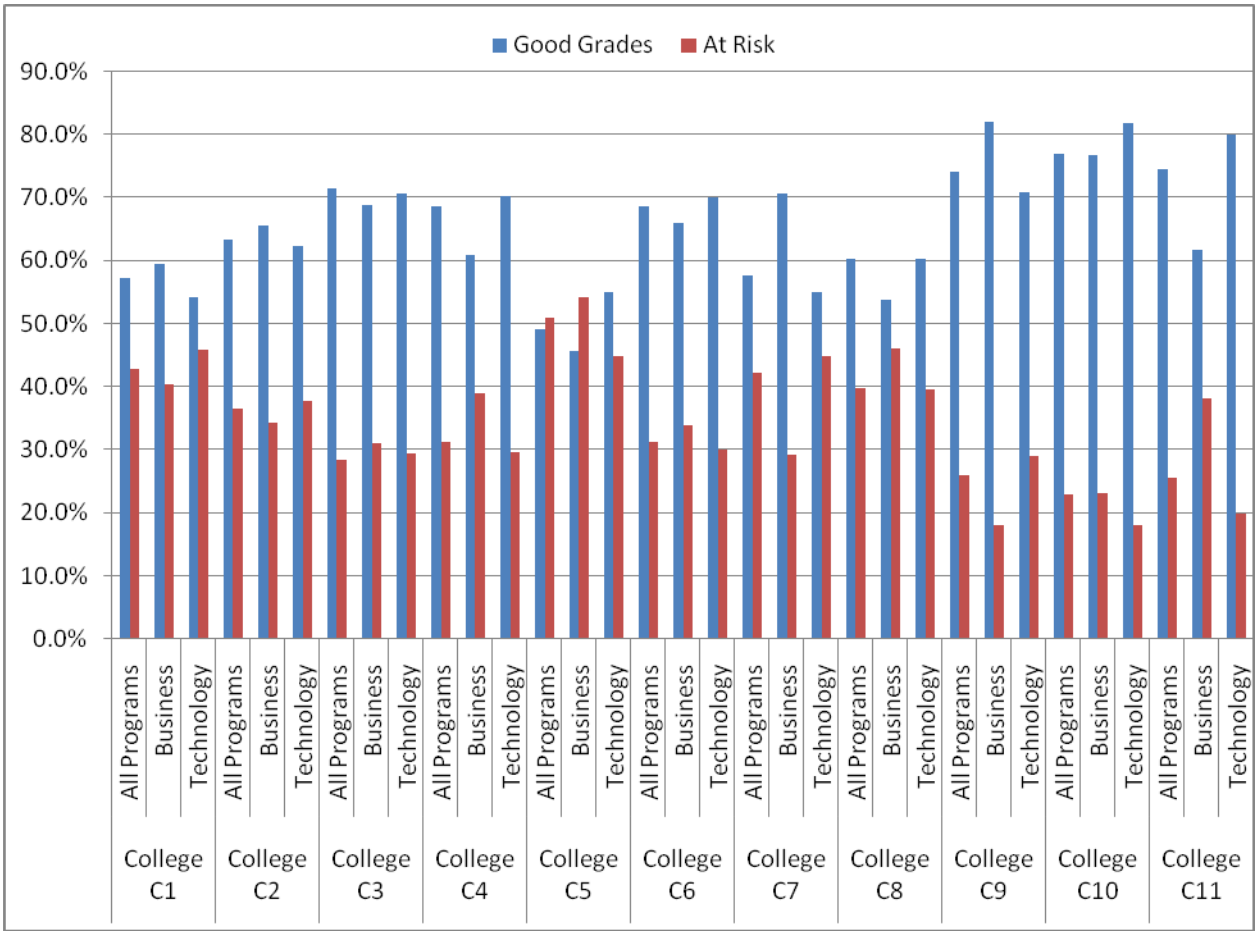


***Figure 7*. Achievement by College: All programs, Business programs & Technology programs**

In this situation, inter-college comparisons are probably of less value than are comparisons of achievement at a given college over time. Since the CMP has yet to build up a longitudinal and comprehensive database, this will not be possible until data covering several years are available. In the meantime, the CMP does not encourage the use of this analysis as an indicator of the quality of any college or of the school boards whose graduates are enrolled there.

Achievement in Mathematics and English

Participants at CMP Forums in earlier years had suggested that it would be informative to investigate the relationship, if any, between college students' achievement in Mathematics and English. Since CMP data collection includes grades in all first semester courses, such a comparison was relatively straightforward and is presented in Table 7. From this analysis, we can see, for example, that 10.7% of all students received an A grade in both Mathematics and English and 12.3% failed both, and that a relationship appears to exist between achievement in the two subject areas.

Table 7.

Achievement in Mathematics and English

		COLLEGE MATHEMATICS GRADES					
		A	**B**	**C**	**P**	**D**	**F**
COLLEGE ENGLISH GRADES	**A**	10.7%	3.0%	2.0%	1.3%	0.8%	0.8%
	B	7.4%	4.0%	3.9%	1.6%	1.8%	1.9%
	C	3.3%	2.9%	3.5%	0.8%	1.9%	3.1%
	P	3.7%	1.6%	1.4%	2.0%	1.0%	2.3%
	D	1.0%	1.1%	1.5%	0.4%	1.3%	2.3%
	F	2.3%	1.5%	2.5%	0.8%	1.8%	12.3%

Overall, the CMP found that, when withdrawals are also included, 53.2% of all students received "good grades" in both Mathematics and English while 20.7% were "at risk" in both. There is evidently a significant group of students whose mathematics achievement was high and English achievement low – some immigrant communities might be represented here for example. The fourth group, whose English grades are good and Mathematics grades are poor, is less easy to identify specifically. Further research would be needed to develop clearer profiles of each of these groups.

The College Heads of Language are conducting their own analysis of College English achievement using data collected by CMP and their study should provide interesting analyses of the factors associated with success and failure in these courses.

Mathematics Background at Secondary School

The goal of the College Mathematics Project is not just to document first semester college students' mathematics achievement but also to relate that achievement to the students' mathematics backgrounds in secondary school. The CMP is well aware, of course, that student success and failure at college is dependent on many factors, of which academic preparation in secondary school is only one[19]. In particular, academic and social integration at the postsecondary level appear to be important factors in promoting student success and retention, according to Ma and Frempong. Nevertheless, significant efforts have been made in recent years by the Ministry of Education and secondary schools both to implement a curriculum designed to meet the needs of students going to various postsecondary destinations, and to increase graduation rates from secondary school. It is therefore useful to study the relationships between students' participation and achievement in secondary school mathematics and their subsequent achievement in first semester college mathematics.

[19] Xin Ma and George Frempong. *Reasons for Non-Completion of Postsecondary Education and Profile of Postsecondary Dropouts*. (Ottawa: Human Resources and Social development Canada, 2008).

There are additional benefits of conducting linked analyses of mathematics achievement at secondary and postsecondary levels. From the schools' perspective, there are few (if any) other projects in Ontario that can provide direct feedback to both school boards and individual secondary schools concerning the postsecondary success of their graduates. This information can thus provide an additional measure of their effectiveness, beyond the use of graduation rates. In addition, the Ministry continues to be engaged in revising the curriculum in all subject areas and CMP research data can potentially provide feedback on the effectiveness of curriculum revisions and other policy initiatives aimed at increasing student success.

The final report of CMP 2007 documented the college mathematics achievements of recent graduates of Ontario secondary schools and related these to the mathematics pathways (sequence of mathematics courses) chosen in secondary school. This year, CMP 2008 has repeated these analyses for the next cohort of students and for the larger number of colleges now participating in the Project. We have also added an additional analysis: comparison of students' college mathematics achievement with their individual marks in selected secondary school mathematics courses. Forum participants in CMP 2007 recommended this, suggesting that analyses based on the mere possession of a given course credit might mask significant differences (in subsequent mathematics achievement at college) between students with high marks in the secondary school course and those with minimal passing marks.

Mathematics Pathways in Secondary School

The Ontario mathematics curriculum for secondary schools contains 16 mathematics courses, three at each of Grades 9 and 10[20], four at Grade 11, and six at Grade 12. For secondary school graduation, all students are required to take 3 credits in mathematics (at least 1 credit in Grade 11 or 12), and admission to many postsecondary programs requires four or more mathematics courses. Although many of the Grade 11 and 12 courses have prerequisite courses as shown in the Ministry curriculum policy document[21], the CMP finds that many students are admitted to College with very varied collections of mathematics courses on their transcripts.

CMP 2008 found that the 14,676 students whose records were examined followed a total of 560 distinct pathways or combinations of mathematics courses through secondary school (see

[20] These include Locally Designed Credit Courses (LDCC).

[21] The reader should note that, while the current revision of the Ontario Mathematics Curriculum was published in 2007, students whose records are reported here completed secondary school under the previous Mathematics curriculum. CMP 2009 will be the first time that the records of graduates of the revised curriculum will be available for study.

Table 8.) Over 400 of these were followed by fewer than 10 students and a further 27 included courses from the former OSIS curriculum that was replaced in 2000[22].

Table 8.
Mathematics Pathways Followed by CMP Students

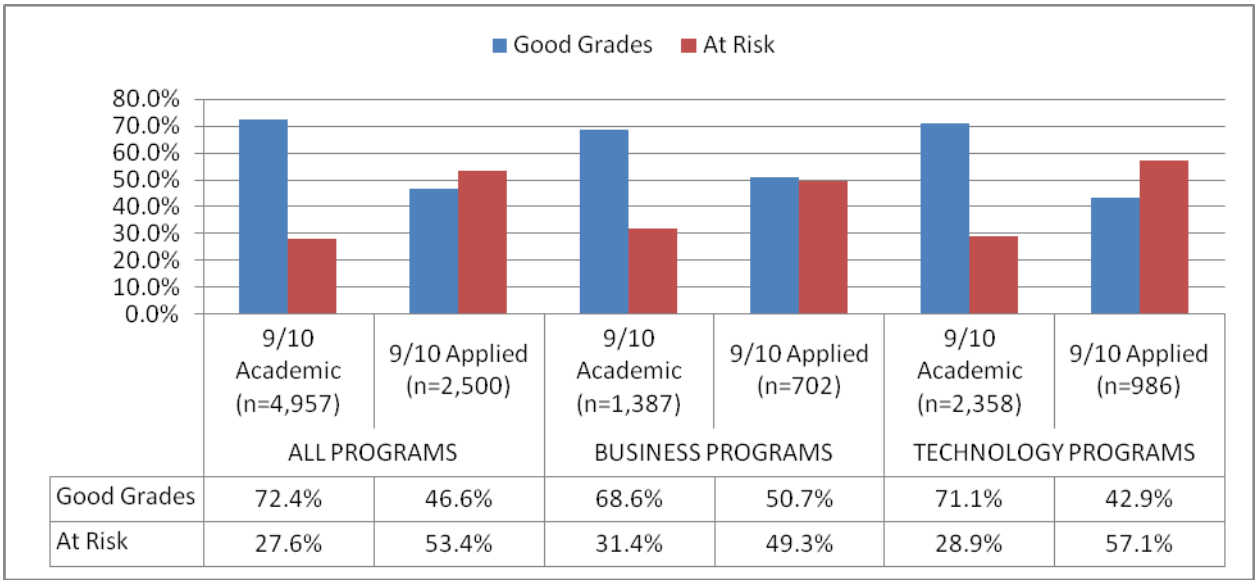
	Number of Pathways	Number of Students[23]	Percentage of Total
All Pathways	560	14,676	100%
Pathways followed by 10 or more students	150	13,227	90.1%
Pathways based on Ontario Curriculum (2000)	123	11,970	81.6%

The CMP therefore restricted its analysis to the 11,970 students who followed 123 pathways. We are confident that this does not have a significant effect on the quality of the analysis, since the average percentage of good grades obtained by this reduced sample is 61.2%, compared with 63.0% in the overall cohort.

Impact of Grade 9/10 Course Selection

On entry into secondary school, students must decide whether to take academic or applied mathematics in Grades 9 and 10. While Figure 8 shows the college achievement categorized according to Grade 9 and 10 choices, Forum participants have reminded us that great care must be taken in its interpretation. While it is clear that students who have followed a pathway beginning with Academic Mathematics courses in Grades 9 and 10 subsequently perform better at college mathematics than do students who have taken the Applied Mathematics courses, that does not mean that taking applied courses was a mistake nor that they are unimportant courses in the overall Ontario curriculum. There are a variety of good reasons for students to take Applied Mathematics in Grades 9 and 10 related to their interests and abilities and their backgrounds in mathematics in elementary schools. All that the CMP data shows is that if a student starts with Applied Mathematics in Grades 9 and 10 and decides later to pursue a career path that is math dependent, then some additional math courses may be necessary to ensure success at the postsecondary level.

[22] One reason for the apparently large number of pathways may be that, in recent years, there has been a "full disclosure" policy with respect to the Ontario Student Transcript, as a result of which marks in any repeat courses taken by a student are shown rather than having the earlier marks being replaced by those of the later one.
[23] The reader is reminded that the statistics reported here are from students enrolled in a first-semester college mathematics course who are also Recent Ontario Graduates (see Table 5 on p. 17).



	ALL PROGRAMS		BUSINESS PROGRAMS		TECHNOLOGY PROGRAMS	
	9/10 Academic (n=4,957)	9/10 Applied (n=2,500)	9/10 Academic (n=1,387)	9/10 Applied (n=702)	9/10 Academic (n=2,358)	9/10 Applied (n=986)
Good Grades	72.4%	46.6%	68.6%	50.7%	71.1%	42.9%
At Risk	27.6%	53.4%	31.4%	49.3%	28.9%	57.1%

Figure 8. **Achievement of students with Grades 9/10 Academic and Applied Mathematics**

Table 8 also shows that Applied Mathematics in Grades 9 and 10 (in the version of the curriculum from 2000) does not appear to provide a good foundation for entry to Business and Technology programs. The newly revised Mathematics curriculum (2006 and 2007) enables students to move from Grade 10 Applied Mathematics to Functions and Applications (MCF3M) in grade 11 (a revision of the previous Functions course for University/College) and from there to MCT4C (Mathematics for College Technology). No students followed this sequence in the CMP 2008 cohort but in CMP 2009 we shall be looking specifically to see if students are beginning to make this transition and to do so with subsequent success in College mathematics.

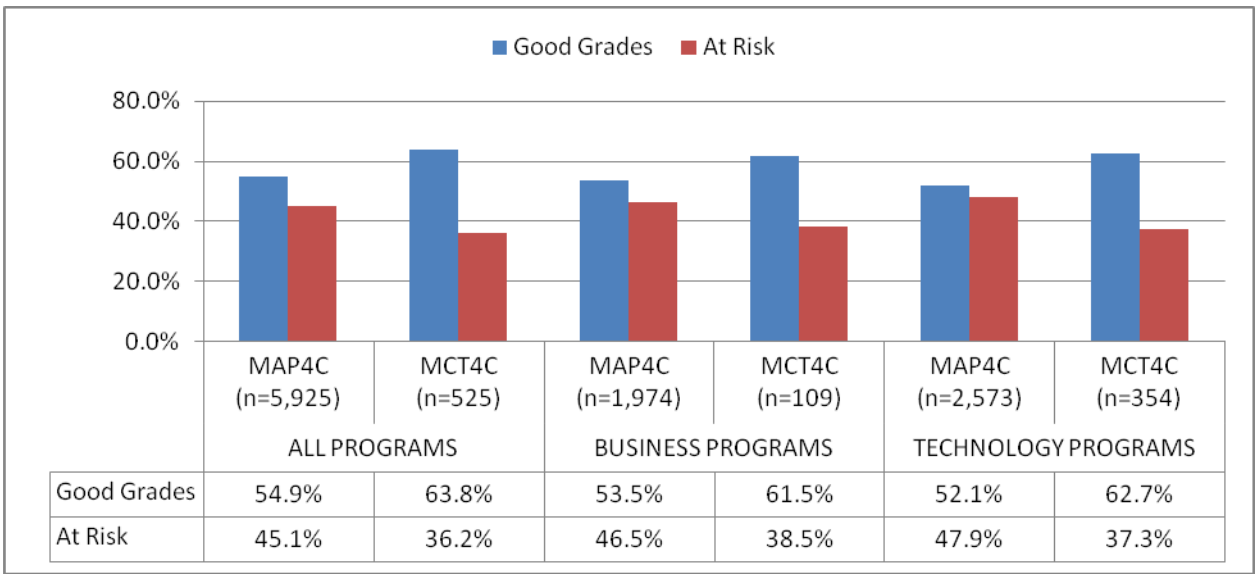
Impact of Grade 12 Course Selection

The two courses in the Grade 12 mathematics curriculum designed to prepare students for College are MAP4C (College and Apprenticeship Mathematics) and MCT4C (Mathematics for College Technology)[24] and the comparison of students who have taken these courses has always been a major focus of the CMP.

Figure 9 compares the first semester college mathematics achievement of students who have taken these two courses in secondary school: the left-hand section of the Figure shows all programs, the centre section, business programs, and the right-hand section, technology programs. It shows, as did the corresponding data in last year's report, that MAP4C is taken by the largest proportion of students. It also shows that while MCT4C is a much more effective preparation for business and technology programs, it is only taken by a very small number of

[24] In the latest (2007) mathematics curriculum, some of these courses have been renamed. However, since the CMP 2008 is based on the 2000 edition of the curriculum, the former course names will be retained throughout this report.

students – fewer than one-tenth of the number taking MAP4C. Forum participants from school boards have confirmed that, as was noted in last year's report also, this is largely because MCT4C has not been available in many secondary schools and in some regions of the province it has not been available at all[25].



	ALL PROGRAMS		BUSINESS PROGRAMS		TECHNOLOGY PROGRAMS	
	MAP4C (n=5,925)	MCT4C (n=525)	MAP4C (n=1,974)	MCT4C (n=109)	MAP4C (n=2,573)	MCT4C (n=354)
Good Grades	54.9%	63.8%	53.5%	61.5%	52.1%	62.7%
At Risk	45.1%	36.2%	46.5%	38.5%	47.9%	37.3%

Figure 9. **Achievement of Students with Grade 12 courses MAP4C and MCT4C**

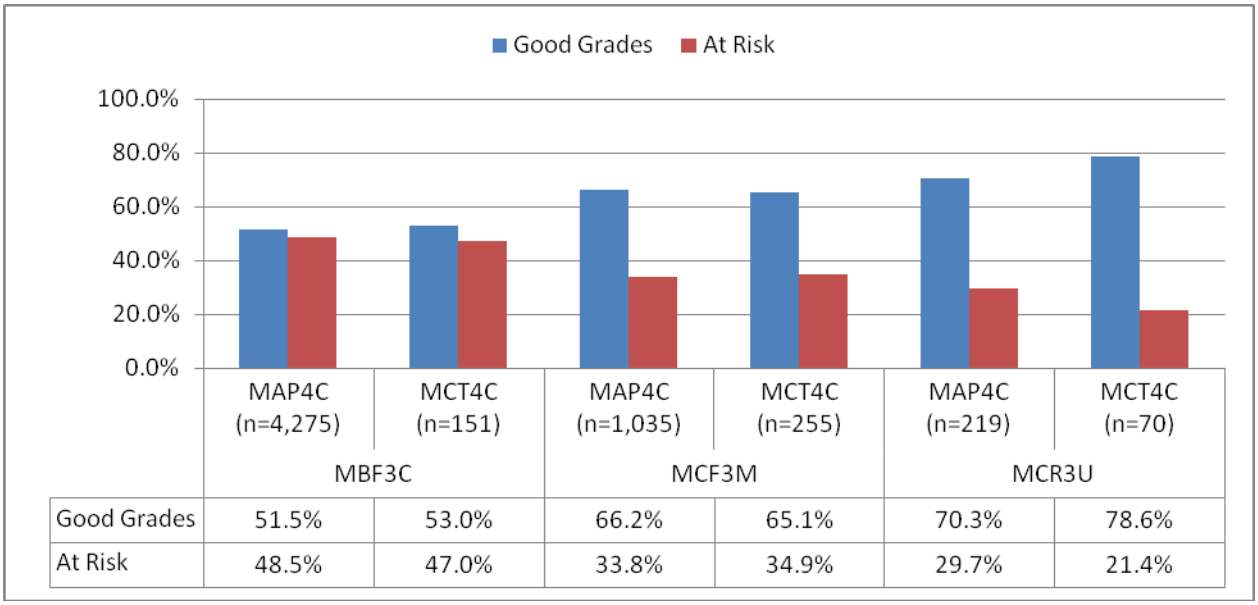
The CMP has highlighted this problem in the past and made recommendations about it, and changes are taking place, even though these data do not yet reflect them. The revised mathematics curriculum now in use has significant changes to the prerequisite courses – in particular enabling a transition from Grade 10 Applied Mathematics to Grade 11 MCF3M and from there to Grade 12 MCT4C – a change aimed at increasing the numbers of students opting for this sequence of courses. CMP 2009 will be the first opportunity to observe if these changes have had the desired effect.

Impact of Grade 11 and 12 Course Selection

Forum participants in 2006 suggested that Grade 11 course selection could be as important to subsequent success in College mathematics as course selection in Grade 12 and so for the past two years we have made a point of examining several combinations of Grade 11 and Grade 12 courses. Figures 10, 11 and 12 show the effects of choosing the college preparation course, (Mathematics of Personal Finance, MBF3C), the course designed for both college and university preparation (Functions, MCF3M), or the university preparation course (Functions and Relations, MCR3U); in conjunction with the two Grade 12 courses, MAP4C and MCT4C. Figure 10 contains

[25] MCT4C is listed as an e-Learning course for the first time in the current (2008-09) school year.

data from all Program clusters, while Figure 11 looks at the Business Program cluster and Figure 12, the Technology Program Cluster.

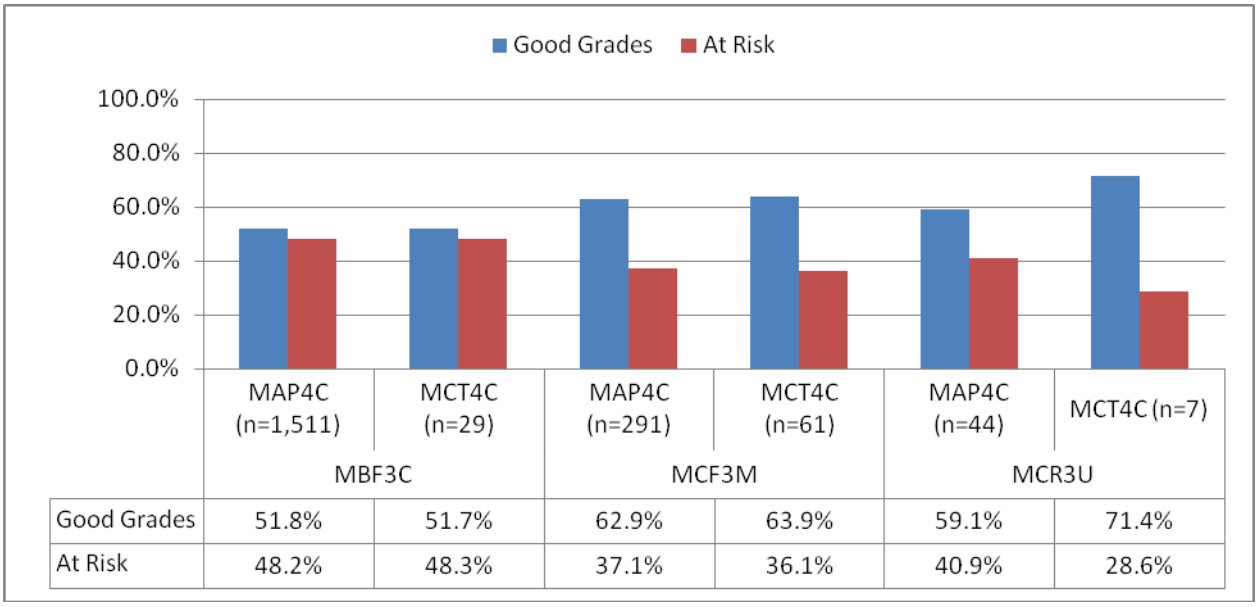


	MBF3C		MCF3M		MCR3U	
	MAP4C (n=4,275)	MCT4C (n=151)	MAP4C (n=1,035)	MCT4C (n=255)	MAP4C (n=219)	MCT4C (n=70)
Good Grades	51.5%	53.0%	66.2%	65.1%	70.3%	78.6%
At Risk	48.5%	47.0%	33.8%	34.9%	29.7%	21.4%

Figure 10. **Achievement of Students with different Grade 11 and 12 course combinations (All Programs)**

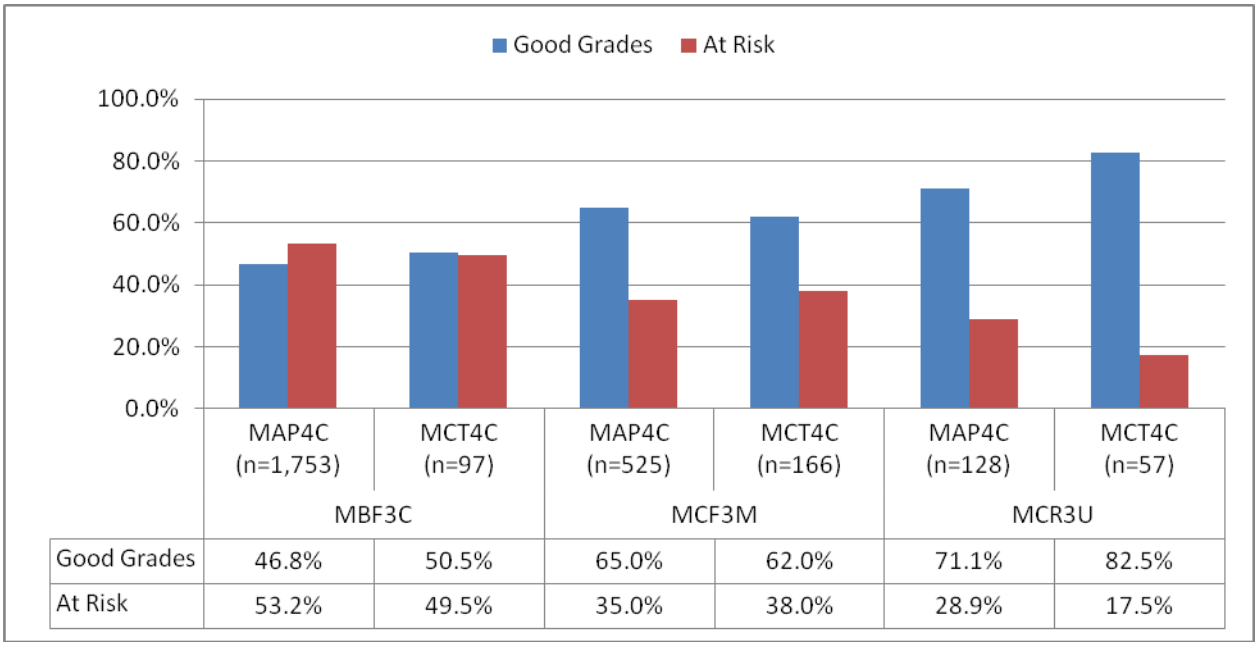
The data shows conclusively that the choice of course in Grade 11 is at least as important as the choice in Grade 12. In particular, MBF3C – in combination with either Grade 12 course – offers a poor preparation for college mathematics. MCF3M, in combination with either MAP4C or MCT4C is significantly better and MCR3U – especially in combination with MCT4C – is better again. Note that MCF3M was the expected prerequisite for MCT4C when the mathematics pathways in the 2000 curriculum were designed.

Once again, the reader is warned against making judgments about the general value of these secondary school courses. CMP merely evaluates their adequacy *as preparation for college mathematics.* The courses MBF3C and MAP4C may well be excellent courses for students whose destination at college is a program that does not depend on mathematics as a foundation, in many Applied Arts programs, for example. This issue was discussed extensively at the CMP Forums and is also taken up as a theme in the final chapter of this report.



	MAP4C (n=1,511)	MCT4C (n=29)	MAP4C (n=291)	MCT4C (n=61)	MAP4C (n=44)	MCT4C (n=7)
	MBF3C		MCF3M		MCR3U	
Good Grades	51.8%	51.7%	62.9%	63.9%	59.1%	71.4%
At Risk	48.2%	48.3%	37.1%	36.1%	40.9%	28.6%

Figure 11. **Achievement of Students with different Grade 11 and 12 course combinations (Business Programs)**



	MAP4C (n=1,753)	MCT4C (n=97)	MAP4C (n=525)	MCT4C (n=166)	MAP4C (n=128)	MCT4C (n=57)
	MBF3C		MCF3M		MCR3U	
Good Grades	46.8%	50.5%	65.0%	62.0%	71.1%	82.5%
At Risk	53.2%	49.5%	35.0%	38.0%	28.9%	17.5%

Figure 12. **Achievement of Students with different Grade 11 and 12 course combinations (Technology Programs)**

Yet another Forum suggestion last year proposed that CMP examine not just which courses had been taken in Grade 12 but the actual marks attained in the chosen Grade 12 course and

analyse these in relation to college mathematics achievement. The next three Tables show these comparisons for All Programs (Table 9), Business Programs (Table 10) and Technology Programs (Table 11).

Table 9.

Mathematics Grades at Secondary School and College (All Programs)

	SCHOOL MATH ACHIEVEMENT		COLLEGE MATH ACHIEVEMENT (ALL PROGRAMS)			
Course	Course Marks	# of Students	GOOD GRADES		AT RISK	
MAP4C	**80% and over**	1,774	1,333	75.1%	441	24.9%
	70-79%	1,593	970	60.9%	623	39.1%
	60-69%	1,618	751	46.4%	867	53.6%
	50-59%	1,420	546	38.5%	874	61.5%
	Overall	6,807	3,770	55.4%	3,037	44.6%
MCT4C	**80% and over**	217	177	81.6%	40	18.4%
	70-79%	190	137	72.1%	53	27.9%
	60-69%	166	107	64.5%	59	35.5%
	50-59%	145	80	55.2%	65	44.8%
	Overall	816	546	66.9%	270	33.1%

The data shown here reveal a striking gradient between students receiving high marks (80% and over) in secondary school mathematics courses and those receiving low but passing marks (50-59%). Even in the results for MAP4C, which we have suggested is not a very good preparation for college programs dependent upon mathematics, we see that over 75% of students obtaining 80% or more went on to achieve good grades in college mathematics. However, students obtaining less than 70% in this course were more likely to be at risk in college. For MCT4C, even a bare pass (over 50%) gave the students a better-than-even chance of achieving good grades in college mathematics. Similar patterns were found for students in Business programs (Table 10) and Technology programs (Table 12).

It was noted by Forum participants that students often choose courses in which they believe they will score high marks in order to achieve a high overall GPA. These data show that in fact any grade in MCT4C is better than at least one grade higher in MAP4C when it comes to preparation for college mathematics and that students need to take this into account as they make their course selections.

Table 10.

Mathematics Grades at Secondary School and College (Business Programs)

	SCHOOL MATH ACHIEVEMENT		COLLEGE MATH ACHIEVEMENT (BUSINESS PROGRAMS)			
Course	Course Marks	# of Students	GOOD GRADES		AT RISK	
MAP4C	**80% and over**	559	404	72.3%	155	27.7%
	70-79%	493	303	61.5%	190	38.5%
	60-69%	527	226	42.9%	301	57.1%
	50-59%	476	176	37.0%	300	63.0%
	Overall	2,174	1,158	53.3%	1,016	46.7%
MCT4C	**80% and over**	40	36	90.0%	4	10.0%
	70-79%	42	28	66.7%	14	33.3%
	60-69%	43	31	72.1%	12	27.9%
	50-59%	23	11	47.8%	12	52.2%
	Overall	179	118	65.9%	61	34.1%

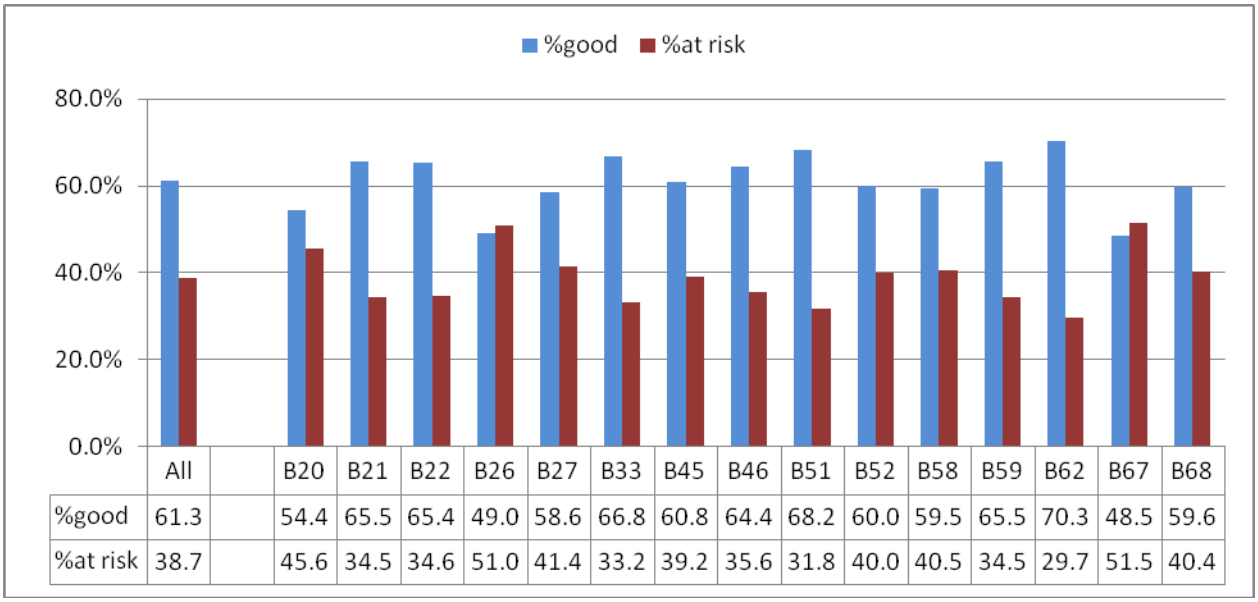
Table 11.

Mathematics Grades at Secondary School and College (Technology Programs)

	SCHOOL MATH ACHIEVEMENT		COLLEGE MATH ACHIEVEMENT (TECHNOLOGY PROGRAMS)			
Course	Course Marks	# of Students	GOOD GRADES		AT RISK	
MAP4C	**80% and over**	859	622	72.4%	237	27.6%
	70-79%	755	426	56.4%	329	43.6%
	60-69%	732	333	45.5%	399	54.5%
	50-59%	645	236	36.6%	409	63.4%
	Overall	3,159	1,687	53.4%	1,472	46.6%
MCT4C	**80% and over**	156	122	78.2%	34	21.8%
	70-79%	136	99	72.8%	37	27.2%
	60-69%	104	60	57.7%	44	42.3%
	50-59%	95	51	53.7%	44	46.3%
	Overall	547	361	66.0%	186	34.0%

Achievement by School Boards and Secondary Schools

Since the CMP obtains its data from student transcripts used in college admissions, it can also identify the school boards and secondary schools, from which Recent Ontario Graduates (ROGs) have graduated, and relate college mathematics achievement to this information. Since the CMP involved 11 Colleges in four different regions of the Province, it collected data of this kind concerning some 60 of the 75 District School Boards By way of example; Figure 13 shows the achievement of the graduates of 15 District School Boards in the Greater Toronto Area. Similar displays were available at the Forums held in other regions of the Province.



	All		B20	B21	B22	B26	B27	B33	B45	B46	B51	B52	B58	B59	B62	B67	B68
%good	61.3		54.4	65.5	65.4	49.0	58.6	66.8	60.8	64.4	68.2	60.0	59.5	65.5	70.3	48.5	59.6
%at risk	38.7		45.6	34.5	34.6	51.0	41.4	33.2	39.2	35.6	31.8	40.0	40.5	34.5	29.7	51.5	40.4

Figure 13. **Achievement by Graduates of School Boards in Greater Toronto Area (n = 8,604)**

As was the case with comparative data from Colleges, interpretation of these results can be somewhat problematic. Since the data relates only to students who enrolled in college in fall 2007, it is not representative of *all* the graduates of any Board, nor even of all the graduates who went on to postsecondary education. In addition, since not all colleges were included in CMP 2008, there are many boards where students went to non-CMP colleges as well as to CMP colleges and so the data obtained to date may not be representative. However, if CMP 2009 includes all colleges in Ontario, then it follows that all Ontario school boards will also be covered and that data will be more representative and useful for feedback purposes, especially longitudinally. The CMP can also show similar data for all secondary schools from which students have graduated. These data can only be accessed by approved school board personnel.

Chapter 3: CMP Forum Results

As a critical part of its Deliberative Inquiry methodology, the College Mathematics Project sponsored four Forums this year in the regions of the participating CMP colleges. These were as follows:

• Greater Toronto Area	Seneca College (King City campus)	October 26
• Eastern Ontario region	Algonquin College, Ottawa	October 30
• Golden Horseshoe region	Hamilton Convention Centre	November 5
• North-western Ontario	Confederation College	November 10

More than 300 participants from colleges, school boards, both Ministries and other provincial organisations spent a day at one of these Forums in pursuit of the following four common goals:

- to receive the results of CMP research on mathematics achievement;
- to share information about initiatives already being undertaken at each college and school board to promote student success in mathematics;
- to reflect on students' personal mathematics experiences at school and college;
- to deliberate over courses of action to improve student success.

The Agenda for each of the Forums followed a common pattern:

Welcome to the CMP Forum
Presentation of the CMP Research
Presentation of Local Action Plans and Best Practices by CMP Colleges and Boards
Student Panel
Breakout Sessions for Deliberations
Reports and Recommendations from Breakout Groups

It is clearly impossible to capture in a summary report all the interesting and significant comments made in over 25 hours of vigorous discussion. The student panels in three of the Forums were videotaped and can be accessed through the CMP web site[26], as can the Best Practices submissions and presentations, and summaries of the breakout sessions' reports.

[26] http://collegemathproject.senecac.on.ca

Best Practices

Since the College Mathematics Project has been holding Forums for three years, some participants from both colleges and school boards have been reflecting on the research and earlier deliberations and implementing innovations in their own institutions as a result. Others, while not participating in CMP directly or personally, have been aware of the CMP findings from reading CMP reports or media accounts and have similarly been seeking ways to increase student success. Still others have been working independently, often with the support of the School/College/Work initiative (SCWI), to address similar problems in their own contexts. We felt that it would be useful to share some of these "Best Practice" experiences at the Forums in order to stimulate discussion about other ways to implement CMP's recommendations.

Time at each Forum for this sharing of Best Practices was quite limited; some reports were submitted as posters that were displayed during breaks in the Forum program while others were presented "live" during the program. All presentations, posters and reports are summarised here and can be accessed in full on the CMP web site[27].

GTA Forum Reports

- ***York Catholic District School Board: "Where Mathematics Meets Technology"***
  This presentation described the integration of selected topics in MCT4C with transportation (automotive) technology, in order to increase positive student attitudes and achievement.

- ***Seneca College, Faculty of Applied Science & Engineering Technology: New Approaches to Support Students in Need of Remediation***
  A new preparatory mathematics course using tablet computers, interactive learning objects, and on-line assessments and a new one-year Applied Science and Technology Fundamentals certificate program were described. This program was developed to address the needs of students lacking the necessary mathematics and science prerequisites for diploma level study. Both strategies were in response to CMP findings.

- ***Dufferin-Peel Catholic District School Board: Impacts of CMP 2007***
  Data on course enrolments in 2007-08 have shown a 60% increase in student enrolment in MCT4C over 2006-07. A promotional campaign has been launched by guidance teachers, targeting students entering Grades 9 and 11 and their parents, focused on the importance of mathematics course selection.

[27] http://collegemathproject.senecac.on.ca

- ***Centennial College: Motive Power Technician program***
  An overhaul in all aspects of the organisation and teaching of mathematics in this program has resulted in increased attendance from 27% to 80% and in increased average achievement from 56% to 64%.

- ***Durham College: Remedial Math Lab (Math1133)***
  A remedial, diagnostic mathematics course which utilizes an interdepartmental teaching team to evaluate and provide necessary remediation to individual student programs was described.

Ottawa Forum Reports

- ***Catholic District School Board of Eastern Ontario***
  A new Additional Qualifications (AQ) course in intermediate mathematics and a special course for students who had taken Grades 9 and 10 Applied Mathematics were described.

- ***Algonquin College: Faculty of Technology & Trades – Math Retention Plan***
  Concerned that remedial courses in mathematics separated students from their cohort, placing them a semester "behind", the Faculty came up with a new approach including self-diagnostic assessment and a math summer prep-camp, a strategy that has been found very successful in 2008.

- ***Algonquin College: Math Drop-In Centre***
  Another element of Algonquin's Math Retention Plan included a Math Drop-In Centre or free tutoring service. This has been well utilised so far and has provoked positive response from students and faculty.

- ***Algonquin College: Test Centre Automation***
  The Accuplacer computer adaptive testing (CAT) system in Arithmetic and Algebra has been introduced to support improved student placement.

Hamilton Forum Reports

- ***Hamilton-Wentworth District School Board & Mohawk College: Pathways Program***
  Specific pathways from secondary school to college programs have been negotiated between school board and college and have enabled students to be more confident in their preparation for college programs. The pathways have resulted in increased

student retention and had numerous subsidiary benefits in mutual understanding and curriculum linkage.

- ***Niagara College: Mathematics Assessment Program***
  A report of the new approach to diagnostic assessment and modular remediation for students in mathematics was described.

Thunder Bay Forum Reports

- ***Northwestern SCWI Regional Planning Team: Math Forum in May 2008***
  While not officially CMP partners in 2006-07, the Northwestern SCWI Regional Planning Team organised a special Forum in May 2008 to consider the implications of the CMP report and recommendations. The report of that Forum provided a foundation for deliberations at the present Forum.

Students' Perspectives

At each Forum, a student panel was held at which students currently at college were invited to reflect on their mathematics experiences at secondary school and college and on their transition from one to the other, and to offer advice to mathematics teachers at both secondary school and college. Each panel was chaired by a student moderator and the questions posed to each panellist were as follows:

1. Program motivation, math background and belief:
   - What was your secondary school math preparation?
   - What decision(s) led you to your choice of program?
   - Before you entered college, how did you view mathematics and what was your belief in your abilities in mathematics?

2. Math assessment practices:
   - Did you have to write a math assessment in order to be placed in a math course? If so, how did you feel about the experience?
   - Were you provided with the results and if so, were they expected or a surprise?
   - Were you placed in a preparatory math course as a result of the test?

3. Please tell us a little about the mathematics course you took (or are taking) in first semester:
   - Would you describe the content as mostly new and at a higher level of difficulty than that presented in secondary school, or is some/all of the material a repeat of what you studied previously?

- Is/was the course presented in the context of your studies?
- In comparison to your secondary school experience, what are the key differences you noticed with respect to:
    - Teaching style and methodology
    - Assessment practices – type and frequency
    - Concrete versus abstract treatment of the material – did you find a more "applied focus" and was this more interesting for you.
    - Student rights and responsibilities – due dates, accommodations, etc.

4. What advice would you give to secondary school teachers (and guidance counselors) with respect to helping students make the transition to college mathematics?

5. What advice would you give to your college mathematics teachers to help you succeed in math?

The panels were quite diverse in terms of their members and the students' views and opinions attracted great interest from Forum participants. In fact, they often attracted so much attention that they clearly influenced the tone and content of the subsequent group discussions.

For example, the student panel at the GTA Forum emphasised the critical importance of the student-teacher relationship and the quality of instruction; the subsequent reports of the group deliberations reflected ways in which teachers could learn more from each other and broaden their ways of teaching. Similarly in Hamilton and again in Thunder Bay, the issue of students' needing to be accountable for their own learning came up in the student panel and carried over to the group discussions. The student panel discussions were videotaped in three of the four Forums and a link to the resulting videos is on the CMP web site[28].

Group Deliberations

The most important component of each Forum is the breakout group deliberations. Once again there were four groups, into which participants were pre-registered to ensure a balance of college and school board participation. The focus of the four groups was as follows:

- Mathematics Curriculum & Pedagogy
- Guidance & Career Counselling
- Student Success
- Provincial Policy

[28] http://collegemathproject.senecac.on.ca

Discussion questions were prepared to stimulate each group's deliberations; summary reports of issues raised and recommendations proposed were presented at the concluding plenary session of each Forum. Summaries of these reports are appended to the CMP web site[29].

[29] http://collegemathproject.senecac.on.ca

Chapter 4: Emerging Themes, Conclusions and Recommendations

The four CMP 2008 Forums brought together a broad representation of stakeholders to receive the results of the CMP research, to share secondary school and college best practices aimed at bringing about student success, and to learn from the perspectives of students currently in college who have experienced the transition from secondary school mathematics to college mathematics. All of these experiences led into the group deliberations to yield an array of recommendations from each Forum.

The general conclusions of CMP 2008 based on the discussion of this year's research must remain exactly the same as in CMP 2007:

- That student achievement in first-semester mathematics in Ontario colleges needs to be significantly improved;
- That the achievement of this goal requires concrete action by all stakeholders, including students and parents, secondary schools and teachers, colleges and faculty and the Government of Ontario.

While the Best Practices presentations at the Forums showed that much is being done, the evidence suggests that more is still needed. CMP 2008 has given participants the opportunity to look beyond the recommendations of last year and to drill deeper into some of the underlying threats to improved student achievement, particularly in mathematics.

As the CMP team reviewed the reports from each of the breakout groups in each Forum, certain themes emerged as being of particular importance at most if not all Forums and we have decided to focus on these in this Final Report for CMP 2008. These are as follows:

1. Accountability for Learning
2. Talking Together about Mathematics Teaching and Learning
3. Pathways to Success in College Programs
4. Focusing on the School/College Interface

In the remaining sections of this report, we expand on each of these and add, as appropriate, recommendations for students and parents, for secondary schools and teachers, for colleges and faculty, and for the Government of Ontario.

Accountability for Learning

Much discussion at Forum deliberations focused on a broad set of skills and attitudes in relation to learning that contribute to success in college. Matt, a member of the student panel at the Golden Horseshoe Forum in Hamilton, put it this way:

> "In high school...kids are getting let off showing up late for class, there are no penalties, they hand in their assignments late. If you do that in the workforce, you will get fired... Get into work ethics before going to college."

College faculty agreed that certain skills, attitudes or habits of mind in relation to learning were of vital importance in college programs. In fact, some went so far as to claim that lack of these contributed more to students' failure in courses than did a lack of formal subject knowledge. Overall, both students and faculty pointed out that college students had to be more accountable for their own learning than they had been at secondary school.

Teachers from secondary schools pointed out that, while they wanted their students to acquire good learning attitudes and habits, Ministry policy did not permit them to incorporate assessment of these skills into formal course marks. Indeed, Ministry of Education policy in regard to what are called "Learning Skills" is clear: the Provincial Report Card includes separate spaces in which teachers are to record course marks, and evaluation of learning skills. The report card includes a comprehensive list of learning skill categories and checklists of sample behaviours, including: independent work; teamwork; organization; work habits/homework; and initiative[30].

At the Forums, participants argued both for and against the Ministry policy. As we see it however, the issue is not so much with the policy itself but with its interpretation by students in secondary schools, by their parents, and sometimes even by teachers. While teachers record their evaluations of students' learning skills on report cards that go home to parents, there is no corresponding record on the Ontario Student Transcript, which is used by colleges and universities for admissions purposes. Students know that because evaluations of learning skills are *not* incorporated into course marks, they do not count either toward secondary school credits or toward postsecondary admission. Students and parents might therefore infer that learning skills are of less importance than course expectations, whose evaluation *is* reflected in course marks. Such an interpretation is not intended by the Ministry and is, in our view, seriously mistaken.

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[30] *Guide to the Provincial Report Card, Grades 9-12*. pp 27-29 (Toronto, Ministry of Education, 1999). The document may be accessed at http://www.edu.gov.on.ca/eng/document/forms/report/sec/srepgde.pdf . While these include skills, attitudes and habits of mind, we shall use the Ministry's term, "Learning Skills," to encompass them all.

Course content can be forgotten over time (although once learned it can be relearned when needed), but the skills and attitudes associated with successful learning can become the habits of a lifetime. The challenge is to correct misunderstandings among students and parents about the importance of learning skills, so that students can acquire the accountability for learning that will help them succeed in postsecondary education.

But there is more than academic success at stake. College students are enrolled in programs leading to specific professional occupations and these programs must not only provide them with the specific knowledge and skills required in those occupations but also inculcate the expectations, values, and norms of behaviour that characterise good professional conduct. Acquiring these skills, attitudes and values are an essential part of effective career preparation and students who lack them may not succeed in their chosen profession.

The following recommendations are designed with this challenge in mind.

1. Even though learning skills do not contribute to formal grades, students and their parents should pay close attention to the indicators of learning skill development on students' report cards, discussing them at home, and ensuring that learning skills are well developed prior to students reaching college level.

2. Teachers at secondary schools should take every opportunity to stress the importance of learning skills from Grade 9 onwards, developing systematic means for supporting students' development in these areas, improving their methods of assessing learning skill development, and drawing student attention to the lack of skills in specific areas, where this is warranted.

3. Colleges and college faculty should reference the importance of learning skills in their advertised program admission requirements. They should also identify weaknesses in students' learning skills development as early as possible and provide appropriate feedback, advice and remediation.

4. The Ministry of Education should demonstrate its recognition of the importance of learning skills for success at postsecondary levels, by specific communications to secondary schools, teachers and parents, by emphasis in curriculum policy documents, and by amending the Ontario Student Transcript policy to enable a record of a student's learning skill development to be transmitted to postsecondary institutions along with course marks.

Talking Together about Mathematics Teaching and Learning

According to King, over 25 % of all Ontario secondary school graduates go on to college[31]. But, while every secondary school teacher has had personal experience of university and university programs, very few have had any experience of college and college programs, either as student or teacher. Discussions between teachers at secondary school and college at several of the Forums revealed a wide gap in understanding of each other's work on the part of both groups.

Secondary (and elementary) school teachers participate in a distinct "discourse community"; they discuss issues of teaching and learning using a common "language" of curriculum and pedagogy introduced in teacher education programs, used in Ministry documents, and developed through ongoing professional development. College faculty are members of a different discourse community in which they discuss their work and the issues of college teaching and learning in relation to preparation for professional occupations. Since these two discourses are based on different backgrounds, and different experiences it is as if secondary school and college teachers speak different languages with respect to teaching and learning. This is not the place to analyse in depth these differences but we note the dearth of research in this area. Rather, we consider here the consequences for students of this major gap between how teachers of mathematics at secondary school and at college think and talk about what they do.

First, having a personal experience of university may lead teachers easily and unintentionally to refer to university as the "natural" destination for their "good" students, implying that colleges and the students who go to them are of lesser value. This attitude of academic elitism is frequently supported by parents and others in society though it is often based on almost complete ignorance of the college system. In recent years, some colleges have developed relationships with Faculties of Education to acquaint future teachers with aspects of the college system, its students and programs; teacher candidates in these faculties have been amazed to discover that colleges are institutions with rigorous standards, highly motivated students and teachers, and outstanding results (in terms of placement of graduates in occupations). This "discovery" process needs to be developed more systematically through both pre-service and in-service teacher education.

But, beyond better general acquaintance with the college system, teachers in secondary school and college can profit by a much deeper understanding of the different philosophies of teaching

[31] A.J.C. King, W.K. Warren, J.C. Boyer, & P. Chin. Double Cohort Study: Phase 4, Report for the Ontario Ministry of Education. (Kingston: Social Program Evaluation Group, Queen's University, 2005) p. v.

and learning that underlie their institutions. There are differences in the ways that secondary school and college teachers regard students' responsibility for learning (as noted above). But there are also differences in the ways mathematical concepts are represented in the classroom, there are differences in approaches to instruction and differences in assessment, all of which require students to "change gear" as they move from school to college[32]. The problem for students is that there is nobody to help them make this transition; there is no manual for coping with learning in college.

Research cited earlier in this report on why students drop out of postsecondary education cites "academic integration" along with "social integration" at the postsecondary level as the leading predictors of student attrition.[33] The concept of academic integration refers to "sharing common information, perspectives, and values with other members of the community ... instructors and classmates.[34]" Secondary school teachers have all been successfully "integrated" into university academic communities. But until they understand the "information, perspectives, and values" of their colleagues at college, they will not be able to support their students' readiness for college success. Similarly, until college faculty learn more about teaching and learning at the secondary school level (in particular about new programs and initiatives), they will be less understanding of their students and less able to help them to progress.

The School/College/Work initiative has, for many years, addressed this problem through forums and other events designed to bring teachers from school and college together.[35] Yet the problem persists. A greater number of more varied strategies are required in order to ensure that all teachers at the secondary school and college level become involved.

Recommendations:

5. Secondary schools and colleges should create and use additional opportunities for teachers and faculty to observe, collaborate with and, where feasible, exchange with each other in order to share expertise and good pedagogical practice, and also to understand the differences in the teaching and learning environments of colleges and schools.

6. The Ontario College of Teachers should require that Faculties of Education provide appropriate experiences in college settings (such as extended visits, internships and teaching practice) for all Intermediate/Senior teacher candidates.

[32] Current research being conducted by a CMP colleague, Trish Byers from Georgian College, is uncovering mathematical representations in school and college textbooks and teaching methods.
[33] Ma and Frempong, op. cit., p. 33.
[34] Ibid., p. 4.
[35] The SCWI web site (www.gotocollege.ca) provides newsletters and other documentation of these activities.

Pathways to Success in College Programs

Forum discussions as well as CMP research suggest that there is still much confusion on the part of students and teachers at secondary schools about the mathematics pathways students should take both to gain admission to their college program of choice and to be successful in that program. As we listened to Forum participants, we learned about a number of factors contributing to this situation.

Part of the problem lies in the unusually large number of mathematics courses in the Ontario curriculum[36], which leads to a vast number of possible pathways (i.e., combinations of courses) and subsequent difficulty for students who must make choices. While this problem has a long history, it was exacerbated in the late 1990s by the creation of what have become known as "destination-related" courses in Grades 11 and 12 (i.e., courses designated as preparation for university, college, and workplace). In the final report of the "Double Cohort Study[37]," Alan King and his colleagues at Queen's University made the following comments:

> The introduction of College courses into Grades 11 and 12 of the secondary school curriculum has not had the desired effect of facilitating the transition of students from secondary school to college. (p. vii)
>
> Rather than attempting to solve graduation rate deficiencies and ineffective Workplace- and College-preparation course sequences by reviewing and revising individual courses and overlaying a variety of new school-to-work programs, the Ministry of Education needs to conduct a systematic review of the structure and content of the Reorganized Program. (p. xiii)

CMP research and deliberations echo these findings and suggestions. Following CMP reports in the past two years, partner school boards have made real efforts to increase the availability of MCT4C to students. However weak enrolments in this course make offering it difficult for many secondary schools and impossible for others, such as smaller schools in rural areas. This often results in students taking the less demanding MAP4C course, which is an inadequate preparation for college mathematics.

We also heard that there is little knowledge about the possible consequences of their course choices. As the CMP research data clearly shows, the two Grade 12 mathematics courses designed as College preparation courses are not equally appropriate for all students wishing to go to college. For those aiming to enroll in a program that is heavily mathematics dependent (such as most technology and business programs) MCT4C is clearly the appropriate course,

[36] Ontario has 16 courses in Mathematics covering Grades 9 through 12, compared with 7 in Saskatchewan, 9 in Atlantic Canada and Alberta, and 10 in Manitoba and British Columbia.
[37] A.J.C. King, W.K. Warren, J.C. Boyer, & P. Chin. op.cit.

while for students going to a college program in a non-mathematical area, such as most areas of applied arts, MAP4C may be entirely satisfactory. As CMP data also shows, the choice of mathematics course in Grade 11 is at least as important as the choice of Grade 12 course, with MCF3M being much preferred as a preparation for future college mathematics to MBF3C. Until the CMP data became available, there was a general lack of such information about the consequences of course selection throughout the secondary school system and students had to rely entirely on the advice of parents and teachers.

Finally, while we often heard secondary school teachers complain that "colleges ought to make clear exactly what they expect," we also heard from college personnel how difficult in practice that actually is. The MTCU Binding Policy Directive on Admissions described earlier prohibits colleges from *requiring* students to have a course designated as U (university preparation) and it is unrealistic to require a course that few students have access to. While all colleges want to have the best prepared students enroll in their programs, the reality is that some programs are over-subscribed and admissions standards rise, while other programs are under-subscribed and admission standards are less than the college prefers. And this situation is also variable from college to college as each has a unique mix of programs and a unique student population from which to draw.

The long term solution to the overall problem lies, we believe, with an overhaul of (at least) the structure of the mathematics courses in the Ontario curriculum. Based on the cyclical revision system now in place, this is not likely to occur for another four years. In the meantime, students and teachers need clearer guidance on the most appropriate pathways to lead to college programs. At our Hamilton Forum, we learned about an excellent model: Mohawk College and the Hamilton-Wentworth DSB have developed an agreement, whereby students' admission to selected Mohawk College Technology programs is greatly facilitated if they successfully complete a particular selection of secondary school courses, which have been negotiated under the agreement.[38]

Accordingly, CMP offers the following three short-term recommendations and a long-term one.

7. Colleges should clarify for secondary schools those Grades 11 and 12 mathematics courses and levels of achievement that are most likely to lead to success in each program, using such communications vehicles as web sites, program brochures, and special communications for parents.

[38] The *Pathways to Mohawk* program is described on the Hamilton-Wentworth District School Board web site: www.hwdsb.on.ca/schools/course_calendar/pathways.aspx

8. Secondary schools should make further efforts to ensure that students have access to important college preparation courses such as MCT4C, using summer school, e-learning and other means where enrolment is insufficient for regularly scheduled classes.

9. Secondary school guidance teachers should use data on the likely consequences of course selection (such as are provided by CMP) to advise students.

10. The Ministry of Education should give serious consideration to the revision and simplification of the course structure at Grades 11 and 12 (as recommended in the Double Cohort Study) with a view to the implementation of a new system as each subject area's next cyclical revision takes place.

Focus on the School/College Interface

> *"Improving the education and skills of Ontarians is the centrepiece of our plan for Ontario….When we equip our children to take on the world and win, we equip Ontario to come out on top in the truly global, hypercompetitive economy of the 21st century."*[39]
>
> *"The brains and know-how of a skilled workforce are the competitive edge of the 21st century….The government's … Reaching Higher Plan will significantly increase access to college and university and the quality of education provided."*[40]

The Government of Ontario is clearly committed to increasing student success as these recent quotes attest. At the secondary school level, the Ministry of Education's *Student Success: Learning to 18* program has led the way to increasing the proportion of students graduating from secondary school[41]. At the postsecondary level, the Ministry of Training, Colleges and Universities is now three years into *Reaching Higher*, a five-year program of increased investment in postsecondary education, focusing on access, quality and accountability, three of the main themes of Bob Rae's report on postsecondary education in Ontario.[42]

Yet, while more students are graduating from secondary schools and more are entering colleges and universities, graduation rates within the postsecondary sector are still not high enough to ensure confidence that the transition for students is a seamless one, as the Key

[39] Government of Ontario, 2007 Progress Report (www.gov.on.ca)
[40] Government of Ontario, 2005 Budget Backgrounder (www.gov.on.ca)
[41] Charles Ungerleider. "Evaluation of the Ontario Ministry of Education's Student Success-Learning to 18 Strategy: Final Report" (Vancouver, Canadian Council on Learning, 2008). http://www.ccl-cca.ca/pdfs/OtherReports/StudentSuccessStage2Report_Oct_15_2008.pdf
[42] Bob Rae. *Ontario: A Leader in Learning*. (Toronto: Government of Ontario, 2005).

Performance Indicators from both colleges[43] and universities[44] show. We have mentioned earlier that academic preparation is by no means the only factor affecting graduation rates at postsecondary education institutions. However, we do believe that it is significant enough not to be ignored. Yet student success *through the interface between secondary and postsecondary education* in Ontario does not appear to be of major concern to policymakers. The one bright light in this area is the School/College/Work Initiative (SCWI), funded jointly by the two Ministries, which supports student transitions from school to college through sponsoring "dual credits" and forums to bring college and secondary school teachers together[45].

Ontario is by no means alone in according a low priority to the relationship between secondary and postsecondary education. In the United States, concerns for the same issues were expressed in the final report of the "Bridge Project" in language that was echoed almost word for word at the CMP Forums held this fall.

> States have created unnecessary and detrimental barriers between high school and college, barriers that are undermining … student aspirations. The current fractured systems send students, their parents, and K-12 educators conflicting and vague messages about what students need to know and be able to do to enter and succeed in college. For example, the coursework between high school and college is not connected; students graduate from high school under one set of standards and, three months later, are required to meet a whole new set of standards in college. … Current data systems are not equipped to address students' needs across systems, and no one is held accountable for issues related to student transitions from high school to college.
>
> Many students and parents are confused by what is expected of students when they enter college, and these misunderstandings can contribute to poor preparation for college. We found that many students believe a variety of misconceptions, ranging from "Meeting high school graduation requirements will prepare me for college," to "Community colleges don't have academic standards.[46]

The prescription for change proposed by The Bridge Project and now being implemented aggressively by an increasing number of American states is to adopt a K-16 perspective on student success. From this perspective, new light is being focused on issues of the secondary-postsecondary interface, including curriculum continuity, alignment of assessments, responsibility for remediation, data collection and analysis, institutional and governmental accountability. Indeed, the three themes already discussed in this chapter can all be seen as components of this overarching theme.

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[43] Colleges Ontario. 2008 Environmental Scan (Toronto: Author, 2008)
[44] Common University Data Ontario (CUDO) http://cou.on.ca/_bin/relatedSites/cudo.cfm
[45] SCWI also supported CMP in its first two years.
[46] A. Venezia, M. Kirst, & A. Antonio. Betraying the College Dream, Final Report of The Bridge Project. (Palo Alto CA: Stanford University Institute for Higher Education Research, 2003), p 2.

Creation of a seamless educational system geared to the 21st century rather than the 19th or 20th requires action by all stakeholders[47] but leadership is needed by the Government of Ontario. The concept of a K-16 vision of student success was proposed in last year's CMP Final Report but we believe that it is so fundamental, not just to college mathematics but to the future of education in Ontario, that we bring it forward again this year as our final recommendation.

11. The Government of Ontario should broaden its vision of student success to encompass a K-16 perspective and should invite the Higher Education Quality Council of Ontario to study ways in which this perspective has been of value in other jurisdictions, to consult the Ontario educational community widely, and to propose concrete ways in which this vision can be most appropriately implemented.

Ontario has an educational system from elementary through secondary to postsecondary of which it is justly proud. And in the fiercely competitive environment of the 21st century, successful participation at and between all levels of this system has been rightly recognised as essential. In recent years, the traditional gulf that used to exist between elementary and secondary education has given way to greater cooperation and understanding, free flow of student data from one level to the next, and a combined commitment to student success at both levels. Now is the time for the continuing gulf between secondary and postsecondary (and especially the colleges) systems to be bridged, with the same goal in mind. We call on the Government of Ontario and all educational stakeholders to broaden their vision, so that all parts of the system are equally committed to the goal of **success for every student**.

[47] D. Conley. "What We Must Do To Create a System That Prepares Students for College Success," Policy Perspectives (Los Alamitos, CA: WestEd, 2006). http://www.wested.org/cs/we/view/rs/810