EQAO

VOLUME 1

Revisiting EQAO Research from 2011 to 2019

A Close Look at Mathematics

Understanding Student Learning and Achievement in Ontario

August 2021

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Integrative Opening from the Chief Operating Officer at EQAO

It is a pleasure to present EQAO's *A Close Look at Mathematics* series, a compilation of information gleaned from EQAO data and research on mathematics in Ontario.

When evaluating student outcomes, it is important to examine learning contexts, demographics, attitudes, behaviours and achievement. EQAO research shows that while students have good knowledge of math facts, they are more likely to be challenged by items designed to assess critical thinking and the application of math facts. EQAO research also indicates that developing a positive attitude toward math and using math strategies early on (in the primary grades) strongly relates to math achievement in Grade 9. A persistent achievement gap between students enrolled in the applied course and those enrolled in the academic course is observable, regardless of early learning experiences, and students enrolled in an academic course of study demonstrate higher achievement, regardless of past experiences with large-scale assessment.

Achievement is impacted by a variety of individual student factors, such as demographics, attitudes and behaviours. For example, a lower proportion of students with special education needs meet the provincial standard each year and continue to be disproportionately represented in the applied course, compared to those without special education needs. Positive attitudes toward mathematics, application of effective learning strategies, homework completion and fewer absences from class are also associated with higher achievement.

As an agency that assesses student achievement province-wide, EQAO values its role in providing and disseminating educational data and research. We hope that the *A Close Look at Mathematics* series can be a valuable resource for improvement planning and can foster critical discussions about student supports and strategies for mathematics learning at the classroom, school, board and provincial levels.

Laurie McNelles, Ph.D.
Chief Operating Officer (Interim)

01

Students' Knowledge and Skills in Mathematics

Lessons from EQAO Data on Fundamental Math Skills: How Are Ontario Students Doing? (2019)

Preparing Students for the World Beyond the Classroom: Linking EQAO Assessments to 21st-Century Skills (2011)

Education Quality and Accountability Office

EQAO

Lessons from EQAO Data on Fundamental Math Skills: How Are Ontario Students Doing?

March 2019

Purpose of This Report

The purpose of this informational report is to provide an overview of provincial achievement of fundamental math skills among primary and junior students. The report draws from EQAO data gathered in 2016, 2017 and 2018.

Context

In summer 2018, the Ontario Ministry of Education released a teacher's guide called "Focusing on the Fundamentals of Math," designed to help teachers build students' knowledge and skills in mathematics (Ontario Ministry of Education, 2018). The guide highlights the importance of fundamental math concepts and skills and provides information on how to support students in improving in these areas. The guide also outlines examples of the fundamental concepts and skills.

In response to the Ministry of Education's focus, EQAO examined data associated with the fundamentals of math outlined by the government.

Results

Percentage of Students Meeting Expectations on Fundamental Math Skills [1]

Panel	Multiple-Choice	Open-Response	Knowledge and Understanding[2]	Application	Critical Thinking
Primary (Grade 3)	71%	54%	81.5%	68%	58%
Junior (Grade 6)	66%	59%	72.5%	65%	58%

Summary

This report offers a preliminary investigation into student achievement on fundamental skills in mathematics. The results show that students are better able to demonstrate their skills in the multiple-choice format than on open-response items. It is also clear that Ontario students in Grades 3 and 6 have stronger knowledge and understanding of fundamental math skills than they have the ability to apply their skills and to think critically about them. The challenge with mathematics in Ontario may be less about students "knowing" math and more about their ability to apply math knowledge and to engage in related critical thinking.

This analysis can serve as a baseline toward continuous improvement as educators focus on the fundamentals of mathematics in Ontario schools.

[1] Results for English- and French-language students are presented as one average percentage, as statistical differences were not observed.

[2] Multiple-choice questions are divided into three categories: Knowledge and Understanding, Application and Critical Thinking.

Updated on May 13, 2019.

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Education Quality and Accountability Office

EQAO

2 Carlton Street, Suite 1200,Toronto ON MSB 2M9
Telephone: 1-888-327-7377 I Web site:www.eqao.com

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EQAO RESEARCH

January 2011 Research Bulletin #7

- What are 21st-century skills? Which of them relate to the literacy and numeracy expectations that inform EQAO assessments?
- Which OSSLT and Grade 9 Assessment of Mathematics data are related to 21st-century skills?
- What conclusions can be drawn about how Ontario secondary school students are progressing toward acquiring 21st-century skills?

Preparing Students for the World Beyond the Classroom: Linking EQAO Assessments to 21st-Century Skills

Judith Hunter, Education Officer, Assessment and Reporting, Director's Office, Education Quality and Accountability Office

EQAO Research

EQAO undertakes research for two main purposes:

- **to maintain best-of-class practices and to ensure that the agency remains at the forefront of large-scale assessment and**
- **to promote the use of EQAO data for improved student achievement through the investigation of means to inform policy directions and decisions made by educators, parents and the government.**

EQAO research projects delve into the factors that influence student achievement and education quality, and examine the statistical and psychometric processes that result in high-quality assessment data.

Research conducted by

Mélanie Daigle,
Assessment Officer, EQAO

Régine Guyomard,
Assessment Officer, EQAO

Acknowledgement
This research project was a collaborative effort among EQAO staff on the Assessment, Data Management and Analysis and Psychometric teams.

PURPOSE

This bulletin summarizes the findings in the "21st-Century Skills" section of *EQAO's Provincial Secondary School Report on the Results of the Grade 9 Assessment of Mathematics and the Ontario Secondary School Literacy Test, 2009–2010.* The purpose of the section was to examine and report the links between students' performances on the Ontario Secondary School Literacy Test (OSSLT) and the Grade 9 Assessment of Mathematics and the 21st-century skills that young people need to develop during their school years in order to participate effectively and successfully in the world and workplace of the 21st century.

The following questions were considered:

- What are 21st-century skills? Which of them relate to the literacy and numeracy expectations that inform EQAO assessments?
- Which OSSLT and Grade 9 Assessment of Mathematics data are related to 21st-century skills?
- What conclusions can be drawn about how Ontario secondary school students are progressing toward acquiring 21st-century skills?

BACKGROUND

EQAO develops and administers high-quality provincial assessments in Ontario. An important part of this work is to investigate and report on trends that will enable the agency to continue to report useful information to educators and the public in a world-class manner.

EQAO's Board of Directors, in developing its strategic directions for the agency to 2014, identified two descriptions of 21st-century skills as reference points: one by the Conference Board of Canada (2010) and the other by the Ontario Ministry of Training, Colleges and Universities (MTCU) (2010).

The 21st-century skills are also referred to as employability skills or essential skills and can be organized into six categories: numeracy; communication; critical thinking and problem solving; personal; interpersonal; and information management, technology and information systems.

Furthermore, the Board of Directors committed to having the agency examine the Ontario Secondary School Literacy Test (OSSLT) and the Grade 9 Assessment of Mathematics to determine which literacy (reading and writing) and numeracy (mathematics) data allow insights into how well secondary school students are acquiring 21st-century skills. It is important to note that the 21st-century skills identified by the Conference Board of Canada and the MTCU are essential skills that high school graduates must possess to be successful in the workplace and everyday life. This bulletin provides information on the progress students are making toward acquiring the 21st-century skills expected by *The Ontario Curriculum* to the end of Grade 12.

DATA ANALYSIS PROCEDURES

The first step was to consider the 21st-century skills and identify those related to the *Ontario Curriculum* literacy and numeracy expectations and skills that EQAO assesses. The relevant 21st-century skills were clustered into three of the six categories (communication, numeracy, and critical thinking and problem solving). The 2006–2010 data sets for the OSSLT and the Grade 9 Assessment of Mathematics were analyzed for patterns and trends related to the 21st-century skills. The following charts summarize the links among the 21st-century skills, the literacy and numeracy skills assessed by the OSSLT and the Grade 9 Assessment of Mathematics, respectively, and the EQAO data related to the 21st-century skills.

COMMUNICATION CATEGORY

21st-Century Skills	Literacy Skills Assessed by the OSSLT	EQAO Data Sources Related to the 21st-Century Skills 2006–2010
■ Communicate clearly and correctly in different written forms ■ Respond to written text in a manner that ensures effective communication	In the writing component of the test, students are given multiple-choice questions and are asked to write two short responses, a series of paragraphs expressing an opinion and a news report. Through their responses, students demonstrate their ability to communicate ideas and information clearly and coherently and use conventions appropriately (grammar, spelling, punctuation and usage).	1. Overall achievement results 2. Percentage first-time-eligible (FTE) students at top scores for writing tasks averaged over the past five years:[1] ■ Long-writing tasks: average percentage at top scores (Codes 50 and 60) for topic development; average percentage below Code 50 ■ Short-writing tasks: percentages at top score (Code 30) for topic development 3. Student Questionnaire data: time spent writing and the variety of writing done outside school
■ Read and understand information presented in a variety of forms (e.g., words, graphs, charts, diagrams)	In the reading component of the test, students are expected to read a variety of texts (narrative, informational and graphic) and demonstrate their understanding of directly stated information and ideas. They are also asked to make inferences and to interpret by connecting the meaning of the texts to their personal knowledge and experience.	1. Overall achievement results 2. Average results among FTE students for clusters of questions (multiple-choice and open-response) by reading skill: understanding explicitly stated information and ideas, making inferences and making connections (interpreting reading selections by integrating information and ideas in a reading selection with personal knowledge and experiences). 3. Student Questionnaire data: time spent reading and the variety of reading done outside school.

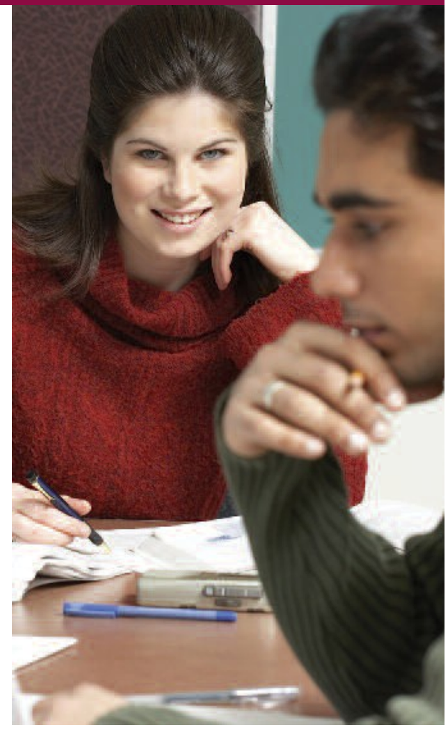
[1] First-time eligible students (FTE) typically entered Grade 9 during the 2008–2009 school year. These students (and any others placed in this cohort) were required to write the OSSLT for the first time in April 2010. "FTE" includes all students in the FTE cohort who are working toward an Ontario Secondary School Diploma (OSSD).

NUMERACY CATEGORY

21st-Century Skills	Mathematics Skills and Processes Assessed by the Grade 9 Assessment of Mathematics	EQAO Data Sources Related to the 21st-Century Skills 2006–2010
▪ Execute mathematical operations accurately ▪ Decide what needs to be measured or calculated ▪ Use relevant mathematical knowledge and skills to explain or clarify ideas	Students are expected to demonstrate a considerable understanding of mathematical concepts and procedures and to apply their knowledge and skills effectively. Students are also expected to select and use a variety of computational strategies; make connections among mathematical concepts and procedures; communicate their thinking in writing using mathematical vocabulary and conventions; connect, compare, select, represent and apply the appropriate mathematical ideas and monitor their thinking.	1. Overall achievement results 2. Item analysis for multiple-choice and open-response questions related to skills of application and of knowledge and understanding 3. Student Questionnaire data: perceptions of mathematical learning and its connection to real-life contexts

CRITICAL THINKING AND PROBLEM SOLVING CATEGORY

21st-Century Skills	Mathematics Skills and Processes Assessed by the Grade 9 Assessment of Mathematics	EQAO Data Sources Related to the 21st-Century Skills 2006–2010
▪ Apply a systematic approach to solve problems ▪ Use a variety of thinking skills to solve problems ▪ Analyze ideas and information to draw conclusions and make judgments	Students are expected to solve problems by selecting and applying a variety of strategies. They have to follow an effective process to find a complete solution and look back at it: make a plan and carry it out; identify the most important elements of the problem; understand relationships between elements; and draw appropriate conclusions with supporting evidence.	1. Overall achievement results 2. Item analysis for multiple-choice and open-response questions related to problem solving
	Literacy Skills Assessed by the OSSLT	**EQAO Data Sources Related to the 21st-Century Skills 2006–2010**
	Students are expected to analyze ideas and information in reading selections and respond to questions that require them to make and justify interpretations of a text.	1. Average results among FTE students for clusters of questions (multiple-choice and open-response) related to the reading skills of making inferences and making connections (interpreting reading selections by integrating information and ideas in a reading selection with personal knowledge and experience) 2. Item analysis for multiple-choice and open-response questions related to these same reading skills



FINDINGS

An examination of the OSSLT and the Grade 9 Assessment of Mathematics (including Student and Teacher Questionnaires) indicates that there is a link to some of the 21st-century skills in the categories of communication, numeracy and critical thinking and problem solving.

The following information from the OSSLT and the Grade 9 Assessment of Mathematics provides indications of how Ontario secondary school students are progressing toward acquiring the 21st-century skills described above.

COMMUNICATION CATEGORY

Since 2006, more than 80% of fully participating FTE students have been successful on the OSSLT. Students successful on the test have acquired the basic cross-curricular literacy skills in reading and writing up to the end of Grade 9 and are progressing toward the acquisition of the 21st-century skills related to communication (writing clearly, correctly and effectively and understanding information presented in a variety of forms).

Over the past five years,

- approximately one-third of students have reached the top scores (Codes 50 and 60) for topic development on the long-writing tasks. Students who reached the top scores were able to communicate clearly and effectively by organizing specific and relevant ideas and by developing a clearly stated opinion or a clear, consistent focus. The other two-thirds of students require continued support to ensure that they become able to communicate effectively and develop clear, well-organized writing.
- more than three-quarters of students have reached the top score (Code 30) on topic development on the short-writing tasks. These students were able to communicate clearly by supporting a main idea in complete sentences.
- the Student Questionnaire data have shown that more than 90% of students applied their skills outside school to write e-mail messages and have chat-room conversations. However, less than one-half of students applied their skills to write in other forms for their own use outside school, including personal and work-related writing.
- successful students have performed equally well on reading questions assessing all three reading skills, which means that they were able to read, understand and respond to information presented in a variety of forms (narrative, informative, graphic text). Unsuccessful students have had difficulty with questions assessing all three reading skills.
- the Student Questionnaire data have shown that more than one-half of students applied their reading skills to interact with a variety of texts, such as Web sites, e-mail messages, magazines, newspapers and fiction, for their own use outside school.

NUMERACY CATEGORY

Academic Mathematics Course

Since 2006, approximately three-quarters of students taking the academic mathematics course have performed at or above the provincial standard (Level 3). These students were able to apply their knowledge and skills in mathematics effectively and were progressing toward acquiring the 21st-century skills related to numeracy (performing mathematical operations accurately, deciding what to measure or calculate, and explaining or clarifying mathematical thinking).

Over the past five years,

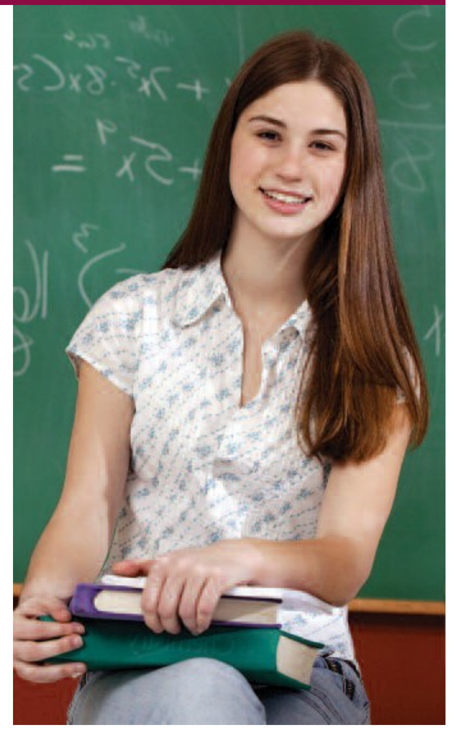
- approximately two-thirds of students have performed well on multiple-choice questions assessing knowledge and understanding, and the application of mathematical concepts. This suggests that students were able to select and use computation strategies and apply formulas related to the assessed concepts.
- one-half to three-quarters of students have received the top scores (Codes 30 and 40) on the majority of open-response questions assessing the application of mathematical concepts. Students who reached the top scores were able to use relevant mathematical knowledge to represent and explain their mathematical thinking.
- the Student Questionnaire data have shown that although nearly three-quarters of students indicated that they understood most of what they have been taught, fewer than one-half of students stated that the mathematics they were learning was very useful for everyday life, suggesting that many students did not see real-life connections to the mathematics they were learning.

Applied Mathematics Course

Since 2006, just over one-third of students taking the applied mathematics course have performed at or above the provincial standard (Level 3). These students were able to apply their knowledge and skills in mathematics effectively and were progressing toward acquiring the 21st-century skills related to numeracy (performing mathematical operations accurately, deciding what to measure or calculate, and explaining or clarifying mathematical thinking).

Over the past five years,

- more than one-half of students have performed well on multiple-choice questions assessing knowledge and understanding, and the application of mathematical concepts. These students were able to select and use computation strategies and apply formulas related to the assessed concepts.
- one-third to two-thirds of students have received the top scores (Codes 30 and 40) on the majority of the open-response questions assessing the



application of mathematical concepts. Students who received the top scores were able to use relevant mathematical knowledge and skills to represent and explain their answers.

- the Student Questionnaire data have shown that although almost two-thirds of students indicated that they understood most of what they have been taught, fewer than one-half of students stated that the mathematics they were learning was very useful for everyday life, suggesting that many students did not see real-life connections to the mathematics they were learning.

CRITICAL THINKING AND PROBLEM SOLVING CATEGORY

Students who performed at or above the provincial standard (Level 3) on the Grade 9 Assessment of Mathematics and met the minimum standard for literacy on the OSSLT were progressing toward acquiring the 21st-century skills related to critical thinking and problem solving (applying a variety of thinking skills and a systematic approach to solving problems, and analyzing information to make judgments and draw conclusions).

Academic Mathematics Course

Over the past five years,

- students taking the academic mathematics course have generally performed well on multiple-choice and open-response questions assessing problem solving, indicating they were able to select and use problem-solving strategies to determine a solution and support their thinking.
- students have performed better on questions assessing knowledge and understanding and the application of mathematical concepts than on the questions assessing problem solving.

Applied Mathematics Course

Over the past five years,

- students taking the applied mathematics course have performed least well on multiple-choice and open-response questions assessing problem solving, indicating that they had difficulty solving multi-step problems.

OSSLT

Over the past five years,

- at least three-quarters of students have performed well on multiple-choice questions assessing the reading skills of making inferences and constructing interpretations based on the ideas and information in different reading selections.

- one-half to three-quarters of students have received the top score (Code 30) for open-response questions related to these same reading skills, indicating that they could interpret texts and support their interpretations.
- unsuccessful students have had difficulty analyzing ideas and information in texts to make judgments, draw conclusions and support their answers.

SUMMARY

Although the full range of 21st-century skills is more comprehensive than what is discussed in this report, data from the Grade 9 Assessment of Mathematics and the OSSLT provide one indication of how well Ontario secondary school students are progressing toward acquiring the 21st-century skills in communication, numeracy, and critical thinking and problem solving. The findings suggest that the majority of students were well on their way to acquiring these essential and enduring skills. However, the findings also suggest areas for consideration when providing support for students. These include

- using critical-thinking skills to solve problems;
- communicating ideas clearly, coherently and effectively and
- making real-life connections to numeracy and literacy skills.

The 21st-century skills are enduring and have an impact on students' academic, personal and work lives. All students today—not only a select few—need to acquire them.

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Education Quality and Accountability Office

EQAO

2 Carlton Street
Suite 1200
Toronto ON M5B 2M9

Telephone: 1-888-327-7377
Web site: www.eqao.com

02

Teacher and School Practices Influencing Math Achievement

Characteristics of High- and Low-Achieving English-Language Schools (2012)

Comparative Examination of the Influence of Selected Factors on Achievement in Grade 9 Academic and Applied Mathematics Courses in English-Language Schools in Ontario (2013)

EQAO RESEARCH

February 2012 Research Bulletin #8

This bulletin summarizes results that are part of a larger, comprehensive study being conducted by EQAO to better understand school and teacher practices that contribute to higher levels of student achievement on the Assessments of Reading, Writing and Mathematics in the primary and junior divisions. The focus of the analysis for this bulletin was on the responses to the principal, teacher and student questionnaires to identify differences in attitudes and behaviours between respondents in high- and low-achieving schools.

Characteristics of High- and Low-Achieving English-Language Schools

By Rhona Shulman, M.A., and Michael Kozlow, Ph.D., Education Quality and Accountability Office

SUMMARY OF TRENDS OF EDUCATIONAL INTEREST BASED ON QUESTIONNAIRE DATA FROM 2008–2009 AND 2009–2010

Characteristics of High-Achieving Schools Relative to Those of Low-Achieving Schools

Teacher Responses (Class Level)

- More sharing of information and use of a wider variety of means of communication with parents and guardians
- Greater sense of community (co-operation, respect, pride) among students and staff
- More mathematics classes taught in the morning
- More evidence of improvement-goal setting, high student expectations and enforcement of rules
- More use of EQAO resources in Grade 3
- More years of teaching experience

Principal Responses (School Level)

- More sharing of information with parents and more parent participation and collaboration with teachers
- Greater sense of community
- Greater success in accomplishing improvement goals for mathematics
- More meetings related to school data and instructional and student matters for the Grade 3 sample
- More opportunities for extended learning activities
- Lower rate of student absenteeism

Student Responses

- More engagement in reading and mathematics
- More use of subject-specific cognitive strategies and instructional tools
- More participation in physical activities outside school
- More discussions with parents or another adult at home about school work, school activities and school agenda
- Less frequent playing of video games, watching of TV and use of the Internet

There is a high level of congruency between the characteristics reported in high-achieving schools and the indicators identified in the literature on effective school practices.

EQAO Research

EQAO undertakes research for two main purposes:

- **to maintain best-of-class practices and to ensure that the agency remains at the forefront of large-scale assessment and**
- **to promote the use of EQAO data for improved student achievement through the investigation of means to inform policy directions and decisions made by educators, parents and the government.**

EQAO research projects delve into the factors that influence student achievement and education quality, and examine the statistical and psychometric processes that result in high-quality assessment data.

Research conducted by

Rhona Shulman, M.A.,
For EQAO

Michael Kozlow, Ph.D.,
Director, Data and Support Services, EQAO

Acknowledgement
This research project was a collaborative effort among EQAO staff on the Assessment and Data Management and Analysis teams.

METHOD

The 2008–2009 and 2009–2010 questionnaire results for principals, teachers and students were sorted into high- and low-achieving-school categories based on the definitions in the sidebar. High- and low-achieving schools for Grades 3 and 6 were identified separately, which yielded two samples for each year (the Grade 3 sample and the Grade 6 sample). If a school had both Grade 3 and Grade 6 students, the principal completed only one questionnaire. Therefore, there are some principal questionnaire results that apply to both samples. Demographic information for the students in the samples was also analyzed. Principal, teacher and student responses were summarized for each sample, and differences between the responses in high- and low-achieving schools were examined. Responses were considered to be similar if the difference was smaller than five percent, which was considered to be an educationally meaningful difference.

The questionnaires were revised and expanded between the two test administrations. The revised questionnaires for 2009–2010 had a specific focus on mathematics, while the questionnaires for 2008–2009 covered reading, writing and mathematics. There were a number of items common to both sets of questionnaires. The questionnaires included numerous items (see sidebars); only the highlights are presented in this bulletin.

CHARACTERISTICS THAT ARE RELATED TO ACHIEVEMENT BASED ON FINDINGS FROM TEACHER AND PRINCIPAL QUESTIONNAIRE RESPONSES

Sense of Community: Teachers in high-achieving schools responded more favourably than teachers in low-achieving schools to most items related to school climate (tone and relationships promoted in the school). The trends for principals were similar to those for teachers, but the responses for principals were more positive than those for teachers in both high- and low-achieving schools, and the differences were smaller for principals.

School Climate: Percentage of Principals and Teachers in the 2009–2010 Grade 3 Sample Who "Strongly Agree" or "Agree"*

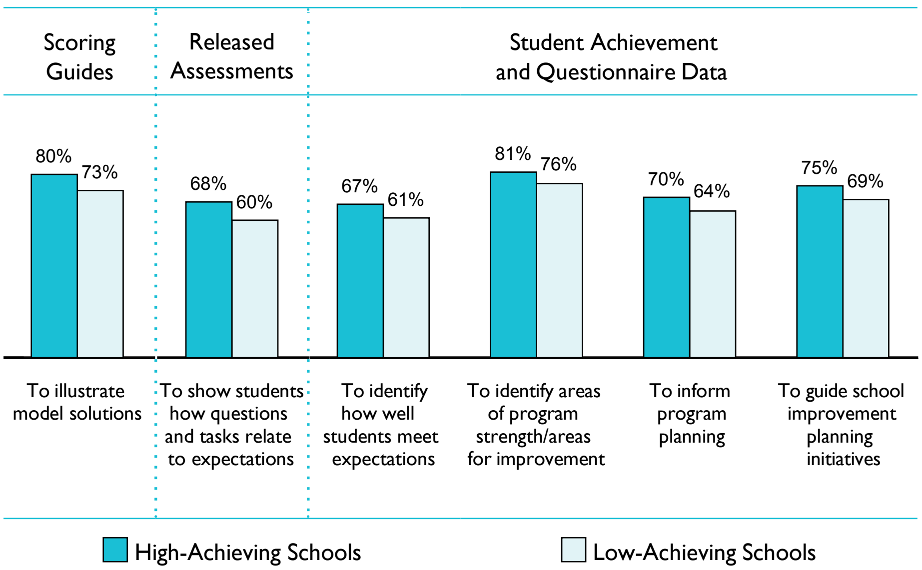
	Teachers		Principals	
Questionnaire Item	High-Achieving Schools	Low-Achieving Schools	High-Achieving Schools	Low-Achieving Schools
Students take pride in this school.	90%	69%	96%	90%
There is strong school spirit in this school.	80%	61%	91%	83%
Students at this school respect one another.	82%	52%	93%	81%
There is co-operation at this school among students.	88%	64%	95%	86%
There is co-operation between students and teachers.	91%	76%	96%	90%
There is co-operation between teachers and parents.	86%	63%	92%	83%
Staff consistently enforces rules for student conduct.	74%	64%	n/a	n/a
The school culture promotes success for all students.	91%	80%	n/a	n/a
Had support of other staff in work toward math improvement goals.	73%	65%	n/a	n/a

* A similar pattern of differences was observed in the responses of principals in the Grade 6 sample and in those of Grade 6 teachers.

Teaching Mathematics in the Morning: A larger percentage of teachers in high-achieving schools than in low-achieving schools reported teaching mathematics classes in the morning (37% compared to 32%, respectively, in Grade 3, and 51% compared to 46%, respectively, in Grade 6).

Use of EQAO Resources: A larger percentage of Grade 3 teachers in high-achieving schools than in low-achieving schools used EQAO resources for a variety of purposes (see table below). Smaller differences among Grade 6 teachers were noted for the following: using sample EQAO student assessments and scoring guides as a model for designing assessments, using EQAO data to identify how well students are meeting curriculum expectations, and communicating with parents and guardians about student achievement.

EQAO Resources Used Most Frequently by Grade 3 Teachers in 2008–2009



Years of Teaching Experience: A larger percentage of primary- and junior-division teachers in high-achieving schools than in low-achieving schools had taught for 11 years or more (on average 49% and 39%, respectively). A larger percentage of teachers in low-achieving schools than in high-achieving schools had taught for two years or less (on average 44% and 34%, respectively).

Staff Collaboration and Improvement Planning: Principals in the Grade 3 sample in high-achieving schools had more frequent meetings to discuss school data and instructional and student-related matters than did principals in low-achieving schools. As well, a larger percentage of principals in high-achieving schools reported considerable success in accomplishing goals related to improvement planning for mathematics than did their colleagues in low-achieving schools in both the Grade 3 and Grade 6 samples.

High-Achieving Schools

Schools in which 75% or more of the students achieved the provincial standard or above (Levels 3 and 4)

Low-Achieving Schools

Schools in which fewer than 50% of the students achieved the provincial standard or above (Levels 3 and 4)

These definitions are based on the EQAO reading results from 2008–2009 and the mathematics results from 2009–2010.

Components of Teacher Questionnaires

- Classroom demographics *(2 items)*
- Teaching background, experience and professional development *(16 items)*
- Resources for instruction and assessment of reading, writing and mathematics *(58 items)*
- Teacher collaboration *(6 items)*
- Use of EQAO resources *(25 items)*
- School climate *(23 items)*
- Parental engagement *(20 items)*

Demographic and Contextual Similarities

The profiles for **principals** in high- and low-achieving schools were similar in terms of

- gender,
- training and experience,
- professional development,
- use of EQAO data and
- ways in which results were communicated to staff.

The profiles for **teachers** in high- and low-achieving schools were similar in the following respects:

- gender,
- professional development,*
- accessibility of resources for instruction and assessment and
- frequency and use and availability of specified resources.

* More teachers in low-achieving schools had participated in special education courses.

Components of Principal Questionnaires

- Background information, experience and professional development *(10 items)*
- School demographics *(4 items)*
- Staff collaboration and improvement planning *(18 items)*
- School climate and learning opportunities *(16 items)*
- Use of EQAO resources *(12 items)*
- Parental engagement *(30 items)*

Improvement-Planning Activities: Percentage of Principals in the Grade 3 Sample Who Indicated the School Was "Very Successful" or "Successful" in 2009–2010*

Questionnaire Item	High-Achieving Schools	Low-Achieving Schools
Analyzing student achievement data	42%	27%
Identifying strategies to improve instruction	45%	30%
Clarifying expectations for student achievement	48%	32%
Establishing one or more improvement teams	50%	40%

* A similar pattern of differences was observed in the responses of principals in the Grade 6 sample.

Teachers in high-achieving schools reported more frequent but briefer meetings to plan or discuss instruction, general school issues, tracking of student progress and participation in school-based professional development activities; teachers in low-achieving schools met a bit less often but for longer periods of time.

Parental Engagement: Although there were some similarities between the responses of teachers in high- and low-achieving schools to the questions on parental engagement, teachers in high-achieving schools were more proactive in sharing information and used more ways to communicate with parents and guardians, particularly in Grade 3, than those in low-achieving schools. A larger percentage of principals in high-achieving schools than in low-achieving schools indicated success in sharing information with parents, parent participation in school activities and parents working collaboratively with teachers. Smaller differences were reported for items related to considering parental input and providing school activities for parents and families (e.g., sessions on mathematics and literacy and on ways to provide academic and social support for their child).

Parental Engagement: Percentage of Principals in the Grade 3 Sample Who Indicated to "A Great" or "Some Extent" in 2009–2010*

Questionnaire Item	High-Achieving Schools	Low-Achieving Schools
Parents or guardians participated in school activities	85%	73%
Parent showed support for teachers' efforts	93%	79%
Parents volunteered in classroom activities	83%	59%
Parents worked collaboratively with teacher to meet learning goals	80%	53%

* A similar pattern of differences was observed in the responses of principals in the Grade 6 sample.

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Extended Learning Opportunities (2009–2010): A large percentage of principals in both high- and low-achieving schools indicated that extended opportunities were provided for students in **reading** (in the Grade 3 sample, 79% of principals in high-achieving schools and 75% in low-achieving schools responded to "a great" or "some extent"). Fewer schools offered extended learning opportunities in **mathematics**; a greater percentage of principals in high-achieving schools than in low-achieving schools responded to "a great" or "some extent" (e.g., 41% of principals compared to 25%, respectively, in the Grade 3 sample). A similar pattern of responses was observed among principals in the Grade 6 sample.

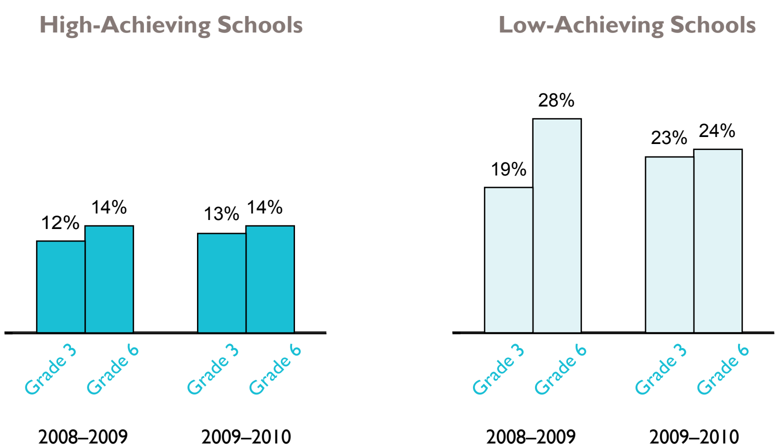
CHARACTERISTICS RELATED TO ACHIEVEMENT ACCORDING TO FINDINGS FROM STUDENT DEMOGRAPHIC DATA AND QUESTIONNAIRE RESPONSES

STUDENT CHARACTERISTICS

Demographic Similarities: Students in high- and low-achieving schools were similar with respect to the following demographic variables: birth in Canada, length of time in the board, first language learned at home and use of English at home.

Demographic Differences: For both cohorts and both grade levels, there was a consistently larger percentage of students with special education needs in low-achieving schools than in high-achieving schools.

Percentage of Students with Special Education Needs (Excluding Gifted)



Student Population

The number of schools and students was different in the two cohorts due to a change in selection criteria based on reading achievement in 2008–2009 and mathematics achievement in 2009–2010.

STUDENT ATTITUDES

In What Ways Were Students' Attitudes Similar? Student responses in high- and low-achieving schools were similar for 18 of 45 items in both Grades 3 and 6. Students in high- and low-achieving schools responded in a similar way to the following items:

- perceptions about writing;
- use of a computer at school;
- reading materials outside school, such as comics, graphic novels and instant messages, and
- participation in activities such as art, music and after-school clubs outside school.

These trends were consistent between 2008–2009 and 2009–2010.

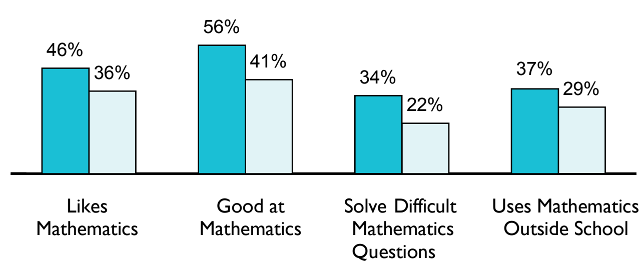
Differences in Students' Engagement with Literacy and Numeracy: The most notable finding was that the small differences between the engagement in mathematics and reading of the Grade 3 cohort in high- and low-achieving schools became larger in Grade 6. Responses for students in high-achieving schools were more positive than those for students in low-achieving schools. The results for Grade 6 students are presented in the graphs below.

Components of Student Questionnaires

- Engagement in reading, writing and mathematics *(15 items)*
- Cognitive strategies and instructional tools used in mathematics *(9 items)*
- Computer use *(3 items)*
- Out-of-school activities *(5 items)*
- Screen time *(6 items)*
- Parental engagement *(7 items)*

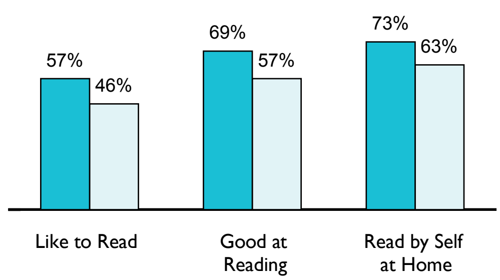
Grade 6 Students' Engagement in Mathematics, 2009–2010

Percentage of Students Who Responded "Most of the Time"



Grade 6 Students' Engagement in Reading, 2008–2009

Percentage of Students Who Responded "Yes"



High-Achieving Schools Low-Achieving Schools

The above attitudes of students with special education needs were similar in high- and low-achieving schools. Among other students, the attitudes were more positive in high-achieving schools.

Other Differences: Students in high-achieving schools responded somewhat more favourably than students in low-achieving schools to items such as the following:

- reading by myself “every day or almost every day” (59% and 53% of students, respectively);
- reading the whole math question to make sure I know what to do (72% and 64% of students, respectively);
- participating in sports and other physical activities three to seven days per week (81% and 73% of students, respectively) and
- talking about school activities with a parent or another adult at home (73% and 67% of students, respectively).

A larger percentage of students in low-achieving schools than in high-achieving schools indicated doing the following when not at school:

- playing video games “every day or almost every day” (41% and 35% of students, respectively) and
- watching four TV programs or more after school (59% and 50% of students, respectively).

Gender: Gender differences were similar in high- and low-achieving schools for most questionnaire items.

IMPLICATIONS

The findings in this review confirm that characteristics identified and associated with effective schools were present to a greater extent in high-achieving schools than in low-achieving schools. In particular, the largest differences were observed for the following factors:

- school climate established by school staff for learning,
- meeting improvement-planning goals,
- parental engagement and
- engagement of students in learning.

The characteristics exemplified by teachers, principals and students in these high-achieving schools could be a useful starting point as teachers and principals focus on school improvement planning to improve the learning opportunities for students in their schools.

Some Areas to Consider

It is important to keep in mind that the data presented in this bulletin are summary results of high- and low-achieving schools and that they do not characterize all schools in either category. There is a wide range of response patterns in both groups.

The purpose of this bulletin is to stimulate conversations that will lead to action on behalf of students. It is important that principals and teachers reflect on how the findings apply to their school. The following points may assist in guiding discussions toward leadership action:

- the importance of common goals, values and expectations among students, staff and parents;
- the promotion and nurturing of positive relationships among colleagues, students and parents;
- effective use of data 1) to meet curriculum and instructional goals and 2) to improve student achievement;
- successful strategies for engaging parents in their children's learning and strategies to improve current practices;
- levels of student engagement in their own learning and success and
- information and strategies for teachers to help all students become effective learners (differentiated instruction).

The following resources on the EQAO Web site may be of some assistance in addressing some of these issues:

- *Exploring the Underlying Traits of High-Performing Schools*
- "Strategies That Work for Schools: Thinking Globally in the Postmodern World"
- "School Stories—Case Studies: Schools on the Journey of Learning"

SAMPLE SIZE

The number of schools and completed questionnaires for each of the eight samples are presented below.

Number of Schools and Completed Questionnaires

	Primary Division: Grade 3				Junior Division: Grade 6			
	2008–2009 (Reading)		2009–2010 (Mathematics)		2008–2009 (Reading)		2009–2010 (Mathematics)	
	High Achieving	Low Achieving	High Achieving	Low Achieving	High Achieving	Low Achieving	High Achieving	Low Achieving
Schools	686	897	1 473	422	1 226	344	750	977
Principal Questionnaires	682	874	1 456	412	1 207	329	740	960
Teacher Questionnaires	1 651	2 072	3 855	892	2 686	672	1 624	2 092
Student Questionnaires	24 032	26 570	57 246	11 186	50 745	10 244	30 973	34 113

Education Quality and Accountability Office
EQAO

2 Carlton Street,
Suite 1200,
Toronto ON M5B 2M9
Telephone: 1-888-327-7377
Web site: www.eqao.com

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RESEARCH

Comparative Examination of the Influence of Selected Factors on Achievement in Grade 9 Academic and Applied Mathematics Courses in English-Language Schools in Ontario

Report prepared for the Education Quality and Accountability Office (EQAO) by

Xiao Pang

Psychometrician, EQAO

W. Todd Rogers

Scholar-in-Residence, EQAO, University of Alberta

JUNE 2013

About the Education Quality and Accountability Office

The Education Quality and Accountability Office (EQAO) is an independent provincial agency funded by the Government of Ontario. EQAO's mandate is to conduct province-wide tests at key points in every student's primary, junior and secondary education and report the results to educators, parents and the public.

EQAO acts as a catalyst for increasing the success of Ontario students by measuring their achievement in reading, writing and mathematics in relation to *Ontario Curriculum* expectations. The resulting data provide a gauge of quality and accountability in the Ontario education system.

The objective and reliable assessment results are evidence that adds to current knowledge about student learning and serves as an important tool for improvement at all levels: for individual students, schools, boards and the province.

About EQAO Research

EQAO undertakes research for two main purposes:

- to maintain best-of-class practices and to ensure that the agency remains at the forefront of large-scale assessment and
- to promote the use of EQAO data for improved student achievement through the investigation of means to inform policy directions and decisions made by educators, parents and the government.

EQAO research projects delve into the factors that influence student achievement and education quality, and examine the statistical and psychometric processes that result in high-quality assessment data.

EQAO RESEARCH

Education Quality and Accountability Office, 2 Carlton Street, Suite 1200, Toronto ON M5B 2M9, 1-888-327-7377, www.eqao.com

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Abstract

The purpose of the present study was to identify student and teacher variables that influence the achievement of English-language students, in both academic and applied courses, on the Grade 9 Assessment of Mathematics. A two-level (student and teacher) hierarchical linear modeling (HLM) analysis was conducted.

For the academic course, 19 student variables accounted for 54 percent of the initial variance in student achievement, while 12 teacher variables accounted for 67 percent of the variance. For the applied course, 18 student variables accounted for 41 percent of the initial variance and 15 teacher variables accounted for 33 percent of the variance. Some of the coefficients for the predictor variables were the same for the academic and applied courses, while others differed. For example, the largest coefficient at the teacher level, whether or not teachers counted some or all of the components of the EQAO assessment as part of their students' final course marks, was essentially the same for both courses. In contrast, the coefficient for students with special education needs was much larger for the applied course than for the academic course. In addition, students who completed their homework outperformed students who did not to a greater degree in the academic course than in the applied course.

Given that there is variance yet to be explained, it would be useful to explore what other variables might account for the unexplained variance. Further, given that approximately one-third of the students in the applied course were students with special education needs compared with about one in 20 in the academic course, it might be prudent to replicate the two-level analyses with these students removed from the corresponding samples. This would help identify and describe similarities and differences between the remaining students in the two courses.

Introduction

The Educational Quality and Accountability Office (EQAO) is responsible for the assessment program in Ontario. EQAO annually administers assessments in language arts and mathematics at the end of the primary (Grade 3) and junior (Grade 6) divisions and in mathematics in Grade 9 academic and applied courses, in each of Canada's two official languages—English and French. As well, EQAO administers the Ontario Secondary School Literacy Test (OSSLT) in Grade 10 in both languages.

Over the years, students enrolled in the Grade 9 applied mathematics course have consistently performed less well than students enrolled in the academic mathematics course. The lower achievement of students in the applied course is a concern, given the government's focus on improving the learning of all students in the province.

The focus of the present study was the Grade 9 English-language academic and applied mathematics assessments. The French-language assessments were not included in the study due to small sample sizes, particularly at the teacher level. A separate regression analysis was conducted on the results in French-language schools (Pang & Rogers, 2013).

Purpose of the Study

The purposes of the study were:

- to use hierarchical linear modeling (HLM) to systematically examine the influence of an expanded set of multilevel variables, including student background, class/teacher practice and student learning context, on student achievement in 2011
- to examine differences in these relationships in the academic and applied courses

The following specific research questions were addressed:

1. Which student background, class/teacher practice and student-learning context variables are related to achievement on the Grade 9 English-language academic and applied mathematics assessments?
2. Is the influence of the set of variables identified in the analysis for Question 1 similar across courses?

Literature Review

As in other countries, large-scale achievement testing is being used to monitor the quality of education in schools throughout Canada. At the provincial level, all provinces and territories have large-scale achievement testing programs. At the national level, all provinces and one territory participate in the *Pan-Canadian Assessment Program* (PCAP, formerly the School Achievement Indicators Program (SAIP). Internationally, all provinces participate in the *Programme for International Student Assessment* (PISA) (Council of Ministers of Education, www.cmec.ca). The results and information gained from these national and international programs are used to influence policy at the provincial level.

At the same time, increasing attention is being paid on determining student, classroom and school variables that influence achievement (Battistich, Solomon, Kim, Watson, & Schaps, 1995; Beller & Gafni, 1996; Lytton & Pyryt, 1998; Mandeville & Anderson, 1987; Raudenbush & Byrk, 2002; Rogers, Wentzel, & Ndalichako, 1997; Rumberger, 1995; Sammons, West, & Hind, 1997; Willms, 1992). Relevant student-level variables include gender, prior achievement and family characteristics such as socio-economic status (SES). For example, females tend to perform better in language arts and males tend to perform better in mathematics and science (Battistich, Solomon, Kim, Watson, & Schaps, 1995; Beller & Gafni, 1996; Sammons, West, & Hind, 1997; Willms, 1992). Willms (1992) pointed out the essential roles of both prior achievement and SES when studying variables that influence student and school achievement. Rogers, Wentzel and Ndalichako (1997) found that prior achievement accounted for 40 percent to 50 percent of the initial variance in achievement in language arts and mathematics as measured by the corresponding Alberta Provincial Achievement Tests (PATs) at the end of Grades 3 and 6. Lytton and Pyryt (1998) described SES as the "most ubiquitous and significant influence on achievement found in almost all investigations" (p. 282). They found that between 35 percent and 50 percent of the variability in the achievement of elementary school students was attributable to SES.

At the class and school levels, variables such as parental involvement, emphasis on academic success, disciplinary climate in the classroom, teaching and learning activities and procedures and school context have been shown to have strong relationships with student achievement (Ho & Willms, 1996; Zigarelli, 1996; Ma & Klinger, 2000; Ma & Willms, 1995). As at the school level, variables such as class and school size and average SES are often considered in studies of factors that influence achievement (Raudenbush & Willms, 1995; Willms, 1992).

In a follow-up study to Rogers et al. (1997), Rogers, Ma, Klinger, Dawber, et al. (2006) examined the influence of a more comprehensive set of variables at the student, class and school levels on student achievement on the Grade 6 language arts and mathematics PATs. For language arts, retained student variables, in order of strength of prediction, were prior reading achievement; gender; student designated with a mild/moderate disabling condition; number of parents; and reading self-concept. The class variables included teacher gender; percent of students in class who were in Academic Challenge (that is, gifted) programs; percent of students in class who had a speech, hearing, vision or other health-related problem; use of a variety of teaching methods; parent/guardian involvement in their child's education; percent of students in class who were repeating a grade; and use of a variety of assessment methods. The school variables included frequency of severe discipline problems and frequency of academic recognition. These variables accounted for 51.8 percent of the initial variability among students, 72.8 percent of the initial variability among classes and 90.5 percent of the initial variability among schools.

For mathematics, the student variables, in order, were student designated with a mild/moderate disabling condition; prior reading achievement; student designated with a severe disabling condition; mathematics self-concept; number of parents; school enjoyment; and student gender. The class variables were mathematics taught in the morning; percent of students in the class who were repeating Grade 6; percent of students in the class who were gifted; percent of students who worked independently or in small groups; and parent/guardian involvement in their child's education. The school variables included percent of students in school who were chronically late; frequency of severe discipline problems; and percent of students in school who had English as a second language. These variables accounted for 44.0 percent of the variability at the student level, 61.4 percent of the initial variability at the class level and 89.1 percent of the initial variability at the school level. Given that the majority of variability was at the student level and the amount of explained variability was lowest at the student level for both subject areas, additional variables need to be identified to better explain this variability.

The analyses used in the majority of the studies referenced above took into account the hierarchical nature of schools. That is, students belong to classes that in turn belong to schools. If the effects at the class and school levels are not separated, the findings at the student level will be confounded by relationships with variables at the class and school levels. HLM can be used to systematically estimate the separate influences at the student level and class and/or school levels, therefore effectively addressing this issue (Luke, 2004; Raudenbush & Byrk, 2002; Raudenbush & Willms, 1995). For example, Rogers, Ma, et al. (2006) used a three-level (student, class and school) HLM analysis in their study.

Method

Variables

Student achievement on the 2011 Grade 9 Mathematics Assessment in the academic and applied courses was the dependent variable. The scores were expressed as percentages. The reliability of the scores for the academic course was 0.83. For the applied course, the reliability was 0.71. The predictor variables at the student level included prior mathematics achievement, which was expressed as a percentage and measured by the EQAO mathematics assessment administered in Grade 6 in 2008, and the variables measured in the 2011 Student Questionnaire. The predictor variables at the teacher level were the variables measured in the 2011 Teacher Questionnaire and prior achievement aggregated to the teacher level. Prior mathematics achievement was included because previous studies suggested that, if an HLM analysis does not include measures of prior achievement, the estimates of effects at the class and school levels would likely be biased (Willms, 1992, p. 58). While the majority of items were the same in the questionnaires for the academic and applied courses, some items differed because of differences between the two courses (for example, students in the academic course take analytic geometry, while students in the applied course do not).

The questionnaire and background variables for students were organized into six categories:

1) *Attitude toward mathematics:* Students were asked how they felt about mathematics, the usefulness of mathematics and the importance of learning mathematics; their confidence in answering mathematics questions in each of the strands of mathematics; and the reasons they saw for getting good marks in mathematics.
2) *Doing mathematics:* Students were asked how they approached mathematics questions; the time they spent on mathematics homework and how often they completed their mathematics homework; the resources they used to solve a mathematics question (for example, calculator, graphing calculator and computer software); and how often they were absent from mathematics classes.
3) *Out of school activities:* Students were asked how often they participated in various out-of-school activities such as reading; mathematics-related activities; using the Internet; sports, arts activities and clubs; playing video games; volunteering in the community; and working in a paid job.
4) *Expectations about your future:* Students were asked about their expectations for the highest level of education they planned to complete and about the educational expectations their parents held for them.
5) *Background variables:* Students were asked about the number of schools attended and the languages they spoke. Information was obtained from schools on the gender of the students and whether or not students were English-language learners or students with special education needs.
6) *Use of the EQAO assessment results in students' final course marks:* Students were asked if they knew whether or not the assessment results were counted as part of their final course marks; the weighting given to the assessment; and whether this practice motivated them to take EQAO assessments more seriously.

The predictor variables for teachers were organized into seven sections:

1) *About your school:* Teachers were asked how often they met with other school staff for the purposes of discussing general school issues, planning, professional learning, delivery of mathematics curriculum and coordination of mathematics instruction among mathematics teachers; the degree to which they agreed with their school's improvement goals in mathematics in 2011; the level

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of school spirit, respect and co-operation among staff, among students and between staff and students; the degree of consistency of enforcing school discipline; how much emphasis they placed on the quality of student work; how school culture was promoted; and the variety of instruction methods used and disruptions that occurred during instruction time.

2) *Use of EQAO resources for instructional purposes:* Teachers were asked about the extent to which they used EQAO assessments and data to help students understand mathematics questions, to communicate with parents, to inform classroom instruction and to design classroom assessments.
3) *Use of instructional resources in your classroom:* Teachers were asked about the accessibility and frequency of use of calculators, graphing calculators, types of computer software, the Internet, concrete manipulatives (for example, geoboard, algebra tiles and connecting tubes), measuring devices (such as ruler, metre stick and protractor) and presentation technology (for instance, interactive white board and LCD projector).
4) *Teaching practices:* Teachers were asked about the time they spent on each mathematics strand, their teaching practices, the frequency of homework assignments, anticipated time to complete homework and how frequently they used various instructional materials and procedures.
5) *Parental engagement in student learning:* Teachers were asked how often and for what purpose they contacted parents/guardians over a full school year.
6) *Background and professional development:* Teachers were asked to indicate their gender and teaching experience; their area of study during post-secondary education; other qualification training they had completed or were presently engaged in; and their involvement in professional development activities.
7) *Use of EQAO assessment results in students' marks:* Teachers were asked if they included the EQAO assessment results as part of their students' final course marks and, if so, for how much, what is counted (strand, types of items) and who decides; and if they thought counting some or all components of the assessment motivated students to take the EQAO assessments more seriously.

For both the student questionnaires and teacher questionnaires, response options varied according to the nature of the item. For example, a two-point "yes" and "no" format was used for some items (such as, Do some or all of the components of the Grade 9 Assessment of Mathematics count as part of your students' final course marks?). Other items used a four- or five-point labelled Likert scale (for example, According to you, if you get a good mark in mathematics, is it mostly because you were lucky? (five-point Likert scale: 1 = strongly disagree, 2 = disagree, 3 = neither agree nor disagree, 4 = agree and 5 = strongly agree)).

Samples

The student and teacher responses for two samples, one of each course, were analyzed. The following were excluded from the analysis:

- Teachers and students who could not be matched.
- Students who did not respond to at least 50 percent of the questions in their student questionnaire.
- Teachers with fewer than ten students.

Teachers were required to complete only one questionnaire, for either the applied course or the academic course, regardless of the number of classes they taught. The final sample sizes for students and teachers are reported in Table 1.

Table 1
Sample Size

Course	Number of Students	Number of Teachers/Classes
Academic	67 972	2505
Applied	22 457	1441

Data Reduction/Variable Regrouping

To reduce the large number of variables (questionnaire items) at the student and teacher levels, factor analysis was conducted with variables that were logically related and belonged to the same cluster of items within the questionnaires. Three steps were followed:

1) identification of the number of common factors using the Kaiser-Guttman rule,

Scree test and image analysis (Guttman, 1954; Kaiser, 1958; Cattell, 1966; Kaiser, 1963)

2) unweighted least squares extraction of the retained factors followed by a varimax rotation and direct oblimin ($\delta = 0$) (Harman & Jones, 1966; Kaiser, 1958; Jennrich & Sampson, 1966) to obtain a final factor pattern with the best simple structure with clearest interpretation

3) computation of factor scores using unit weighting of variables with pattern coefficients greater than or equal to |0.30| (Morris, 1979)

These analyses resulted in 38 student variables for the academic course and 37 variables for the applied course, including individual items that were not included in the factor analysis, and 63 teacher variables for both courses.

HLM Analysis

A two-level (student and teacher) random-intercepts model with fixed slopes HLM was conducted to determine the influence of the variables on mathematics achievement for the two English-language assessments. All the student variables were grand-mean centred so that the intercept at the student level was the mean for each teacher unit. Since a teacher completed only one questionnaire form, the teacher mean is for all the classes (academic or applied, but not both) that the teacher taught during the semester or year. It was not possible to include school as a level in the HLM analysis because data were not collected at this level.

Each two-level HLM analysis was completed using the HLM 6.08 computer program (Raudenbush, Byrk, Cheong, Congdon, & du Toit, 2004). First, a null model analysis was conducted in which there were no predictor variables. The goal was to obtain an initial partitioning of the total variance into two components corresponding to the student and teacher levels, and to provide estimates of the total variance that is potentially explainable at each level for the academic and applied courses:

$$Y_{ij} = \beta_{oj} + r_{ij} \text{ at the student level}$$

$$\beta_{oj} = \gamma_{00} + u_{0j} \text{ at the teacher level}$$

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where Y_{ij} is the score of student i with teacher j; β_{oj} is the mean of teacher j; r_{ij} is the residual of student i with teacher j; γ_{00} is the grand mean across teachers; and u_{0j} is the residual for teacher j. It is assumed that the residual at the student level is normally and independently distributed with mean zero and variance σ^2 (that is, the student level variance, $r_{ij} \sim NID(0, \sigma^2)$ for $i = 1, 2, ..., n_j$) and the residual at the teacher level is normally and independently distributed with mean zero and variance τ_{00} (that is, the teacher level variance, $u_{0j} \sim NID(0, \tau_{00})$).

Second, a two-level full model analysis (intercepts as outcomes model) was conducted to obtain the final set of influential predictor variables and proportion of explained variance at each level for the academic and applied courses:

$$Y_{ij} = \beta_{oj} + \beta_{kj} \sum_{k=1}^{K} X_{ij} + r'_{ij}$$

$$\beta_{oj} = \gamma_{oo} + \gamma_{0m} \sum_{m=1}^{M} \varphi_{mj} + u'_{0j}$$

$$\beta_{kj} = \gamma_{k0} + u_{kj}$$

where β_{kj} is the coefficient for the k^{th} student predictor for the j^{th} teacher, X_j, k = 1, 2, …, K, for teacher j; r'_{ij} is the residual at the student level remaining after the K predictors have been entered; γ_{0m} is the coefficient for the m^{th} predictor of the mean for teacher j, φ_m, m = 1, 2, …, M; u'_{0j} is the residual at the teacher level after the M predictors have been entered; γ_{k0} is the mean of the β_{kj} across the j teachers; and u_{kj} is the corresponding residual (that is, fixed slopes). The analyses were performed using the observed scores. No problems were encountered due to collinearity of the predictor variables at either level.

Results

Given the large sample sizes, many of the coefficients of the predictor variables at the student and teacher levels were found to be significantly different from zero but small in value. Coefficients as high as 3.057 in absolute value were found at the student level and coefficients as high as 4.666 in absolute value were found at the teacher level. Therefore, the decision was made to retain variables with coefficients that were significantly different from zero at the 0.05 level of significance and at least 0.300 in absolute value. Given that the original score metrics of the variables were retained and to clarify the interpretation of the results, the means and standard deviations of the dependent variable and the influential variables that were retained are provided in Appendix A. The final results of the HLM analyses are reported in Table 2 for the student level and in Table 3 for the teacher level for the academic and applied courses.

Table 2
Student Level Influential Variables for the Academic and Applied Courses

	Academic		Applied	
Variable	Coeff.	SE	Coeff.	SE
Gender	0.923	0.087		
English-language learner	1.110	0.340		
Students with special education needs	–0.667	0.185	–3.057	0.180
Language I speak at home	–0.399	0.072		
Language others speak to me at home	0.724	0.066		
Prior math achievement	0.416	0.003	0.396	0.006
I have a positive attitude toward math	0.592	0.013	0.597	0.023
Math is easy for me	1.076	0.049	1.010	0.094
I work hard	–0.790	0.050	–0.458	0.094
I understand math	–0.368	0.024		
I hide troubles I have with math	–0.503	0.036	–1.004	0.070
I get good marks in math mostly because I am lucky	–0.595	0.041	–0.745	0.076
I am confident that I can answer questions in each of the math strands	0.674	0.017	0.676	0.035
I used the Internet frequently in math	–0.732	0.039	–0.847	0.075
I used calculators and computer measuring devices frequently in math			–0.420	0.066
Time I spend on math homework	–0.408	0.058	–0.664	0.105
How often I completed my math homework	1.507	0.050	0.392	0.077
How often I am absent from my math class	–1.000	0.054	–0.911	0.095
I read frequently outside of school	0.382	0.040	0.569	0.077
I use the Internet frequently outside of school			0.462	0.019
Parent support at home			–0.354	0.021
My parents'/guardians' expectation of my continuing education after secondary school			0.436	0.110
I know the assessment results will be counted as part of my final course mark	0.841	0.047	0.651	0.085

The values of the coefficients and their standard errors for the retained variables

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are reported. The bio-demographic variables that satisfied the inclusion criteria mentioned above are listed first, followed by the remaining questionnaire variables organized in terms of the sections in the student and teacher questionnaires that met the inclusion criteria. The sections of the questionnaires are described in the *Variables* section of the report under *Method*.

The values of the coefficients are interpreted as follows. At the student level, the coefficient for *prior mathematics achievement* is 0.416 for the academic course. This value indicates that by holding all of the other student variables constant except *prior mathematics achievement*, a change of one standard deviation in *prior mathematics achievement* (16.0 percent) is associated with an improvement of 0.416 standard deviations or 7.1 percent in achievement on the academic mathematics assessment. In the case of a dichotomous variable like *gender*, the value 0.923 indicates that females scored, on average, 0.923 standard deviations or 15.7 percent higher on the academic mathematics assessment than males, holding all other variables constant.

At the teacher level (Table 3), the coefficient for *prior mathematics achievement* is 0.330 for the academic course. This value indicates that by holding all of the other teacher variables constant except *prior mathematics achievement*, a change of one standard deviation in the mean *prior mathematics achievement* (4.6 percent) is associated with an improvement of 0.326 standard deviations or 1.5 percent in the teacher mean achievement on the academic mathematics assessment. It is important to note that there is no cause-and-effect claim. Instead, these results reflect a relational interpretation that indicates, for example, that high scores on the mathematics assessment in Grade 6 tend to go with high scores on the academic mathematics assessment in Grade 9, and that females tend to score higher than males on this test at the student level and at the teacher level (Rogers, Anderson, Klinger, & Dawber, 2006).

Table 3
Teacher Level Influential Variables for the Academic and Applied Courses

	Academic		Applied	
Variable	Coeff.	SE	Coeff.	SE
Gender	0.902	0.212	1.638	0.313
Prior math achievement	0.330	0.016		
Instruction coordinated among teachers	0.397	0.075		
Students and diversity respected in school			0.592	0.132
Fair and consistent enforcement of school rules			–0.366	0.099
Frequency of using concrete manipulatives			0.395	0.191
Assignment of homework	1.040	0.195		
Time spent on completing homework	0.600	0.184		
Frequency of contacting parents to discuss child's progress			0.675	0.178
Frequency of contacting parents to discuss child's behaviour			–0.682	0.202
Additional qualification: computer and technology			–2.006	0.680
No additional courses enrolled	–0.560	0.243		
Number of years teaching mathematics at secondary level			0.418	0.144
Professional development in teaching students with special education needs	–0.579	0.218		
I count assessment results as part of final course marks	4.166	1.050	4.666	1.200
The assessment counts x% as part my final course marks	0.667	0.118	0.425	0.171
I tell my students how much assessment results will count as part of their final course mark			–2.124	1.011
In my opinion, counting assessment results motivates students to take the assessment more seriously	1.059	0.197	0.683	0.252
I count the multiple-choice items as part of final course marks	–0.946	0.250	–0.780	0.351
I count the open-response items as part of final course marks			0.662	0.238
I believe the time to complete the assessment was sufficient	0.634	0.219	1.095	0.396

The intent of the present study was to identify student and teacher variables that are related to achievement on the mathematics assessments in the academic and applied courses and then determine if the influential factors were the same for the two courses. Comparisons between variables at the student level for the academic and applied courses are presented first, followed by comparisons of the two courses at the teacher level.

Student Level

Of the initial 38 student variables for the academic course, 19 were retained; of the initial 37 student variables for the applied course, 18 were retained. The first six predictors listed in Table 2 at the student level are bio-demographic variables and, as such, are not amenable to manipulation. Of the six, only two were common to both the academic and applied courses. While the first and largest coefficient for the applied course was for *students with special education needs*, –3.057, the coefficient for the academic course was much smaller in absolute value, –0.667. Students with special education needs who took the academic course performed less well (11.3 percent, holding all other variables constant) than other students in the course; in contrast students with special education needs who took applied course performed *much* less well (49.2 percent, holding all other variables constant) than other students in the course. The difference in these coefficients is likely due to the difference in the proportions of students identified with special education needs in the academic and applied courses: 5 percent versus 33 percent, respectively. The specific education needs for students choosing the two courses may also differ. In contrast, the coefficients for *prior mathematics achievement* were more similar. Students in the academic course who performed well in Grade 6 scored 0.416 standard deviations (7.1 percent) higher on the Grade 9 assessment than did students who performed less well in Grade 6, while students in the applied course scored 0.396 standard deviations (6.4 percent) higher.

Four additional student background variables also predicted achievement on the academic assessment but not on the applied assessment. *English language learners* performed 1.110 standard deviations higher (18.9 percent, holding all other variables constant) in Grade 9 than other students in the academic course. Consistent with this finding, students who tended to be *spoken to in a language other than English* performed 0.724 standard deviations (12.3 percent) higher than students in homes where English was the dominant language spoken. However, students who spoke a language other than English at home did less well than students who spoke English by 0.399 standard deviations (6.8 percent). Lastly, *girls* outperformed *boys* by 0.923 standard deviations (15.7 percent).

Of the variables that potentially could be manipulated, *completion of homework* was the strongest predictor for the academic course, but was a weak predictor for the applied course. Whereas students in the academic course who completed their homework outperformed those who tended not to complete their homework by 1.507 standard deviations (25.6 percent, holding all other variables constant), students in the applied course who completed their homework outperformed those who tended not to complete their homework by a lesser amount, 0.382 standard deviations (6.3 percent).

The next three largest differences between the students in the academic and applied courses were *I hide troubles I have with math*, *I work hard* and *I read frequently outside of school*. The impact of hiding troubles with mathematics was stronger for students in the applied course than in the academic course (–1.004 versus –0.503). In contrast, *I work hard* was also negatively related to achievement, but the impact was stronger for students in the academic course than for those in the applied course (–0.790 versus –0.458). The observation that students who tend to hide the troubles they are having with mathematics achieve less well than those who do not is troublesome; these students should feel free to ask their teachers for assistance.

Interestingly the coefficient for *I read frequently outside of school* is larger for the applied course than for the academic course. Students in the applied course who reported they read by themselves outside of school scored, on average, 0.569 standard deviations higher than those who did not, while students in the academic course who reported they read by themselves outside of school scored 0.382 standard deviations higher than those who did not.

Several student variables had more similar relations to achievement for both courses. For example, *knowing that EQAO results will be counted as part of the final course mark* had a positive effect on achievement in both courses. Students in the academic course who knew that the EQAO marks would be included as part of their final course marks scored 0.841 standard deviations (14.3 percent) higher than students who said they did not know, while this group of students in the applied course scored 0.651 (10.5 percent) higher. Students in both courses who indicated that *math is easy* scored on average 1.076 (academic) and 1.010 (applied) standard deviations higher than students who found mathematics to be more difficult.

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In contrast, student *absence from the math class* was negatively related to achievement for both courses; students who were frequently absent scored on average 1.000 (academic; 17.0 percent) and 0.911 (applied; 14.7 percent) standard deviations lower than students who were infrequently absent from their math class. The coefficients were almost equal in the two courses for *confidence about answering questions in each of the math strands*; students who felt confident answering the questions outperformed those who felt less confident by 0.674 (academic) and 0.676 (applied) standard deviations. This was also true for *I have a positive attitude toward math*, with coefficients of 0.592 for the academic course and 0.597 for the applied course. *I get good marks in math mostly because I am lucky* and *I use the Internet in math frequently* were both negatively related to achievement in both courses. Students who indicated they get good marks in mathematics because they are lucky outperformed students who felt otherwise by 0.595 standard deviations for the academic course and by 0.745 standard deviations for the applied course. Students who frequently used the Internet in mathematics performed less well by 0.732 (academic) and 0.847 (applied) standard deviations than students who infrequently used the Internet in mathematics.

Of the remaining five predictor variables, one was related to achievement in the academic course but not in the applied course, and four were related to achievement in the applied course but not in the academic assessment. Students in the academic course who indicated they *understand math* performed less well than students who indicated they did not understand math by 0.368 standard deviations. Students in the applied course who indicated that they *frequently used calculators and measuring devices* in class scored 0.420 standard deviations lower than students who used these resources less frequently, but students in the applied course who indicated that *they use the Internet frequently outside of school* scored 0.462 standard deviations higher than students who did so less frequently. The last two variables were related to parents of the students in the applied course. Students whose *parents had high expectations of my continuing education after secondary school* outperformed students whose parents had low expectations by 0.436 standard deviations. However, students whose *parents showed more support* performed less well than students whose parents showed less support by 0.354 standard deviations. It may well be that students who receive more support from their parents are among those who are having greater difficulty in learning math.

Teacher Level

Of the 63 teacher variables, 12 were retained for the academic course and 15 were retained for the applied course (see Table 3). Only one of the two teacher bio-demographic variables had a coefficient that was significantly different from zero for both courses. Classes *taught by male teachers* outperformed classes taught by female teachers by 0.902 standard deviations or 4.1 percent for the academic course and by 1.638 standard deviations or 8.0 percent for the applied course. Interestingly, *prior math achievement (Grade 6)* influenced achievement in the Grade 9 academic course at the teacher level (0.330 standard deviations, holding all other variables constant), but not in the applied course.

Of the remaining variables, five were related to achievement for both courses, eight were related to achievement only for the academic course and nine were related to achievement only for the applied course. The largest coefficient for teachers of academic and applied courses was for the classes in which *teachers count assessment results as part of final course marks*. The mean of the teacher units in which the assessment results did count was 4.166 standard deviations (19.2 percent) greater than the mean of the teacher units in which the assessment results did not count for the academic course, and 4.666 standard deviations (22.9 percent) greater for the applied course, holding all other teacher variables constant. Likewise, while classes taught by teachers who *felt counting assessment results motivates students to take the assessment more seriously* outperformed classes taught by teachers who did not for both courses, the influence was stronger in the academic course (1.059 standard deviations) than in the applied course (0.683 standard deviations). Further, while not as strong, there was a positive relation between *how much the assessment counted* and achievement. The mean of classes taught by teachers who gave more weight to the assessment results as part of the final course marks was 0.667 standard deviations higher than the mean of the classes taught by teachers who gave less weight for the academic course, and 0.425 standard deviations higher for the applied course.

Interestingly, and in contrast, the classes of teachers who *told their students how* *much the assessment results will count as part of their final course mark* scored 2.124 standard deviations below the classes of teachers who did not provide this information for the applied course, but this was not significant for the academic course. Further, classes in which the *multiple-choice items were included as part of final course marks* performed less well than classes in which no multiple-choice items were included as part of the students' final course marks (0.946 standard deviations for the academic course and 0.780 for the applied course). For the applied course, classes in which the *open-response items were included as part of the final course mark* outperformed classes in which the open-response items were not included by 0.662 standard deviations. Lastly, teachers who believed that *the time allotted to complete the assessment was sufficient* had a stronger relationship with achievement in the applied course than in the academic course: applied classes with teachers who believed the time allotted was sufficient scored 1.095 standard deviations higher than applied classes with teachers who believed otherwise, while this was 0.634 standard deviations for the academic course.

Of the five remaining variables that influenced achievement only in the academic course, classes in which *homework was frequently assigned* scored on average 1.040 standard deviations higher than classes in which homework was assigned less frequently or not at all, and classes taught by teachers who *expected average students to spend more time on homework* scored 0.600 standard deviations higher than classes taught by teachers who expected less time to be spent on homework. The mean for teachers who *frequently met with other teachers to coordinate their instruction in mathematics* were 0.397 standard deviations greater than the mean for teachers who met less frequently or not at all. The last two items dealt with extra teacher professional development. First, the mean of classes taught by teachers who *had not or were not presently enrolled in a course leading to advanced qualification in mathematics, information and computer technology in instruction, English as a Second Language and/or special education* was 0.560 standard deviations below the mean of classes taught by teachers who had taken or were presently enrolled in at least one of these qualification courses. Second, and in a similar way, the mean of classes taught by teachers who *had not participated in professional development in teaching students with special education needs* during the last two years was lower than the mean of classes taught by teachers who did participate in these activities by 0.579 standard deviations.

Of the seven remaining variables that influenced achievement only in the applied course, classes taught by teachers who had *additional qualifications in integration of information and technology in instruction* performed 2.006 standard deviations below classes taught by teachers without this qualification. In contrast, applied classes taught by teachers with *more experience teaching mathematics at the secondary level* performed 0.418 standard deviations higher than classes taught by teachers with less experience teaching mathematics. Likewise, classes with teachers who more *frequently used concrete manipulatives* in their instruction performed 0.395 standard deviations higher than classes with teachers who used concrete manipulatives less frequently or not at all.

Applied classes in which *students respect each other and diversity among students* outperformed classes where such respect was less prevalent by 0.592 standard deviations. In contrast, and somewhat surprisingly, classes in which *school rules are fair and consistently applied* performed less well by 0.366 standard deviations. Lastly, the frequency with which teachers of applied classes *contacted parents to discuss a child's progress* or *behaviour* were influential, but in opposite ways. Classes in which the contact for academic purposes was frequent outperformed classes when such contact was less frequent by 0.675 standard deviations, while classes in which the contact for a behaviour issue was frequent performed less well than classes in which the contact was less frequent by 0.682 standard deviations.

Explained Variance

Table 4 contains the initial and final estimates of residual variance together with the percent reduction between the two estimates for each course. In both courses, most of the initial variance was among students, clustered within teachers: 77.7 percent for the academic course and 86.2 percent for the applied course. The influential student level and teacher level variables listed in Tables 2 and 3 accounted for more than half of the initial variance for the academic course (54.4 percent for student level and 66.7 percent for teacher level). In contrast, the amount of variance accounted for by these variables was less for the applied course (41.0 percent for student level and 33.3 percent for teacher level).

Table 4
Explained Variance

	Student		Teacher	
	Initial	Final (% Reduction)	Initial	Final (% Reduction)
Academic	224.95	102.51 (54.4%)	64.38	21.47 (66.7%)
Applied	225.88	133.37 (41.0%)	36.18	24.13 (33.3%)

The amount of unexplained variance at both levels is still substantial, especially for the applied course, suggesting that variables not included in the current questionnaires need to be explored to explain student achievement. For example, it might be useful to present teachers with a series of four or five vignettes and ask them to indicate which one best captures their teaching style to better measure the complexity of teaching and the interactions that take place in the classroom.

Discussion

Both similarities and differences between the results for the academic and applied courses were identified for several influential variables. The inclusion of EQAO assessment results as part of students' final course marks deserves special attention. At the student level, the effect of students knowing that their teachers count some or all of the Grade 9 assessment positively influenced achievement for both the academic and applied students. At the teacher level, including the Grade 9 assessment as part of the final course mark was the strongest predictor for both academic and applied courses. But it is important to note that not all students knew that the assessments results counted, and there was variability in how teachers implemented this option. Regardless of the school and teacher, and in the interests of fair and equitable student assessment practices, all students should be informed of the assessment practices for their courses. This should include clear information about counting the EQAO assessment for part of the final class mark (*Principles for Fair Student Assessment Practices for Education in Canada*, 1993). It is possible that teachers may have informed students, but the students did not remember.

The issue of students with special education needs was much more influential in the applied course than in the academic course. If students with a special education need are required to write the same test as other students in applied mathematics, then renewed attention needs to be paid to determine how best to help these students so they acquire the knowledge and skills measured by the tests and/or how their scores on these tests are interpreted (Guideline B. II. 2, *Principles for Fair Student Assessment Practices for Education in Canada*, 1993, p. 17). For example, are students with more severe needs screened into the applied course, and if so, what could be done at an earlier point in their education to more effectively address their learning needs? Might locally-developed courses be more appropriate for some of these students?

The effect of homework completion on student achievement also differed markedly between in the two courses. It is not clear why the effect was weak for the applied students but strong for the academic students. Research indicates that students in the applied course have a lesser tendency to complete their mathematics homework (Pang, Kozlow, & Rogers, 2012, p. 21). Further investigation is needed to determine the reasons for this difference. One option would be to conduct focus-group interviews with teachers and students.

The third influential variable for which there were differences was gender. While gender was one of the more influential variables at the student level for the academic course, with girls outperforming boys, the variable had no influence for the applied course. At the teacher level, students in classes taught by male teachers outperformed students taught by female teachers for both courses. Rogers, Ma, et al. (2006) found a similar result at the student and teacher levels for Grade 6 mathematics. Differences between male and female achievement have been found in other studies and many ideas have been put forward to explain these differences (Battistich, Solomon, Kim, Watson, & Schaps, 1995; Gambell & Hunter, 1999; Klinger, Shula, & Wade-Woolley, 2009; Ma & Klinger, 2000; Maltais, Fleuret, & Mougeot, 2009; Sammons, West & Hind, 1997). However, only the study by Rogers, Ma, et al. (2006) found differences between the achievement of students with male or female teachers. Further research is needed to gain greater understanding of this finding in the two Canadian studies. For example, are the teaching practices of male and female teachers comparable? Do male and female teachers attend different professional development workshops (for example, mathematics versus language arts)?

A comparison of the number of variables retained for both courses with the total number of variables considered reveals that several variables were not influential. Although two reasons may explain why some variables were not influential, reasons why others were not influential are not as obvious. First, predictor variables that are highly related to the academic achievement of interest and at the same time to each other will not all enter the model because of the common variance they share. Information about other variables reported to affect achievement in studies of school effectiveness, such as principal leadership, was not collected in the current study. Another limiting factor is the reliance on self-report survey methods (Willms, 1992). Self-report measures are subject to the social desirability response set. Respondents might simply endorse questionnaire items on the basis of what is considered acceptable or desirable, rather than reflecting on the specific content of the items before responding. In other words, respondents often answer in a way to portray themselves in a good light. Replicated case studies in which classes are observed over an extended period of time and teachers and principals are interviewed at different points in time during the school semester or year may yield the data and information needed to clarify issues like these and to identify other variables that will further reduce the amount of unexplained variance.

Implications for Practice

The findings presented in this report provide information useful to educators as they review classroom practices and program delivery in schools. The relationship between background and questionnaire variables on the one hand, and achievement on the other, can inform decision making for school improvement planning and teacher practices employed in the classroom.

The relationship between achievement in Grades 6 and 9 demonstrates the importance of early awareness of learning difficulties and appropriate interventions. Results of another EQAO research study showed that a large number of students who had not met the provincial standard in mathematics in Grades 3 and/or 6 were able to succeed in the Grade 9 mathematics courses, including the academic course (Pang, Kozlow, &

Rogers, 2012). This was particularly true for students who experienced success in Grade 8. However, many students who did not meet the standard in the early grades continued to experience challenges in later grades. It is critical to identify these students early in their schooling and put interventions in place to improve their knowledge and skills so students can build on them in later grades.

Other findings from this study provide potential opportunities to improve student achievement. For example, initiatives to encourage and assist students to complete homework and attend classes more regularly have potential to improve their achievement. In addition, the strong and persistent relationships among achievement, student attitude toward mathematics and their confidence in their ability to do well in mathematics have the potential to improve student achievement. When reviewing the relevant data, it is important to consider the following question: Do students who have developed positive attitudes toward mathematics learn mathematics more effectively, or is it that students who do well in mathematics develop positive attitudes? While it is not possible to claim a cause and effect relationship between positive attitudes and higher achievement, it is likely that each reinforces the other. That is, it is likely that students who are taught mathematics in an engaging way that builds positive attitudes will have higher achievement. Also if students are given opportunities to succeed in mathematics, they may develop more confidence and achieve higher results. As students achieve higher levels, it is likely that their attitudes will become more positive.

In addition to the differences between the coefficients for the two courses for the predictor variables discussed above, another study identified a number of differences between the students in the two courses with respect to their responses to the student questionnaire (Pang, Kozlow, & Rogers, 2012), which might account for some of difference in the achievement levels for the two courses. Students in the applied course tend to give less positive responses to a number of items related to student achievement, such as knowing that the EQAO assessment results would count as part of the final course mark, attitudes toward mathematics, confidence in doing mathematics, completion of homework and absence from mathematics class. These differences are also reflected in the averages presented in Appendix A. In addition, the average achievement in mathematics in Grade 6 was much lower for students in the applied course than for students in the academic course. A larger portion of students in the applied course than in the academic course are students with special education needs. These differences in the characteristics of students in the two courses must be taken into account when planning instruction.

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Appendix A

Means and Standard Deviations for the Influential Predictor Variables

Table A.1
Means and Standard Deviations of Dependent and Influential Student Predictor Variables

	Academic		Applied	
Variable	Mean	SD	Mean	SD
Students				
Grade 9 Mathematics Score (%)	67.00	17.00	58.60	16.10
Level 1 Predictors				
Gender	1.52	0.50		
English-language learner	1.01	0.12		
Students with special education needs	1.05	0.22	1.31	0.46
Language spoken at home	1.83	1.01		
Language others speak to me at home	1.95	1.13		
Prior math achievement (%)	67.40	16.00	45.70	13.70
I have a positive attitude toward math	23.85	5.40	21.42	5.27
Math is easy for me	3.11	1.14	2.82	1.12
I work hard	4.06	0.90	3.91	0.95
I understand math	12.40	1.97		
I hide troubles I have with math	2.31	1.11	2.48	1.15
I get good marks in math mostly because I am lucky	2.40	1.11	2.68	1.16
I am confident that I can answer questions in each of the math strands	17.22	3.48	13.02	2.99
I used the Internet frequently in math	2.19	1.11	2.13	1.14
I used calculators and measuring devices frequently in math			6.51	1.29
Time I spend on math homework	2.82	0.79	2.21	0.86
How often I completed my math homework	3.83	0.97	3.31	1.20
How often I am absent from my math class	2.21	0.76	2.45	0.86
I read frequently outside of school	2.64	1.06	2.24	1.07
I use the Internet frequently outside of school			3.59	0.75
Parent support at home			14.76	4.14
My parents/guardians expectation of my continuing education after secondary school			2.64	0.74
I know the assessment results will be counted as part of my final course mark	2.35	0.88	1.90	0.95

Table A.2
Means and Standard Deviations of Dependent and Influential Teacher Predictor Variables

Variable	Academic		Applied	
	Mean	SD	Mean	SD
Teachers				
Grade 9 Mathematics Score (%) (Aggregated)	66.70	4.60	58.40	4.90
Level 2 Predictors				
Gender	1.61	0.49	1.53	0.50
Prior math achievement (%)	66.9	6.70		
Instruction coordinated among teachers	3.57	1.39		
Student and diversity respected in school			7.64	1.33
Fair and consistent and school rules			7.06	1.78
Frequency of using concrete manipulatives			3.95	0.19
Assignment of homework	3.56	0.55		
Time spent on completing homework	1.68	0.57		
Frequency of contacting parents to discuss child's progress			2.49	1.00
Frequency of contacting parents to discuss child's behaviour			1.89	0.89
Additional qualification computer and technology			1.05	0.23
No additional courses enrolled	1.23	0.42		
Number of years teaching mathematics at secondary level			2.83	1.10
Professional development: teaching students with special needs	1.34	0.47		
I count assessment results as part of final course marks	1.99	0.10	1.98	0.13
The assessment count x% as part my final course marks	1.92	0.89	1.96	0.97
I tell my students how much assessment results will count as part of their final course mark			1.98	0.15
In my opinion, counting assessment results motivates students to take the assessment more seriously	2.83	0.52	2.75	0.62
I count the multiple-choice items part of final course marks	1.17	0.41	1.21	0.44
I count the open-response items as part of final course marks			1.96	0.70
I believe the time to complete the assessment was sufficient	1.66	0.47	1.81	0.39

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Student Factors on Math Achievement: Demographics, Attitudes and Behaviours

An Analysis of Questionnaire and Contextual Data for Grade 9 Students in the Academic and Applied Mathematics Courses (2012)

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#DataInAction—Math Superpowers (2019)

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EQAO RESEARCH

An Analysis of Questionnaire and Contextual Data for Grade 9 Students in the Academic and Applied Mathematics Courses

Report Prepared for the
Education Quality and Accountability Office (EQAO) by

Xiao Pang, M.A., Ph.D.
Psychometrician, EQAO

Michael Kozlow, Ph.D.
Director, Data and Support Services, EQAO

W. Todd Rogers, Ph.D.
Scholar in Residence, EQAO; Professor, University of Alberta

MAY 2012

About the Education Quality and Accountability Office

The Education Quality and Accountability Office (EQAO) is an independent provincial agency funded by the Government of Ontario. EQAO's mandate is to conduct province-wide tests at key points in every student's primary, junior and secondary education and report the results to educators, parents and the public.

EQAO acts as a catalyst for increasing the success of Ontario students by measuring their achievement in reading, writing and mathematics in relation to *Ontario Curriculum* expectations. The resulting data provide a gauge of quality and accountability in the Ontario education system.

The objective and reliable assessment results are evidence that adds to current knowledge about student learning and serves as an important tool for improvement at all levels: for individual students, schools, boards and the province.

About EQAO Research

EQAO undertakes research for two main purposes:

- to maintain best-of-class practices and to ensure that the agency remains at the forefront of large-scale assessment and
- to promote the use of EQAO data for improved student achievement through the investigation of means to inform policy directions and decisions made by educators, parents and the government.

EQAO research projects delve into the factors that influence student achievement and education quality, and examine the statistical and psychometric processes that result in high-quality assessment data.

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An Analysis of Questionnaire and Contextual Data for Grade 9 Students in the Academic and Applied Mathematics Courses

Xiao Pang, Michael Kozlow and Todd Rogers
Education Quality and Accountability Office

February 8, 2012

Introduction

This report presents the results of the first phase of a larger research project designed to examine the relationships between student achievement on the EQAO Grade 9 Assessment of Mathematics and a number of student and teacher factors. This phase of the research involved an analysis of the use of the EQAO results as part of the final course mark for English- and French-language academic and applied mathematics courses, a summary of student demographic characteristics and questionnaire responses and cohort analyses. The second phase, which is presented in a separate report, involved an examination of the factors that influence the performance of students in the English- and French-language academic and applied courses and a comparison of the factors identified across the four groups defined by language and mathematics course. The results of the first phase are provided in three parts:

- Part 1 presents the results of an analysis of the responses to the teacher and student questionnaire items about counting the EQAO Grade 9 Assessment of Mathematics as part of students' final mathematics course marks.
- Part 2 provides a summary of the demographic characteristics of students enrolled in the Grade 9 academic and applied courses.
- Part 3 presents the results of a cohort analysis of the Grade 3, Grade 6 and Grade 9 data for the students assessed in mathematics in Grade 3 in 2004, in Grade 6 in 2007 and in Grade 9 in 2010.

The information provided in Part 3 is supplemented with the report card mathematics data obtained from the Ontario School Information System at the Ministry of Education.

Part 1

Teacher and Student Responses Concerning the Practice of Counting the EQAO Assessment and the Impact of These Practices on Achievement

This part of the report is based on the analysis of the responses to questions on the Grade 9 teacher and student questionnaires that deal with the practice of counting the EQAO Grade 9 Assessment of Mathematics as part of the students' final course marks. The following research questions were addressed:

- How prevalent is the practice among teachers, and do students know whether their EQAO results will count as part of their final course marks? Do they know for how much the assessment results will count?
- Is there a relationship between achievement on the EQAO assessment and students' awareness that the EQAO assessment will count as part of their final course marks?
- Do students and teachers feel that counting the assessment motivates students to take the assessment more seriously?
- Which components of the assessment (question types and strands) do teachers use when calculating the score to contribute to the course mark, and who decides?

Teacher and Student Responses About Counting the Assessment

The first aspect examined was the number of teachers who included EQAO assessment results in their students' course marks. The results are reported in Table 1.1 for each of the four language and course groups. While at least 80% of teachers indicated that they included the EQAO results as part of their students' final course marks, the percentage of teachers indicating that they did so was larger among academic course teachers than among applied course teachers. This difference was more marked among French-language teachers (89% vs. 82%) than English-language teachers (96% vs. 94%).

Table 1.1 Number and Percentage of Teachers Who Counted the EQAO Assessment Results as Part of Their Students' Course Marks

Course	Response	*n*	%
English Applied	No Response/Ambiguous Response	60	3.0
	No	66	3.3
	Yes	1863	93.7
	Total	1989	100.0
English Academic	No Response/Ambiguous Response	71	2.5
	No	45	1.6
	Yes	2748	95.9
	Total	2864	100.0
French Applied	No Response/Ambiguous Response	2	2.0
	No	15	15.3
	Yes	81	82.7
	Total	98	100.0
French Academic	No Response/Ambiguous Response	1	0.6
	No	16	10.2
	Yes	140	89.2
	Total	157	100.0

The students were asked if they knew that some or all of the Grade 9 assessment questions would be counted toward their course mark. Their responses are summarized in Table 1.2. About half of the students in the English- (57%) and French-language (48%) applied courses indicated they did not know, while just over 30% of the students in the two academic courses indicated they did not know. About four in 10 applied students in both languages said they knew the EQAO results would count, while slightly more than six in 10 academic students said they knew.

Table 1.2 Number and Percentage of Students Who Knew the EQAO Assessment Results Would Count as Part of Their Course Mark

Course	Response	*n*	%
English Applied	No Response/Ambiguous Response	1 129	2.6
	Don't Know	24 414	56.5
	No	1 358	3.1
	Yes	16 297	37.7
	Total	43 198	100.0
English Academic	No Response/Ambiguous Response	3 072	3.2
	Don't Know	29 872	30.8
	No	1 822	1.9
	Yes	62 371	64.2
	Total	97 137	100.0
French Applied	No Response/Ambiguous Response	48	3.4
	Don't Know	682	48.0
	No	68	4.8
	Yes	624	43.9
	Total	1 422	100.0
French Academic	No Response/Ambiguous Response	93	2.3
	Don't Know	1 236	30.8
	No	160	4.0
	Yes	2 521	62.9
	Total	4 010	100.0

While more than 80% of teachers indicated that they counted the assessment, only 40 to 60% of students indicated that they knew. The next set of results, presented in Table 1.3, examines the agreement between students and teachers. The numbers of students and teachers in Table 1.3 do not match the corresponding numbers in Tables 1.1 and 1.2, because there were cases in which students were not matched to any Teacher Questionnaire.

Table 1.3 Agreement Between Teachers and Students Regarding Awareness About Counting EQAO Results as Part of Course Marks

Program	Teachers' Response		Students' Response: Missing	Don't Know	Not Told	Yes, Told	Total
English Applied	Missing	*N*	37	583	32	360	1 012
		%	3.7	57.6	3.2	35.6	100.0
	Do Not Count	*N*	18	491	110	136	755
		%	2.4	65.0	14.6	18.0	100.0
	Yes, Count	*N*	924	20 076	1041	13 639	35 680
		%	2.6	56.3	2.9	38.2	100.0
	Total	*N*	979	21 150	1183	14 135	37 447
		%	2.6	56.5	3.2	37.7	100.0
English Academic	Missing	*N*	65	687	38	1 273	2 063
		%	3.2	33.3	1.8	61.7	100.0
	Do Not Count	*N*	39	511	303	356	1 209
		%	3.2	42.3	25.1	29.4	100.0
	Yes, Count	*N*	2658	25 693	1303	54 972	84 626
		%	3.1	30.4	1.5	65.0	100.0
	Total	*N*	2762	26 891	1644	56 601	87 898
		%	3.2	30.8	1.9	64.2	100.0
French Applied	Missing	*N*	0	8	1	5	14
		%	0.0	57.1	7.1	35.7	100.0
	Do Not Count	*N*	5	74	26	28	133
		%	3.8	55.6	19.5	21.1	100.0
	Yes, Count	*N*	28	413	24	465	930
		%	3.0	44.4	2.6	50.0	100.0
	Total	*N*	33	495	51	498	1 077
		%	3.1	46.0	4.7	46.2	100.0

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Table 1.3 (cont.)

Program	Teachers' Response		Students' Response: Missing	Don't Know	Not Told	Yes, Told	Total
French Academic	Missing	*N*	2	1	0	15	18
		%	11.1	5.6	0.0	83.3	100.0
	Do Not Count	*N*	5	100	79	64	248
		%	2.0	40.3	31.9	25.8	100.0
	Yes, Count	*N*	60	972	60	2 344	3 436
		%	1.7	28.3	1.7	68.2	100.0
	Total	*N*	67	1 073	139	2 423	3 702
		%	1.8	29.0	3.8	65.5	100.0

Note: The percentages in the cells are row percentages.

The percentages in the cells in Table 1.3 are row percentages. For example, of the 35 680 English-language students in the applied course who were taught by teachers who said they counted the assessment results, 38.2% indicated that their teachers had told them that the results would count.

There are inconsistencies between what the teachers indicated they said and what their students indicated they were told, with the agreement being stronger for the academic courses than for the applied courses. Whereas 63% of the English-language students and 65% of the French-language students in the academic course agreed with their teachers, 37% of the English-language students and 46% of the French-language students in the applied course agreed with their teachers.

What Is the Impact of Counting the EQAO Assessment as Part of Students' Course Marks on Student Achievement on the EQAO Assessments?

To address this question, student and teacher responses to the question about counting the assessment were cross-tabulated with student achievement (below the provincial standard and met the provincial standard). As shown in Table 1.4, the percentages of students who met the standard are greater by three percentage points (English applied) to 14 percentage points (French applied) when the teachers counted the EQAO results as part of their students' course marks than when they did not.

Correspondingly, the percentages of students who did not meet the standard are smaller by the same amount when the teachers counted the EQAO results as part of their students' course marks than when they did not.

Table 1.4 The Influence of Teachers Counting the EQAO Results as Part of Course Marks on Student Performance on the EQAO Assessments

		Student Achievement on EQAO Assessments			
	Include EQAO	Below Standard		Met Standard	
Program	Results	*n*	%	*n*	%
English Applied	Missing	876	58.1	631	41.9
	No	848	59.9	567	40.1
	Yes	22 440	56.7	17 155	43.3
English Academic	Missing	603	15.8	3 217	84.2
	No	309	25.9	885	74.1
	Yes	15 491	16.9	76 389	83.1
French Applied	Missing	14	100.0	-	-
	No	131	75.3	43	24.7
	Yes	700	60.8	452	39.2
French Academic	Missing	6	33.3	12	66.7
	No	112	36.4	196	63.6
	Yes	973	27.3	2 591	72.7

Students' awareness that their teachers were counting the EQAO results as part of their course marks influenced the students' performance on the EQAO assessments to a greater degree than did their teachers' having told them. As shown in Table 1.5, the percentages of students who met the standard were greater by 11 percentage points (English academic) to 26 percentage points (French applied) when the students knew that their teachers would count the EQAO results as part of their course marks than when they did not know. Further, the percentages of students who met the provincial standard and who indicated they knew that the EQAO assessment would be counted were greater than the corresponding percentages among students who were taught by teachers who had told

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them (cf., Tables 1.4 and 1.5). Clearly, students' awareness that the EQAO results would be counted had a beneficial effect on their performance.

Table 1.5 The Influence of Students' Awareness That Their Teachers Would Count the EQAO Results on Student Performance on the EQAO Assessment

Program	Awareness That EQAO Results Would Be Counted	Student Achievement on the EQAO Assessment			
		Below Standard		Met Standard	
		n	%	*n*	%
English Applied	Missing	739	65.5	390	34.5
	Don't Know	14 850	60.8	9 564	39.2
	No	905	66.6	453	33.4
	Yes	8 060	49.5	8 237	50.5
English Academic	Missing	606	19.7	2 466	80.3
	Don't Know	7 468	25.0	22 404	75.0
	No	430	23.6	1 392	76.4
	Yes	7 937	12.7	54 434	87.3
French Applied	Missing	36	75.0	12	25.0
	Don't Know	467	68.5	215	31.5
	No	55	80.9	13	19.1
	Yes	343	55.0	281	45.0
French Academic	Missing	26	28.0	67	72.0
	Don't Know	509	41.2	727	58.8
	No	65	40.6	95	59.4
	Yes	548	21.7	1 973	78.3

The third analysis involved combining student and teacher responses. Four student-teacher groups were formed according to the agreement between the teachers' decision whether or not the assessment results would count and the students' awareness of this decision.

- Yes/Yes: students who answered yes taught by teachers who answered yes
- No/Yes: students who answered no taught by teachers who answered yes
- Yes/No: students who answered yes taught by teachers who answered no
- No/No: students who answered no taught by teachers who answered no

The results are presented in Table 1.6. Except for the French academic course, the percentages of students meeting the provincial standard were largest for students in Group Yes/Yes. For the French academic course, the percentages were similar for Group Yes/Yes and Yes/No.

Table 1.6 Student-Teacher Response Combinations Cross-Tabulated with Achievement

		Number and Percentage of Students			
	Student Response/	Below Standard		Met Standard	
Course	Teacher Response	*n*	%	*n*	%
English Applied	Yes/Yes	6665	48.9	6 974	51.1
	No/Yes	681	65.4	360	34.6
	Yes/No	84	61.8	52	38.2
	No/No	72	65.5	38	34.5
English Academic	Yes/Yes	6867	12.5	48 105	87.5
	No/Yes	314	24.1	989	75.9
	Yes/No	74	20.8	282	79.2
	No/No	64	21.1	239	78.9
French Applied	Yes/Yes	257	55.3	208	44.7
	No/Yes	20	83.3	4	16.7
	Yes/No	22	78.6	6	21.4
	No/No	17	65.4	9	34.6
French Academic	Yes/Yes	502	21.4	1 842	78.6
	No/Yes	23	38.3	37	61.7
	Yes/No	13	20.3	51	79.7
	No/No	35	44.3	44	55.7

For the academic course, 88% of the English-language students and 79% of the French-language students in Group Yes/Yes met the provincial standard. For the applied course, these percentages were 51% and 45%, respectively. In contrast, in Group Yes/No, 79% of the English-language and 80% of the French-language students in the academic course met the standard, while the corresponding percentages for the applied course were 38% and 21%, respectively.

For the two remaining groups (No/Yes and No/No), more than half (56% to 79%) of the academic students in both language groups met the standard, with the percentages being considerably smaller for the French-language students. These percentages were smaller than the percentages for Groups Yes/Yes and Yes/No. For students in Groups No/Yes and No/No in the applied course, the percentages who met the standard did not exceed 40% and were, with one exception, smaller than the percentages for Groups Yes/Yes and Yes/No.

Taken together, the results reveal that the percentage of students who met the provincial standard was larger if the students were aware that the assessment results would count as part of their final course mark, and somewhat more so when these students were taught by teachers who said they counted the assessment.

Does Telling Students That the Results Will Count Influence Student Motivation to Do Well on the EQAO Assessments?

The students who indicated they knew the EQAO results would be counted in their course marks and the teachers who indicated they counted the EQAO results in their students' course marks were asked if they felt that counting the EQAO assessment would motivate students to take the assessment more seriously.

As shown in Table 1.7, 83% to 94% of teachers thought counting the EQAO assessment would motivate students to take the assessments more seriously. The percentages among French-language teachers were approximately five percentage points larger than the percentages among English-language teachers. Likewise, within each language of instruction, the percentages were approximately five percentage points larger for the academic course than for the applied course.

Table 1.7 Influence of Counting the EQAO Results as Part of the Students' Course Marks on Student Motivation

Course	Response	Teachers *n*	Teachers %	Students *n*	Students %
English Applied	Missing	6	0.3	202	1.4
	No	114	6.5	1 779	12.7
	Undecided	179	10.3	2 225	15.8
	Yes	1442	82.8	9 853	70.1
	Total	1741	100.0	14 059	100.0
English Academic	Missing	10	0.4	766	1.3
	No	85	3.3	7 470	13.1
	Undecided	194	7.5	7 466	13.1
	Yes	2300	88.8	41 350	72.5
	Total	2589	100.0	57 052	100.0
French Applied	Missing	0	0.0	9	2.1
	No	2	2.8	41	9.7
	Undecided	7	9.7	56	13.2
	Yes	63	87.5	318	75.0
	Total	72	100.0	424	100.0
French Academic	Missing	2	1.6	36	1.9
	No	0	0.0	200	10.5
	Undecided	5	4.1	284	14.9
	Yes	116	94.3	1 390	72.8
	Total	123	100.0	1 910	100.0

While the majority of the students indicated that knowing the assessment would count motivated them to take the test more seriously, the percentages (70% to 75%) were smaller than those among teachers. The fact that at least seven out of 10 students indicated that their motivation was increased, coupled with the findings presented earlier on the discrepancy between teacher and student responses and the beneficial relationship between counting the assessment and student achievement, highlights the importance of teachers clearly communicating their intentions to students.

How Much Do Assessment Results Count?

The teachers who indicated that they counted the EQAO results were asked about the weight the results were given in the students' course marks. Students who were aware that the assessment counted also responded to this question. Results for the teacher responses are presented in Table 1.8.

There was considerable variation in the portion of the final mark assigned for the EQAO assessment. In English-language schools, approximately 85% of teachers who counted the assessment did so for up to 10% of students' final course mark (approximately 50% counted it for 6% to 10%); very few teachers counted it for more than 15%. In French-language schools, approximately 60% of teachers who counted the assessment did so for up to 15% of students' final course mark (approximately 30% counted it for 6% to 10%); approximately 25% counted it for 25% to 30%. The pattern of responses among students was similar to that among teachers.

The teacher and student responses to this question were cross-tabulated with student achievement. Although student achievement was related to students' awareness that the EQAO assessment counted, as stated earlier in this report, there was no consistent relationship between student achievement on the EQAO assessment and the portion of the final mark assigned to the assessment.

Table 1.8 Weight Assigned to the EQAO Assessment Results

Course	Weight (%)	No. of Teachers	% of Teachers
English Applied	1 to 5	626	34.7
	6 to 10	873	48.4
	11 to 15	219	12.1
	16 to 20	38	2.1
	21 to 25	10	0.6
	25 to 30	23	1.3
	Other	15	0.8
English Academic	1 to 5	956	35.6
	6 to 10	1342	50.0
	11 to 15	274	10.2
	16 to 20	66	2.5
	21 to 25	7	0.3
	25 to 30	26	1.0
	Other	11	0.4
French Applied	1 to 5	5	6.3
	6 to 10	25	31.3
	11 to 15	20	25.0
	16 to 20	4	5.0
	21 to 25	0	0.0
	25 to 30	22	27.5
	Other	4	5.0
French Academic	1 to 5	8	5.7
	6 to 10	46	32.9
	11 to 15	29	20.7
	16 to 20	15	10.7
	21 to 25	3	2.1
	25 to 30	35	25.0
	Other	4	2.9

Note: Missing and ambiguous responses have been excluded.

What Parts of the Assessment Count?

The teachers were asked a number of questions about which components of the assessment they selected to include as part of the students' course marks. These questions related to the type of question (multiple-choice or open-response) and the strands of mathematics content.

Item Type: The results for question type are presented in Table 1.9. Teachers in both languages and both courses had a greater tendency to include all multiple-choice items (47% to 79%) than all open-response items (18% to 36%).

Table 1.9 Types of Questions Included in Students' Course Marks

		Number and Percentage of Teachers			
		Open-Response		Multiple-Choice	
Course	Portion of Questions	*n*	%	*n*	%
	Missing	251	13.5	70	3.8
English	All Questions	366	19.6	1405	75.4
Applied	Some Questions	791	42.5	368	19.8
	No Questions	455	24.4	20	1.1
	Missing	384	14.0	118	4.3
English	All Questions	493	17.9	2161	78.6
Academic	Some Questions	1146	41.7	430	15.6
	No Questions	725	26.4	39	1.4
	Missing	7	8.6	3	3.7
French	All Questions	27	33.3	38	46.9
Applied	Some Questions	38	46.9	39	48.1
	No Questions	9	11.1	1	1.2
	Missing	13	9.3	9	6.4
French	All Questions	51	36.4	77	55.0
Academic	Some Questions	58	41.4	53	37.9
	No Questions	18	12.9	1	0.7

French-language teachers showed a greater tendency to use all open-response items than did English-language teachers, but this trend was reversed for multiple-choice questions. Approximately 25% of the English-language teachers and 10% of French-language teachers said they did not use any of the open-response items, while only 1% said they did not use any multiple-choice items.

Mathematics Strands: The results for mathematics strands are presented in Table 1.10. The majority of teachers across languages and courses used questions from each of the strands in the course they taught. However, the pattern of inclusion varied between the language groups.

Table 1.10 Questions by Strand Included in Students' Course Marks

		Number and Percentage of Teachers							
		Number Sense		Linear Geometry		Analytic Relations		Geometry	
Course	Quantity of Questions	*n*	%	*n*	%	*n*	%	*n*	%
English Applied	Missing	214	14.2	218	14.4	213	14.1		
	All Questions	534	35.4	515	34.1	537	35.6	N/A	N/A
	Some Questions	752	49.8	766	50.7	751	49.7		
	No Questions	10	0.7	11	0.7	9	0.6		
English Academic	Missing	365	16.0	359	15.7	365	16.0	347	15.2
	All Questions	833	36.5	803	35.1	809	35.4	816	35.7
	Some Questions	1077	47.1	1116	48.8	1102	48.2	1117	48.9
	No Questions	10	0.4	7	0.3	9	0.4	5	0.2
French Applied	Missing	9	16.1	9	16.1	11	19.6		
	All Questions	5	8.9	6	10.7	6	10.7	N/A	N/A
	Some Questions	42	75.0	41	73.2	39	69.6		
	No Questions	0	0	0	0.0	0	0.0		
French Academic	Missing	21	22.1	21	22.1	22	23.2	21	22.1
	All Questions	15	15.8	15	15.8	15	15.8	15	15.8
	Some Questions	59	62.1	59	62.1	57	60	59	62.1
	No Questions	0	0	0	0	1	1.1	0	0

Approximately 50% of teachers of English applied and academic mathematics who counted the assessment indicated that they used all the questions from each of the strands, and approximately 35% indicated that they used some of the questions. Approximately 10% to 15% of teachers of French applied and academic mathematics who counted the assessment indicated that they used all the questions from each of the strands, and 60% to 75% indicated that they used some of the questions.

Who Made the Decision to Count the EQAO Assessment Results?

The teachers who counted EQAO assessment results as part of their students' final course marks were asked who was involved in the decision about whether or not the results would be counted. As can be seen from Table 1.11, there were differences between the responses among English and French teachers.

For the English-language courses, the largest percentages of teachers said that the decision was made by the mathematics department (45% for the applied course and 65% for the academic course). The next largest percentage (18% for applied and 27% for academic) was by a group of teachers, followed closely (15% and 24%, respectively) by the school board. For the French-language courses, the percentages of people involved in the decision were more equally distributed among the most frequently mentioned decision makers. An approximately equal percentage of teachers indicated that the decision was made by a group of teachers (27% for applied and 28% for academic) and by the principal or vice-principal (26% and 27%, respectively). Approximately 21% indicated that the decision was made by the mathematics department, while another 15% indicated that they made the decision themselves.

Table 1.11 Teacher Responses Concerning the Decision to Count the EQAO Assessment Results as Part of the Students' Course Marks

Course	Who Made the Decision?	Number and Percentage of Teachers	
		n	%
English Applied	Don't Know	105	4.0
	Math Department	1187	45.3
	Math Teacher	171	6.5
	Teacher Group	475	18.1
	Principal/VP	248	9.5
	School Board	405	15.4
	Other	31	1.2
English Academic	Don't Know	147	5.6
	Math Department	1712	65.3
	Math Teacher	163	6.2
	Teacher Group	698	26.6
	Principal/VP	329	12.5
	School Board	616	23.5
	Other	46	1.8
French Applied	Don't Know	0	0.0
	Math Department	31	22.3
	Math Teacher	22	15.8
	Teacher Group	38	27.3
	Principal/VP	36	25.9
	School Board	10	7.2
	Other	2	1.4
French Academic	Don't Know	5	2.2
	Math Department	48	21.0
	Math Teacher	32	14.0
	Teacher Group	65	28.4
	Principal/VP	61	26.6
	School Board	16	7.0
	Other	2	0.9

Note: Missing and ambiguous responses have been excluded.

Part 2
Demographic Characteristics of Grade 9 Students Enrolled in the Academic and Applied Courses

Part 2 of the present report presents data on student background characteristics to address the following question:

- What are the differences and similarities between selected background characteristics of students enrolled in the Grade 9 academic course and their counterparts in the applied mathematics course?

Table 2.1 presents the numbers and percentages of students with special education needs identified by an Identification, Placement and Review Committee (IPRC), of students with an Individual Education Plan but without IPRC identification (IEP only), and of English and French language learners (ELL; ALF/PANA). This information was provided by schools through the Student Data Collection system. As shown in Table 2.1, the percentages of students with special education needs in the applied courses are approximately four times those in the academic courses. For example, of English-language students and French-language students in the applied courses, 32% and 37%, respectively, had an IEP only. In the academic course, these percentages were 8% of English-language students and 9% of French-language students. Similar differences were observed among students identified by an IPRC. There was less difference between the percentages of students who were ELLs or in ALF/PANA in the applied course and in the academic course in both language groups.

Table 2.1 Enrolment of Students with Special Education Needs

Background Information	English Applied		English Academic		French Applied		French Academic	
	n	%	*n*	%	*n*	%	*n*	%
IPRC	9 316	20.7	5999	6.0	390	26.5	272	6.6
IEP Only	14 459	32.1	8025	8.0	549	37.3	368	9.0
ELL; ALF/PANA	2 666	5.9	3770	3.8	26	1.8	65	1.6

Note: Percentages are of the total number of students who participated in each assessment. Therefore the sums will not add to 100%.

Since the percentage of students achieving the provincial standard is considerably smaller among students with special education needs than among other students, the above may account for some of the difference between the percentages of students achieving the provincial standard in the applied and the academic courses.

The following additional factors were examined: access to technology at home, completion of homework, absenteeism, number of schools attended and language spoken at home. The distributions of students by language and course are summarized in Table 2.2. A larger percentage of students in the academic courses than in the applied courses had computers at home that they used for school work, with the difference being more pronounced among the English- than French-language students (60% vs. 46%, English-language; 40% vs. 36% French-language).

Students in the academic courses were more likely to complete their homework than students in the applied courses. Of the English-language students in the academic course, 63% reported they often or always complete their homework, which is approximately 12 percentage points larger than among English-language students in the applied course. Of French-language students in the academic course, 70% often or always completed their homework, which is six percentage points larger than among French-language students in the applied course.

Likewise, students in the academic course were absent less often than students in the applied course. Of English-language students in the academic course, 27% reported that they missed class five or more times, which is 13 percentage points smaller than among students in the applied course. There was less difference between the percentages of French-language students: 28% of students in the academic course missed class five or more times, which is five percentage points smaller than among students in the applied course.

Approximately 40% of the students in the applied courses attended three or more elementary schools, which is approximately five percentage points larger than among students in the academic courses.

Table 2.2 Additional Background Information for Students in Academic and Applied Courses

Background Information	Students' Responses	English Applied		English Academic		French Applied		French Academic	
		n	%	*n*	%	*n*	%	*n*	%
Computer at Home*	Yes	19 795	46.3	57 757	60.2	507	36.1	1566	39.5
	No	22 942	53.7	38 264	39.8	897	63.9	2396	60.5
Homework Complete	Never	2 205	5.2	2 693	2.8	62	4.4	88	2.2
	Seldom	4 666	10.9	9 236	9.6	121	8.6	306	7.7
	Sometimes	13 745	32.2	23 365	24.4	322	23.0	796	20.1
	Often	15 169	35.6	37 685	39.4	609	43.5	1805	45.6
	Always	6 850	16.1	22 755	23.8	286	20.4	967	24.4
Absent From Math Class	Never	4 909	11.5	13 013	13.6	202	14.4	528	13.3
	One to Four Times	20 550	48.2	56 710	59.3	741	52.9	2326	58.8
	Five to Nine Times	10 234	24.0	18 715	19.6	300	21.4	824	20.8
	10 or More times	6 981	16.4	7 118	7.4	159	11.3	278	7.0
Number of Elementary Schools Attended	One	11 638	27.3	27 574	28.9	383	27.5	1185	30.0
	Two	14 050	33.0	34 751	36.5	461	33.1	1411	35.7
	Three	8 266	19.4	18 543	19.5	287	20.6	837	21.2
	Four	4 315	10.1	8 189	8.6	145	10.4	308	7.8
	Five or More	4 304	10.1	6 251	6.6	116	8.3	207	5.2
Languages Spoken at Home	Only or Mostly English/French	34 888	81.5	72 866	76.1	415	29.6	1291	32.6
	One or More Other Languages as Often as English/French	5 041	11.8	14 612	15.3	431	30.7	984	24.8
	Only or Mostly Other Languages	2 856	6.7	8 327	8.7	557	39.7	1685	42.6

* Computer used for school work.

The differences between the English- and French-language students regarding languages spoken at home are more pronounced. Whereas 82% of English-language students in the applied mathematics course and 76% of English-language students in the academic course reported they spoke only or mostly English at home, 30% of French-language students in the applied course and 33% of French-language students in the academic course reported they spoke only or mostly French at home. In the case of

English-language students, 12% (applied) and 15% (academic) spoke another language as often as English, and 7% (applied) and 9% (academic) spoke only or mostly another language at home. In contrast, the percentages of French-language students who spoke another language as often as French at home or spoke only or mostly another language at home were greater than the corresponding percentages in English, ranging from 25% to 42%. Clearly, French schools have a larger percentage of students who do not speak the language of instruction at home.

An analysis of student achievement and questionnaire responses showed a number of positive relationships. Students with the following responses to the student questionnaire tended to have higher achievement results:

- completed their mathematics homework more often;
- were absent from mathematics class less often;
- had more positive attitudes toward mathematics and
- were more confident in their ability to do well in mathematics.

Part 3
Cohort Tracking

EQAO has tracked the progress of the same students beginning with the primary assessment and then moving to the junior assessment and then finally the Grade 9 assessment in the case of mathematics and the OSSLT in the case of reading and writing. Presented in Part 3 of this report are the results for the cohort of students for whom mathematics results are available for primary, 2004; junior, 2007; and Grade 9, 2010. Both achievement and attitudes toward mathematics were examined. The achievement results are provided first, followed by the results for attitude. There were 109 793 students in the English-language cohort and 3741 in the French-language cohort. In addition, report card mathematics marks for Grades 8 and 9 were obtained from the Ministry of Education for the students who wrote the Grade 9 Assessment of Mathematics in 2010.

Achievement

The results for the cohort of students who participated in the primary, junior and Grade 9 assessments are provided in Table 3.1 for the English-language students and in Table 3.2 for the French-language students. The students were first classified into the following four groups according to their combined performance in the primary and junior mathematics assessment components:

- met the provincial standard on both the primary and junior mathematics components (maintained standard);
- did not meet the standard on the primary mathematics component but did on the junior mathematics component (rose to standard);
- met the standard on the primary mathematics component but did not on the junior mathematics component (dropped from standard) and
- did not meet the standard on the primary mathematics component and did not on the junior mathematics component (never met the standard).

Tables 3.1 and 3.2 include the number of students in each of these groups, how these students were distributed between the academic and applied courses in Grades 9 and their results on the Grade 9 assessment.

Table 3.1 Grade 9 Course Enrolment by Primary and Junior Assessment Progress Category and Grade 9 Achievement Results in 2010—English-Language Students

Primary and Junior Results	Grade 9 Course Enrolment	Result	*n*	%
Maintained Standard *n* = 59 135 (54%)	Applied Mathematics *n* = 5603 (9%)	Met the Standard	4 198	74.9
		Did Not Meet the Standard	1 405	25.1
	Academic Mathematics *n* = 53 532 (91%)	Met the Standard	48 807	91.2
		Did Not Meet the Standard	4 725	8.8
Rose to Standard *n* = 11 863 (11%)	Applied Mathematics *n* = 3303 (28%)	Met the Standard	1 961	59.4
		Did Not Meet the Standard	1 342	40.6
	Academic Mathematics *n* = 8560 (72%)	Met the Standard	6 762	79.0
		Did Not Meet the Standard	1 798	21.0
Dropped from Standard *n* = 16 720 (15%)	Applied Mathematics *n* = 7754 (46%)	Met the Standard	3 686	47.5
		Did Not Meet the Standard	4 068	52.5
	Academic Mathematics *n* = 8966 (54%)	Met the Standard	5 720	63.8
		Did Not Meet the Standard	3 246	36.2
Never Met Standard *n* = 22 075 (20%)	Applied Mathematics *n* = 14 716 (67%)	Met the Standard	4 236	28.8
		Did Not Meet the Standard	10 480	71.2
	Academic Mathematics *n* = 7359 (33%)	Met the Standard	3 778	51.3
		Did Not Meet the Standard	3 581	48.7

Students who had met the standard in Grades 3 and 6 had a greater tendency to enroll in the academic course than in the applied course in Grade 9, and those who had never met the standard had a greater tendency to enroll in the applied course. For example, 91% of the English-language students who had maintained the standard enrolled in academic mathematics and 9% enrolled in applied mathematics, while 33% of the students who had never met the standard enrolled in academic mathematics and 67%

enrolled in applied mathematics (see the second column in the tables). The corresponding percentages for French-language students who had maintained the standard were the same for the academic course and were 37% and 63%, respectively, for the applied course. A comparison of the students who had risen to the standard and those who had dropped from it points to the importance of attaining the provincial standard in elementary school, particularly at the junior level—72% of the English- and French-language students who had risen to the standard enrolled in the academic course in Grade 9, while 54% of the English-language and 57% of the French-language students who had dropped enrolled in the academic course in Grade 9.

Table 3.2 Grade 9 Course Enrolment by Primary and Junior Assessment Progress Category and Grade 9 Achievement Results in 2010—French-Language Students

Primary and Junior Results	Grade 9			
	Course Enrolment	Result	*n*	%
Maintain Standard	Applied Mathematics	Met the Standard	107	56.0
	n = 191 (9%)	Did Not Meet the Standard	84	44.0
n = 2025	Academic Mathematics	Met the Standard	1475	80.4
(54%)	*n* = 1834 (91%)	Did Not Meet the Standard	359	19.6
Rose to Standard	Applied Mathematics	Met the Standard	116	43.3
	n = 268 (28%)	Did Not Meet the Standard	152	56.7
n = 952	Academic Mathematics	Met the Standard	452	66.1
(25%)	*n* = 684 (72%)	Did Not Meet the Standard	232	33.9
Dropped from	Applied Mathematics	Met the Standard	19	25.7
	n = 74 (43%)	Did Not Meet the Standard	55	74.3
Standard	Academic Mathematics	Met the Standard	43	43.0
n = 174 (5%)	*n* = 100 (57%)	Did Not Meet the Standard	57	57.0
Never Met Standard	Applied Mathematics	Met the Standard	83	22.4
	n = 371 (63%)	Did Not Meet the Standard	288	77.6
n = 590	Academic Mathematics	Met the Standard	49	22.4
(16%)	*n* = 219 (37%)	Did Not Meet the Standard	170	77.6

In both courses and in both languages, the percentage of students achieving the standard in Grade 9 was considerably larger among students who had maintained the standard than among students who had never met it—by 34% to 58%. There was a decline in success in Grade 9 across the four groups of students in both languages and both courses. For the English-language students, 91% of students who had maintained the standard, 79% students who had risen, 64% of students who had dropped and 51% of students who had never met the standard did so in the Grade 9 academic course. This was also observed in the applied course: 75%, 59%, 48% and 29%, respectively. The results for the French-language students were somewhat lower, but followed the same pattern; 80% maintaining, 66% rising 43% dropping and 22% of the students never meeting the standard did so in the Grade 9 academic course. For the applied course, the percentages were 56%, 43%, 26% and 22%, respectively.

Taken together, the results for both language groups point to the importance of attaining the provincial standard in elementary school, particularly at the junior level. Students who met the standard in Grade 6 have a high probability of meeting the standard in Grade 9, even if they had not met the standard in Grade 3. These results also show that interventions can make a difference; a significant number of students who had not met the standard in Grade 3 and/or Grade 6 were able to in the academic course in Grade 9. Targeted interventions should be provided to students in elementary school who are not meeting the standard.

Student performance in the applied course is of particular concern. A companion study is currently underway to identify factors measured in the student and teacher questionnaires that might shed light on why the performance of students in the applied course is so much lower than that in the academic course.

Report Card Marks

EQAO obtained mathematics report card marks for Grades 8 and 9 from the Ministry of Education for the majority of the students who wrote the Grade 9 assessment in 2010. The Grade 9 report card marks were used to draw a comparison of overall achievement results in Grade 9 mathematics as measured by the EQAO assessment and marks assigned by classroom teachers. The percentage of students receiving Level 3 or 4 on the Grade 9 EQAO assessment was compared with the percentage of students receiving 70% or higher on their report card for Grade 9 mathematics.

The percentage of students receiving 70% or higher on their report card was much smaller for the applied course than for the academic course in both languages, which is consistent with EQAO results. This has been the case in the EQAO results since the assessment program was introduced in 2000–2001. The EQAO and report-card results were very similar in the applied course for English-language students and in the academic course for French-language students. While the EQAO results were higher than the report-card results for English-language students in the academic course, the report-card results were higher than the EQAO results for French-language students in the applied course.

The Grade 8 report card marks were used to further analyze the comparisons of the Grade 6 and Grade 9 EQAO assessment results to determine whether they could provide additional information to explain achievement patterns. As was shown in Table 3.1, English-language students who had not met the provincial standard in mathematics in the elementary grades and enrolled in the academic course demonstrated a higher level of achievement than those of this population who enrolled in the applied course (51% of these students in the academic course met the standard while 29% in the applied course did). In both the applied and academic courses, among French-language students who had not met the mathematics standard in the early grades, 22% did in Grade 9 in both the applied and academic courses.

An analysis of the Grade 8 report card marks of English-language students who had not met the standard in Grade 6 showed that those who enrolled in the academic course tended to have higher Grade 8 report card marks than those who enrolled in the applied course, which partially accounts for the higher level of achievement in the Grade 9 academic course. Of the students who had not met the standard in Grade 6 who enrolled in the academic course in Grade 9, 82% received an average of Level 3 or 4 across the mathematics stands in the Grade 8 report card. Of the students who had not met the standard in Grade 6 who enrolled in the applied course in Grade 9, 49% received an average of Level 3 or 4 in Grade 8 mathematics.

Perceptions

Responses to the following two perception questions included in the Student Questionnaires for all three grade levels were analyzed for the cohort:

- I like math.
- I am good at math.

For this analysis, four groups of students were created based on the achievement results at all three grade levels:

- met the provincial standard for mathematics on the primary, junior and Grade 9 assessments (consistently met standard (Y/Y/Y);
- did not meet the provincial standard for mathematics on the primary assessment, did not on the junior assessment, but did on the Grade 9 assessment (N/N/Y);
- met the standard for mathematics on both the primary and junior assessments, but did not meet the standard on the Grade 9 assessment (Y/Y/N) and
- did not meet the standard for mathematics on any of the assessments—primary, junior or Grade 9 (N/N/N).

The responses to the perception questions at each grade level were summarized for each of the four groups. The results for the two language groups for "I am good at math" are reported in Tables 3.4 and 3.5 and those for "I am good at math" in Tables 3.6 and 3.7.

Like math. As might be expected, the largest percentage of English-language students to say they liked mathematics was among the students who maintained the provincial standard through primary, junior and Grade 9 academic (see Table 3.4). Further, the percentage of students in the Y/Y/Y group who said they liked mathematics in Grade 9 and who enrolled in the academic course in Grade 9 was greater than that among such students who enrolled in the applied course. The percentages for the other three groups were similar for students in the academic and applied courses. For students in the Y/Y/Y group, the percentage of students who said they liked mathematics was similar in Grades 3 and 9 among students in the academic course, but there was a decrease in this percentage from Grades 3 to 9 among students in the applied course. The percentages for the remaining three groups tended to decrease from Grades 3 to 9 according to degree of consistency in meeting the standard. This decrease was particularly large for students who did not meet the provincial standard in Grade 9

(Y/Y/N and N/N/N). For students in the Y/Y/Y and N/N/Y groups, the percentage of students who said they liked mathematics decreased from Grades 3 to 6 and then increased in Grade 9. Taken together, the results for the English-language students indicate that fewer than half of the students said they liked mathematics in Grades 6 and 9.

Table 3.4 I Like Math—English-Language Students

Group	Mathematics Course Enrolment	Like Math	Primary *n*	Primary %	Junior *N*	Junior %	Grade 9 *n*	Grade 9 %
Y/Y/Y	Applied	Yes	1 349	58.1	938	40.4	1 121	48.3
		Sometimes/Undecided	630	27.1	816	35.1	614	26.4
		No	343	14.8	568	24.5	587	25.3
	Academic	Yes	17 174	64.5	14 767	55.5	16 584	62.3
		Sometimes/Undecided	6 822	25.6	8 461	31.8	5 805	21.8
		No	2 621	9.8	3 389	12.7	4 228	15.9
N/N/Y	Applied	Yes	1 042	54.8	577	30.4	866	45.6
		Sometimes/Undecided	512	26.9	735	38.7	556	29.2
		No	347	18.2	589	31.0	479	25.2
	Academic	Yes	988	55.9	643	36.4	781	44.2
		Sometimes/Undecided	516	29.2	692	39.1	547	30.9
		No	264	14.9	433	24.5	440	24.9
Y/Y/N	Applied	Yes	392	59.4	234	35.4	202	30.6
		Sometimes/Undecided	165	25.0	240	36.4	181	27.4
		No	103	15.6	186	28.2	277	42.0
	Academic	Yes	1 434	60.0	1 037	43.4	717	30.0
		Sometimes/Undecided	647	27.0	904	37.8	707	29.6
		No	311	13.0	451	18.8	968	40.5
N/N/N	Applied	Yes	2 220	52.5	1 110	26.3	1 142	27.0
		Sometimes/Undecided	1 152	27.2	1 662	39.3	1 274	30.1
		No	855	20.2	1 455	34.4	1 811	42.8
	Academic	Yes	966	58.3	567	34.2	432	26.1
		Sometimes/Undecided	447	27.0	676	40.8	521	31.4
		No	245	14.8	415	25.0	705	42.5

As shown in Table 3.5, the trends for French-language students were similar to those presented above for English-language students, but, in all four groups, the percentages of French-language students who said they liked mathematics were larger than those of English-language students.

Table 3.5 I Like Math—French-Language Students

Group	Mathematics Course Enrolment	Like Math	Primary *n*	Primary %	Junior *n*	Junior %	Grade 9 *n*	Grade 9 %
Y/Y/Y	Applied	Yes	40	72.7	32	58.2	37	67.3
		Sometimes/Undecided	8	14.6	16	29.1	10	18.2
		No	7	12.7	7	12.7	8	14.6
	Academic	Yes	609	74.3	536	65.4	564	68.8
		Sometimes/Undecided	161	19.6	213	26.0	157	19.2
		No	50	6.1	71	8.7	99	12.1
N/N/Y	Applied	Yes	21	61.8	16	47.1	18	52.9
		Sometimes/Undecided	7	20.6	9	26.5	11	32.4
		No	6	17.6	9	26.5	5	14.7
	Academic	Yes	15	75.0	35	40.0	32	75.0
		Sometimes/Undecided	5	25.0	30	55.0	23	5.0
		No	-	-	14	5.0	24	20.0
Y/Y/N	Applied	Yes	34	70.8	24	50.0	22	45.8
		Sometimes/Undecided	7	14.6	9	18.8	10	20.8
		No	7	14.6	15	31.2	16	33.3
	Academic	Yes	114	64.8	87	49.4	58	33.0
		Sometimes/Undecided	43	24.4	59	33.5	44	25.0
		No	19	10.8	30	17.0	74	42.0
N/N/N	Applied	Yes	68	53.1	35	27.3	45	35.2
		Sometimes/Undecided	31	24.2	58	45.3	41	32.0
		No	29	22.7	35	27.3	42	32.8
	Academic	Yes	44	55.7	35	44.3	32	40.5
		Sometimes/Undecided	16	20.2	30	33.0	23	29.1
		No	19	24.0	14	17.7	24	30.4

There were some differences in the patterns of relative percentages across courses for English- and French-language students. The percentages of French-language students in the Y/Y/Y group who said they liked mathematics were similar for the two courses (just under 70%), while there was a considerable difference for English-language students (62% for academic and 48% for applied). For the N/N/Y group, the percentages of English-language students who said they liked mathematics were similar for the two courses (approximately 45%), while there was a considerable difference for French-language students (75% for academic and 53% for applied).

Taken together, the results for the French-language students indicate that approximately half indicated they liked mathematics, which was a slightly larger proportion than among English-language students.

I am good at math. As with "I like math," the percentages of English-language students who indicated that they were good at mathematics were not large, with the largest among students who consistently met the provincial standard (see Table 3.6). There were generally decreases in these percentages from Grades 3 to 9 among students who continued not to meet the provincial standard or failed to meet the provincial standard in later grades after having done so in earlier grades. In all but the Y/Y/Y group, the percentage of students who said they were good at mathematics was larger for the applied course than for the academic course. Fewer than one-quarter of the N/N/N students indicated that they were good in mathematics in Grade 9. Overall, fewer than half of the English-language students indicated that they were good at mathematics.

Table 3.6 I Am Good at Math—English-Language Students

Group	Mathematics Course Enrolment	Good at Math	Primary *n*	Primary %	Junior *n*	Junior %	Grade 9 *n*	Grade 9 %
Y/Y/Y	Applied	Yes	1 256	53.9	1 022	43.9	1 469	63.0
		Sometimes/Undecided	975	41.8	1 157	49.7	605	26.0
		No	99	4.2	151	6.5	256	11.0
	Academic	Yes	17 800	66.8	19 317	72.5	17 648	66.3
		Sometimes/Undecided	8 345	31.3	6 983	26.2	6 369	23.9
		No	485	1.8	330	1.2	2 613	9.8
N/N/Y	Applied	Yes	734	38.5	436	22.8	941	49.3
		Sometimes/Undecided	969	50.8	1 196	62.7	610	32.0
		No	205	10.7	276	14.5	357	18.7
	Academic	Yes	750	42.2	596	33.6	564	31.8
		Sometimes/Undecided	906	51.0	1 042	58.7	743	41.9
		No	119	6.7	137	7.7	468	26.4
Y/Y/N	Applied	Yes	306	46.2	214	32.3	198	29.9
		Sometimes/Undecided	325	49.1	383	57.8	260	39.3
		No	31	4.7	65	9.8	204	30.8
	Academic	Yes	1 350	56.2	1 191	49.6	494	20.6
		Sometimes/Undecided	978	40.7	1 125	46.8	926	38.6
		No	74	3.1	86	3.6	982	40.9
N/N/N	Applied	Yes	1 484	35.0	660	15.5	920	21.7
		Sometimes/Undecided	2 181	51.4	2 728	64.2	1 571	37.0
		No	581	13.7	858	20.2	1 755	41.3
	Academic	Yes	663	39. 9	423	25.4	252	15.2
		Sometimes/Undecided	854	51.4	1 058	63.7	595	35.8
		No	145	8.7	181	10.9	815	49.0

The highest percentage of French-language students who said they were good at mathematics was among students in the Y/Y/Y group. In most groups, the percentages among French-language students were larger than those among English-language students (see Table 3.7).

Table 3.7 I Am Good at Math — French-language Students

Group	Mathematics Course Enrolment	Good at Math	Primary *n*	Primary %	Junior *n*	Junior %	Grade 9 *n*	Grade 9 %
Y/Y/Y	Applied	Yes	33	60.0	33	60.0	41	74.6
		Sometimes/Undecided	20	36.4	20	36.4	11	20.0
		No	2	3.6	2	3.6	3	5.4
	Academic	Yes	596	73.1	637	78.2	609	74.7
		Sometimes/Undecided	211	25.9	174	21.4	149	18.3
		No	8	1.0	4	0.5	57	7.0
N/N/Y	Applied	Yes	14	41.2	11	32.4	16	47.1
		Sometimes/Undecided	16	47.2	20	58.8	14	41.2
		No	4	11.7	3	8.8	4	11.8
	Academic	Yes	12	60.0	9	45.0	13	65.0
		Sometimes/Undecided	8	40.0	11	55.0	7	35.0
		No	-	-	-	-	-	-
Y/Y/N	Applied	Yes	24	50.0	17	35.4	20	41.7
		Sometimes/Undecided	19	39.6	21	43.8	15	31.2
		No	5	10.4	10	20.8	13	27.1
	Academic	Yes	101	57.7	93	53.1	51	29.1
		Sometimes/Undecided	69	39.4	72	41.1	71	40.6
		No	5	2.9	10	5.7	53	30.3
N/N/N	Applied	Yes	47	37.0	25	19.7	28	22.0
		Sometimes/Undecided	60	47.2	81	63.8	47	37.0
		No	20	15.8	21	16.5	52	40.9
	Academic	Yes	28	35.0	25	31.2	17	21.2
		Sometimes/Undecided	45	56.2	48	60.0	33	41.2
		No	7	8.8	7	8.8	30	37.5

As with the English-language students, there were generally decreases in these percentages from Grades 3 to 9 among students who continued not to meet the provincial standard or who failed to meet the provincial standard in later grades after having done so earlier. In the N/N/Y group, the percentage of students who said they were good at mathematics was larger for the academic course than for the applied course. Fewer than one-quarter of the N/N/N students indicated that they were good in mathematics in Grade 9. Overall, just more than half of the French-language students indicated that they were good at mathematics.

Summary

The above results identify a number of student background and questionnaire response variables that are related to student achievement in both the academic and the applied courses. Although the relationships are similar for the two courses, the student background characteristics and the percentage of students selecting each response to the questionnaire items varies considerably between the two courses. Therefore, the patterns in the data for the variables examined in this study provide some indications of factors that might account for some of the differences between the achievement results on the EQAO Grade 9 Assessment of Mathematics of students in the academic course and those in the applied course (results for students in the academic course having been consistently better). These factors are summarized below:

- The percentage of students in the applied course who said they knew that the EQAO assessment would count for part of their final course mark was considerably smaller than that of students in the academic course. A larger portion of students who knew the assessment would count achieved the provincial standard in both courses.
- Students in the academic course showed a greater tendency to complete homework and reported fewer absences from mathematics class. Both completion of homework and regular attendance are related to higher achievement levels.
- A larger portion of students in the applied course than in the academic course did not meet the standard in Grade 3 and did not meet the standard in Grade 6. In addition, of the students who did not meet the standard in Grade 6, those who enrolled in the applied course were likely to have been less successful in Grade 8 mathematics than those who enrolled in the academic course. Success in earlier grades is a strong predictor of success in later grades.

- Students in the academic course have more positive attitudes toward mathematics than students in the applied course. More positive attitudes are associated with higher achievement levels.
- The percentage of students with special education needs in the applied course is approximately four times the percentage in the academic course. The percentage of students achieving the provincial standard is considerably smaller among students with special education needs.

Implications for Practice

The findings presented in this report provide information useful to educators as they review classroom practices and program delivery in schools. The relationships between background and questionnaire variables on the one hand and achievement on the other can inform decision making for school improvement planning and practices that individual teachers employ in their classrooms.

It is clear that many students do not know whether the Grade 9 Assessment of Mathematics will contribute to their final course marks. It is very important that teachers clearly communicate their intentions, in writing, to students and parents at the beginning of the course. Teachers should also remind students and parents of their intentions when they inform them of the administration dates for the assessment. This is particularly important for the applied course. Although most teachers said that they did count the assessment as part of their students' final course mark, only 40% of the students in the applied course said they knew that it would count.

This communication is important because students should understand how they will be assessed. The questionnaire results show that students' awareness of the EQAO assessment counting has the potential to improve their results. Also, approximately 70% of students indicated that such awareness increased their motivation to take the assessment more seriously.

The results of cohort tracking demonstrate the importance of early awareness of learning difficulties and appropriated interventions. The results show that a large number of students who had not met the provincial standard in mathematics in Grades 3 and/or 6 were able to succeed in the Grade 9 mathematics courses, including the academic course. This was particularly true for students who experienced success in Grade 8. However, many students who did not meet the standard in the early grades continued to experience challenges in the later grades. It is critical that these students be identified early in their schooling and that interventions be made to improve their knowledge and skills so that they can build on these in later grades.

Initiatives to encourage and assist students to complete homework and to attend class more regularly have potential to improve their achievement.

The strong and persistent relationships among achievement, students' attitude toward mathematics and their confidence in their ability to do well in mathematics also provide potential opportunities to improve student achievement. When reviewing the relevant data, it is important to give consideration to the following question: Do students who have developed positive attitudes toward mathematics learn mathematics more effectively, or is it that students who do well in mathematics develop positive attitudes? While it is not possible to claim a cause and effect relationship between more positive attitudes and higher achievement, it is likely that each reinforces the other. That is, it is likely that students who are taught mathematics in an engaging way that builds positive attitudes will have higher achievement. Also if students are given opportunities to succeed in mathematics, they may develop more confidence and achieve higher results. As students achieve higher levels, it is likely that their attitudes will become more positive.

EQAO RESEARCH

Education Quality and Accountability Office, 2 Carlton Street, Suite 1200, Toronto ON M5B 2M9, 1-888-327-7377, www.eqao.com

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EQAO RESEARCH

May 2012 Research Bulletin #11

- What are the differences and similarities in selected background characteristics and questionnaire responses between students enrolled in the Grade 9 academic and applied mathematics courses?
- Which student, class practice and context variables are most strongly related to student achievement?

EQAO Research

EQAO undertakes research for two main purposes:

- to maintain best-of-class practices and to ensure that the agency remains at the forefront of large-scale assessment and
- to promote the use of EQAO data for improved student achievement through the investigation of means to inform policy directions and decisions made by educators, parents and the government.

EQAO research projects delve into the factors that influence student achievement and education quality, and examine the statistical and psychometric processes that result in high-quality assessment data.

Research conducted by

Xiao Pang, M.A., Ph.D.,
Psychometrician, EQAO

W. Todd Rogers, Ph.D.,
Scholar in Residence, EQAO, University of Alberta

Michael Kozlow, Ph.D.,
Director, Data and Support Services, EQAO

Acknowledgement
This research project was a collaborative effort among EQAO staff on the Assessment, Data Management and Analysis and Psychometric teams.

Factors That Are Related to Student Achievement on the EQAO Grade 9 Assessment of Mathematics

By Michael Kozlow, Ph.D., Director, Data and Support Services, Education Quality and Accountability Office

PURPOSE

This bulletin summarizes the results of two EQAO research studies conducted by Xiao Pang, Todd Rogers and Michael Kozlow on differences between academic and applied mathematics courses in English-language schools with respect to student background, attitudes and behaviour and student performance on the Grade 9 Assessment of Mathematics. The following research questions were addressed:

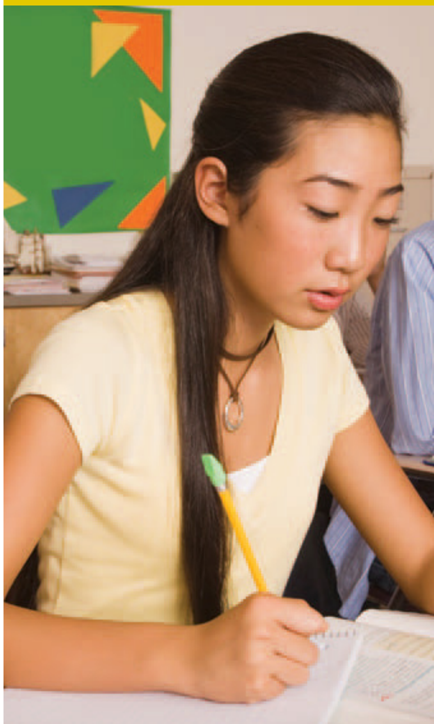
- What are the differences and similarities in selected background characteristics and questionnaire responses between students enrolled in the Grade 9 academic and applied mathematics courses?
- Which student, class practice and context variables are most strongly related to student achievement?

This study is part of EQAO's research program, which promotes the use of EQAO data for improved student achievement by examining factors that influence student achievement and education quality, and investigates means to inform policy directions and decisions made by educators, parents and the government.

DATA-ANALYSIS PROCEDURES

The following three types of analyses were conducted:

- tabulation of responses to questionnaire items and cross-tabulation of questionnaire responses with achievement levels;
- tracking of the achievement of a cohort of students from Grade 3 to Grade 9 and
- a two-level (student and teacher) hierarchical linear modeling (HLM) analysis to examine the strength of relationships between background and questionnaire data and achievement, and to determine the amount of variance in student achievement that can be accounted for by the combination of these variables.

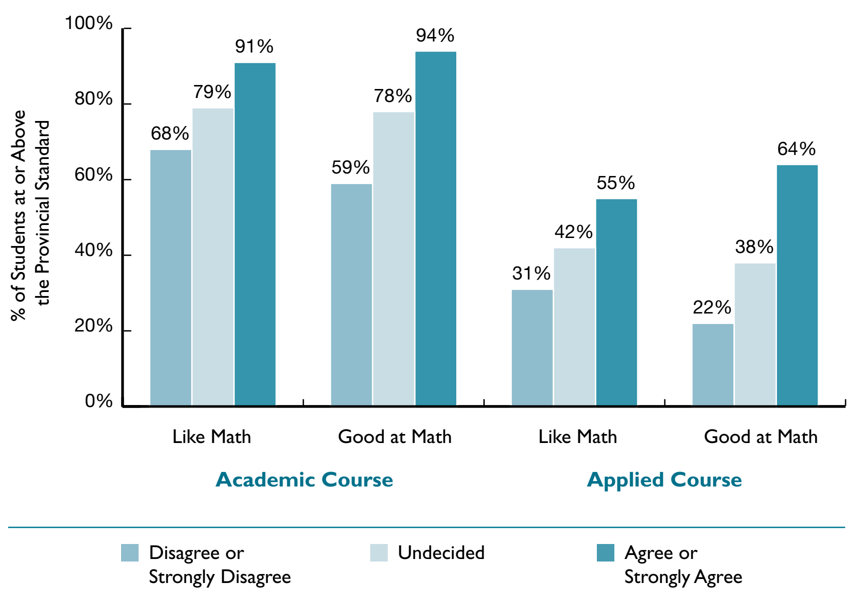


The HLM analyses were conducted on the 2011 assessment data, and the remaining analyses were conducted on the 2010 assessment data.

RESULTS: STUDENT-ATTITUDE AND BACKGROUND VARIABLES

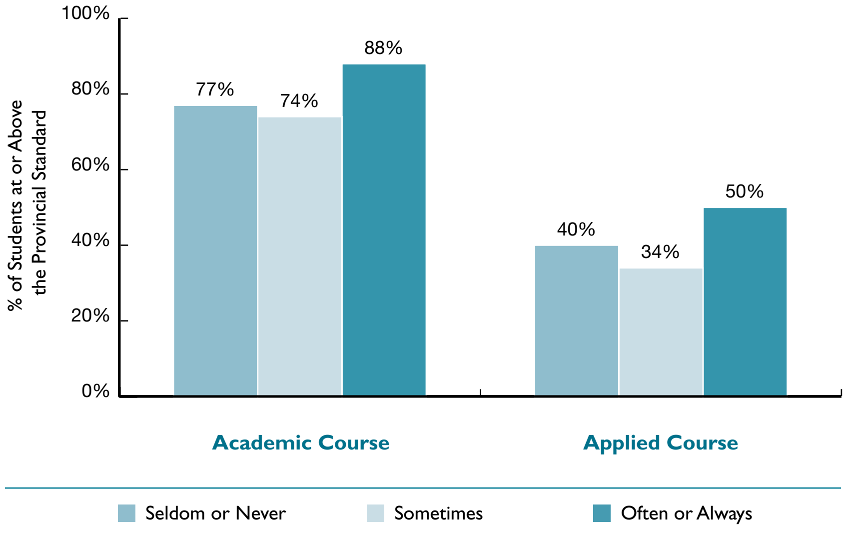
- Students in the academic course were more likely to complete their homework than students in the applied course; 63% of students in the academic course and 51% in the applied course reported that they "often" or "always" completed their homework.
- Students in the academic course were absent less often than students in the applied course; 27% of students in the academic course and 50% in the applied course reported that they missed class more than four times.
- A larger percentage of students in the academic course than in the applied course reported that they had computers at home that they used for their mathematics school work (60% vs. 46%, respectively).
- A larger percentage of students in the academic course than in the applied course indicated that they felt they were good at mathematics; 53% of students in the academic course and 37% in the applied course agreed or strongly agreed with the statement "I am good at mathematics."
- A larger percentage of students in the academic course than in the applied course indicated that they liked mathematics; 55% of students in the academic course and 37% in the applied course agreed or strongly agreed with the statement "I like mathematics."
- The percentage of students with special education needs in the applied course was approximately four times that in the academic course.

Percentage of Students at or Above the Provincial Standard vs. Attitude Toward Mathematics



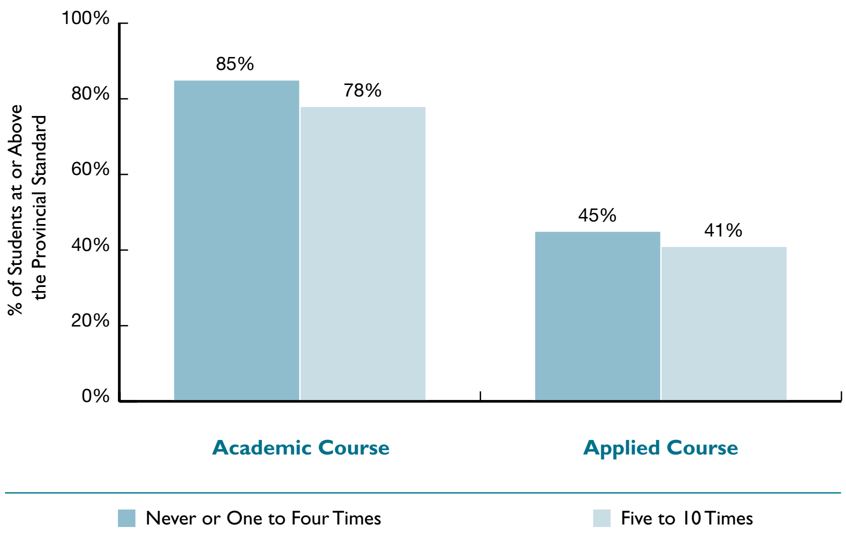
The graph shows the relationship between student attitudes and achievement. Students who said they liked mathematics and felt they were good at mathematics were more likely to meet the provincial standard on the Grade 9 mathematics assessment. For example, of students in the academic course who agreed or strongly agreed with the statement "I like mathematics," 91% met the provincial standard; of those who disagreed or strongly disagreed, 68% met the standard.

Percentage of Students at or Above the Provincial Standard vs. Homework Completion



There is also a relationship between achievement and completing homework (see the graph). Of students who said they completed their homework "often" or "always," 88% in the academic course and 50% in the applied course met the standard. These percentages were 77% and 40%, respectively, among students who said they "seldom" or "never" completed their homework.

Percentage of Students at or Above the Provincial Standard vs. Absence from Math Class



Students who were absent from mathematics class less often were more likely to meet the provincial standard (see the graph). The difference was eight percentage points for the academic course and four for the applied course.

RESULTS: COHORT TRACKING (GRADE 3 IN 2004, GRADE 6 IN 2007 AND GRADE 9 IN 2010)

- The cohort-tracking results showed that students who meet the provincial standard in the early grades are much more likely to meet it in later grades. These results also demonstrate the importance of identifying learning difficulties early and providing interventions to assist students to overcome these difficulties.

- Of students who had met the standard in both Grades 3 and 6, 91% enrolled in the academic course and 91% met the standard in Grade 9.
- Of students who had not met the standard in Grade 3 and had not met the standard in Grade 6, 33% enrolled in the academic course.
- Students who had not met the standard in the early grades and who enrolled in the academic course were much more likely to meet the standard in Grade 9 than those who enrolled in the applied course; 51% of such students met the standard in the Grade 9 academic course compared to the 29% who did in the applied course. This is partially accounted for by the fact that more of the students who enrolled in the academic course had higher achievement levels in mathematics in Grade 8. Of the students who had not met the standard in Grade 6 and enrolled in the academic course in Grade 9, 82% had received an average grade that was equivalent to a Level 3 or 4 across the strands in Grade 8 mathematics. Of the students who had not met the standard in Grade 6 and enrolled in the applied course in Grade 9, 49% had received an average grade that was equivalent to Level 3 or 4 in Grade 8 mathematics.

RESULTS: HLM ANALYSIS

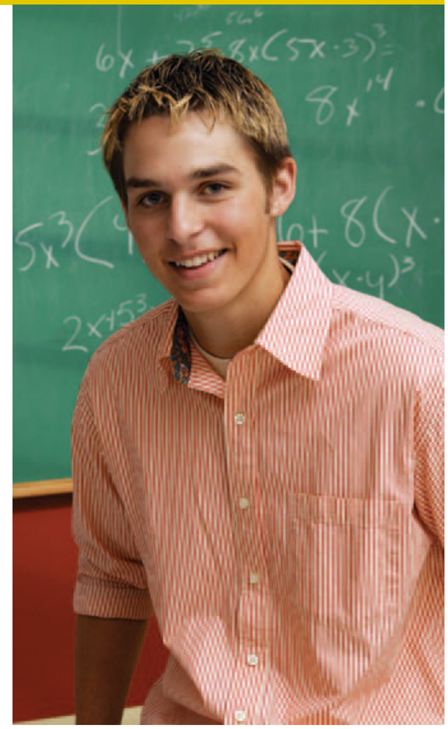
The student variables in the HLM analysis accounted for over 55% of the variance in student achievement in the academic course and approximately 42% in the applied course. The following student variables were consistently related to more positive mathematics performance:

- achievement on the junior mathematics assessment component
- awareness that the EQAO assessment would count as part of the course mark
- perceived ability in mathematics and liking mathematics
- completion of homework
- regular attendance in mathematics classes

CONCLUSIONS

The patterns in the data for the variables examined in this study provide some indications of factors that might account for some of the variation in the achievement results on the Grade 9 Assessment of Mathematics among students in the academic and applied courses, the former of whom consistently show more positive results. These factors are summarized below:

- The percentage of students in the applied course who said they knew that the EQAO assessment would count for part of their final course mark was considerably smaller than that of students in the academic course. A larger portion of students who knew the assessment would count achieved the provincial standard.
- Students in the academic course were more likely to complete homework and reported fewer absences from mathematics class. Both homework completion and regular attendance are related to higher achievement levels.

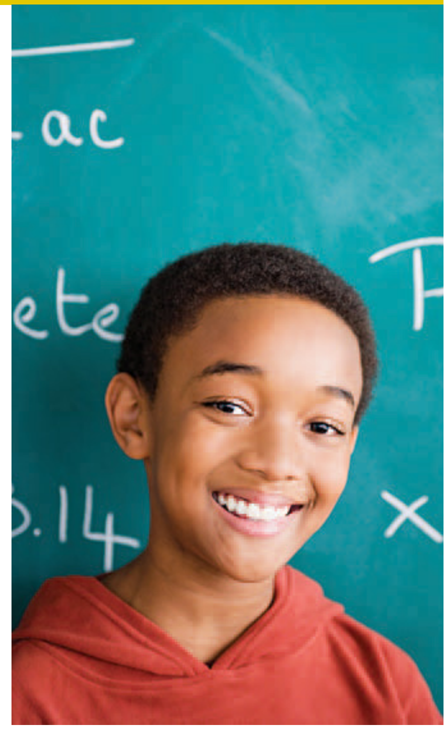


- A larger portion of students in the applied course than in the academic course had not met the standard in Grade 3 and had not met the standard in Grade 6. In addition, of the students who had not met the standard in Grade 6, those who enrolled in the applied course were likely to have had lower achievement levels in Grade 8 mathematics than those who enrolled in the academic course. High achievement in earlier grades is a strong predictor of high achievement in later grades.
- Students in the academic course have more positive attitudes toward mathematics than those in the applied course. Positive attitudes are associated with higher achievement levels.
- The percentage of students with special education needs in the applied course is approximately four times that in the academic course. The percentage of students achieving the provincial standard is considerably smaller among students with special education needs than among the general student population.

IMPLICATIONS FOR PRACTICE

The findings presented in this report provide useful information to educators as they review classroom practices and program delivery in schools. The relationships between background and questionnaire variables and achievement can inform decision making for school improvement planning and practices that individual teachers employ in their classrooms.

- It is clear that many students do not know whether the Grade 9 mathematics assessment will contribute to their final course marks. It is very important that teachers clearly communicate their intentions, in writing, to students and parents at the beginning of the course. Teachers should also remind students and parents of their intentions when they inform them of the administration dates for the EQAO assessment. This is particularly important for the applied course.
- The results of cohort tracking demonstrate the importance of early awareness of learning difficulties and interventions based on this information. The results show that a large number of students who had not met the provincial standard in mathematics in one or both of Grades 3 and 6 were able to achieve the standard in Grade 9 mathematics, including in the academic course. This was particularly true for students who had demonstrated higher levels of achievement in Grade 8. However, many students who do not meet the standards in the early grades continued to experience challenges in the later grades. It is critical that these students be identified early in their schooling and that interventions be made to improve their knowledge and skills so that they can build on them in later grades.
- Initiatives to encourage students to complete homework and to attend class more regularly have the potential to improve student achievement.



- The strong and persistent relationships between achievement and students' attitude toward mathematics and their confidence in their ability to do well in mathematics also provide potential opportunities to improve student achievement. When reviewing the relevant data, it is important to consider the following question: do students who have developed positive attitudes toward mathematics learn mathematics more effectively, or is it that students who do well in mathematics develop positive attitudes? While it is not possible to claim a cause and effect relationship between more positive attitudes and higher achievement, it is likely that each reinforces the other. That is, it is likely that students who are taught mathematics in an engaging way that builds positive attitudes will have higher achievement. Also, if students are given opportunities to succeed in mathematics, they may develop more confidence and achieve higher results. As students achieve at higher levels, it is likely that their attitudes will become more positive and they will become more confident.

Education Quality and Accountability Office

EQAO

2 Carlton Street, Suite 1200,
Toronto ON M5B 2M9
Telephone: 1-888-327-7377
Web site: www.eqao.com

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Education Quality and Accountability Office

EQAO

#DataInAction

Math Superpowers

Presented at the American Educational Research Association annual meeting

April 2019

Presented at the American Educational Research Association annual meeting, April 2019

#DataInAction—Math Superpowers

THE INQUIRY

Is mathematics achievement all about the math, or can students advance their math achievement by empowering themselves as math students? EQAO research suggests that positive attitudes and strategies support success.

PARTICIPANTS

The inquiry considered 100 370 Ontario students (50 321 boys, 50 049 girls) attending publicly funded schools who completed the Grade 3 Student Questionnaire and who had EQAO math assessment results in primary, junior and Grade 9. Math results for Grade 3 (2008–2009), Grade 6 (2011–2012) and Grade 9 (2014–2015) were linked. Students studying in English- and French-language school boards were included.

MEASUREMENT

Responding to statements contained in Table 1, at the end of the Grade 3 assessment, students rated themselves on their attitude toward math and on their use of math strategies using a three-point scale (low, moderate and high). These ratings were used to assign students to one of three groups for Math Attitude (low positive, moderately positive, highly positive). Similarly, the ratings were used to assign students to one of three groups for their use of math strategies (low use, moderate use and high use). Group assignment was established in Grade 3 and remained stable across Grades 3, 6 and 9.

Table 1. Questionnaire Items Associated with Math Strategies and Attitude Toward Math

Student Questionnaire Items
Superpower 1: Attitude Toward Math
1. I am good at mathematics.
2. I like mathematics.
3. I am able to answer difficult mathematics questions.
Superpower 2: Math Strategies
1. I do my best when I do mathematics activities in class.
2. I think about the steps I will use to solve the problem.
3. I read over the problem first to make sure I know what I am supposed to do.

Note: Items within superpowers are more closely related to one another than they are to items in another superpower—EQAO checked the math.

Achievement scores are the raw scores that underlie the achievement levels reported in provincial reporting.[1]

[1] Raw scores range from 0.1 to 4.9.

1

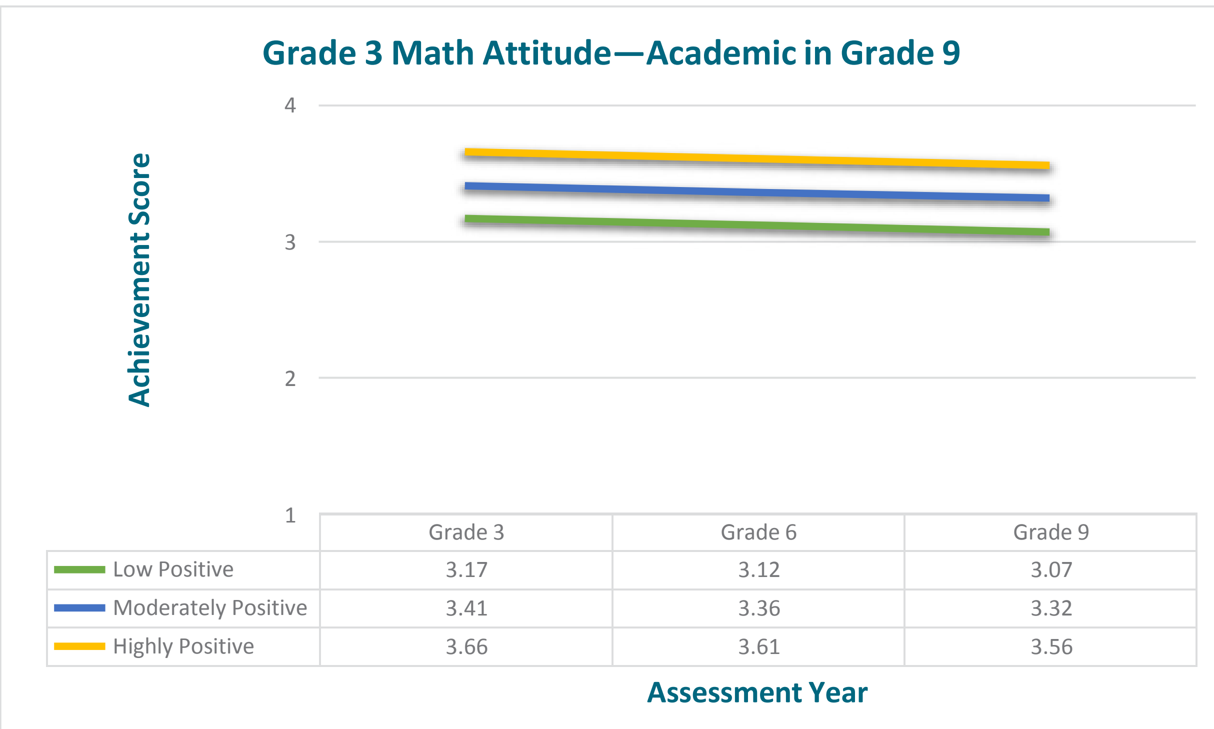
SUPERPOWER 1: MATH ATTITUDE

Students who study in the academic math program in Grade 9 rated themselves as having moderate to high positivity toward mathematics in Grade 3—a finding that is true for both boys and girls (see Table 2). Figure 1 illustrates that higher academic math achievement in Grade 9 is associated with positive attitudes toward math in Grade 3.

Table 2. Frequency of Grade 3 Math Attitude by Gender—Academic Math Program in Grade 9

Math Attitude in Grade 3	Boys	Girls	Total
Low Positive (1)	1 476	1 537	3 013
Moderately Positive (2)	16 089	20 660	36 749
Highly Positive (3)	18 867	16 806	35 673
Total	36 432	39 003	75 435

Figure 1. Math Attitude in Grade 3 by Achievement Scores in Grade 9 Math—Academic



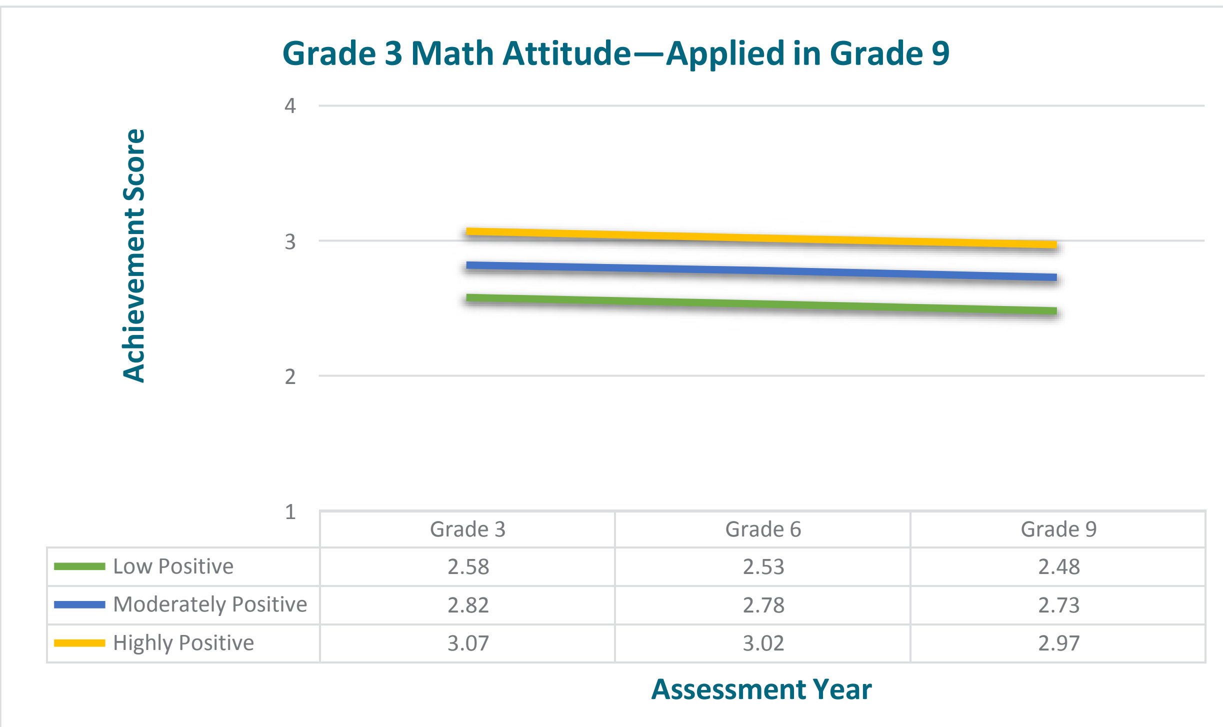
Students who study in the applied math program in Grade 9 most often rated themselves as having moderately positive attitudes toward mathematics in Grade 3—a finding that is true for both boys and girls (see Table 3). As was the case with the students in the academic program, in the applied program, higher math achievement in Grade 9 is associated with positive attitudes toward math in Grade 3 (see Figure 2).

It is noteworthy that only students rating themselves as having highly positive attitudes demonstrated achievement that met provincial standards.

Table 3. Frequency of Grade 3 Math Attitude by Gender—Applied Math Program in Grade 9

Math Attitude in Grade 3	Boys	Girls	Total
Low Positive (1)	1 637	1 163	2 800
Moderately Positive (2)	7 680	6 723	14 403
Highly Positive (3)	4 572	3 160	7 732
Total	13 889	11 046	24 935

Figure 2. Math Attitude in Grade 3 by Achievement Scores in Grade 9 Math—Academic



Taken together, the results highlight that a positive attitude toward math in Grade 3 is likely to lead to higher achievement. And the more positive the attitude in Grade 3, the better the score through the transition to high school. This is true for both programs of study (i.e., academic and applied) and for both boys and girls.

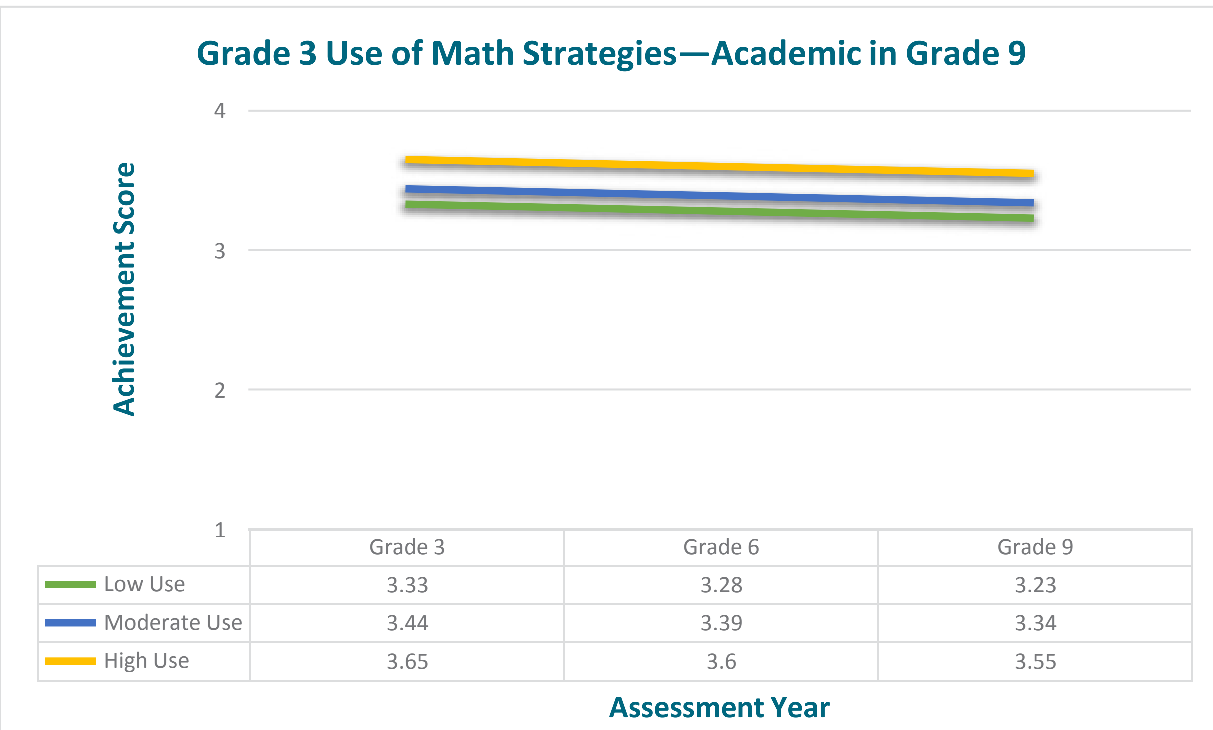
SUPERPOWER 2: USE OF MATH STRATEGIES

Most often, students who study within the academic math program in Grade 9 rated themselves as having low to moderate use of strategies in Grade 3, which is true for both boys and girls (see Table 4). As was the case with Math Attitude, higher use of strategies forecasts higher achievement scores in Grade 9 (see Figure 3).

Table 4. Frequency of Grade 3 Use of Math Strategies by Gender—Academic Math Program in Grade 9

Math Strategies in Grade 3	Boys	Girls	Total
Low Use (1)	15 529	11 133	26 662
Moderate Use (2)	19 115	26 106	45 221
High Use (3)	1 788	1 764	3 552
Total	36 432	39 003	75 435

Figure 3. Use of Math Strategies in Grade 3 by Achievement Scores in Grade 9 Math—Academic

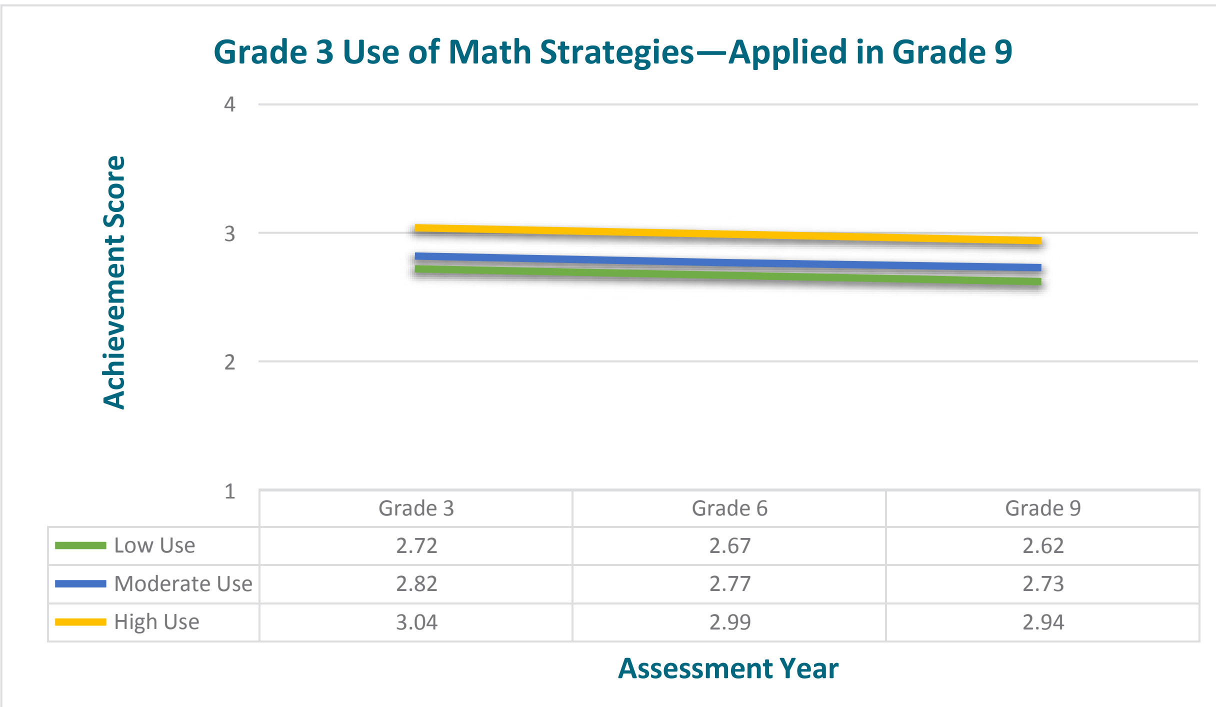


Students who study in the applied math program in Grade 9 most often rated themselves as low users of math strategies in Grade 3 (see Table 5). As was the case with the students in the academic program, in the applied program, higher math achievement in Grade 9 is associated with high usage of math strategies in Grade 3 (see Figure 4). And, similarly to the case with math attitude, only students rating themselves as high users of strategies demonstrated achievement that met provincial standards.

Table 5. Frequency of Grade 3 Use of Math Strategies by Gender—Applied Math Program in Grade 9

Math Strategies in Grade 3	Boys	Girls	Total
Low Use (1)	8 679	7 939	16 618
Moderate Use (2)	4 797	2 831	7 628
High Use (3)	413	276	689
Total	13 889	11 046	24 935

Figure 4. Use of Math Strategies in Grade 3 by Achievement Scores in Grade 9 Math—Applied



When Grade 3 students bring their best work, think about the steps that they need to use and clarify the question, their scores will reflect their actions. The use of these simple and teachable strategies in primary has effects lasting into high school.

CONCLUSION

Success in mathematics is about math, yet this #DataInAction research suggests that there is more to math achievement than the numbers. Developing a positive attitude and using math strategies early have long-term payoffs; they empower students toward greater success.

So, to all Grade 3 students:

1. Choose a positive attitude for math. You can be good at mathematics; you can like math; and you will learn to answer difficult math questions.

2. Bring your best efforts to the math activities you do at school. Think about the steps you use to solve math problems.

3. Practise reading over the problem first to make sure you know what you are supposed to do. Sometimes math is more about the question than the answer.

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Telephone: 1-888-327-7377 I Web site: www.eqao.com

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04

Early Learning Experiences and Math Achievement Trajectories

Tracking the Longitudinal Performance of Students in Mathematics (English) (2014)

Tracking Student Achievement in Mathematics Over Time in English-Language Schools (2014)

EQAO RESEARCH

February 2014 Research Bulletin #13

Cohort studies provide important information about student performance and engagement throughout the students' time in the school system.

Tracking the Longitudinal Performance of Students in Mathematics (English)

By Rhona Shulman, M.A., and Michael Kozlow, Ph.D., Director, Data and Support Services, Education Quality and Accountability Office

INTRODUCTION

This bulletin highlights a number of student cohort tracking studies conducted by the Education Quality and Accountability Office (EQAO) to understand students' long-term experiences in mathematics, from kindergarten to Grade 9.[1] Cohort studies provide important evidence-based data for educators and policy-makers about the pathways of student learning, and foster conversations about opportunities and interventions to meet the diverse learning needs of all students.

Since every student in the province is assigned an Ontario Education Number, the results of their EQAO assessments for Grades 3, 6 and 9 can be linked and the progress of individuals or groups of students can be tracked through their school career.

THE EARLY YEARS: LINKING EARLY-CHILDHOOD DEVELOPMENT WITH STUDENT OUTCOMES IN GRADE 3

There is an increasing amount of evidence for the importance of early-childhood readiness to learn in positioning children for success in school. EQAO worked in partnership with researchers from the Offord Centre at McMaster University to explore the relationship between early-childhood development and the subsequent pathways of student learning and achievement.[2] The graph on page 2 illustrates the relationship between scores on the five domains of development measured by the Offord Centre's Early Development Instrument (EDI) and EQAO results in Grade 3 mathematics. Senior kindergarten students are classified in the following four readiness categories based on the results of the EDI: "vulnerable," "at risk," "ready" and "very ready."

EQAO Research

EQAO undertakes research for two main purposes:

- to maintain best-of-class practices and to ensure that the agency remains at the forefront of large-scale assessment and
- to promote the use of EQAO data for improved student achievement through the investigation of means to inform policy directions and decisions made by educators, parents and the government.

EQAO research projects delve into the factors that influence student achievement and education quality, and examine the statistical and psychometric processes that result in high-quality assessment data.

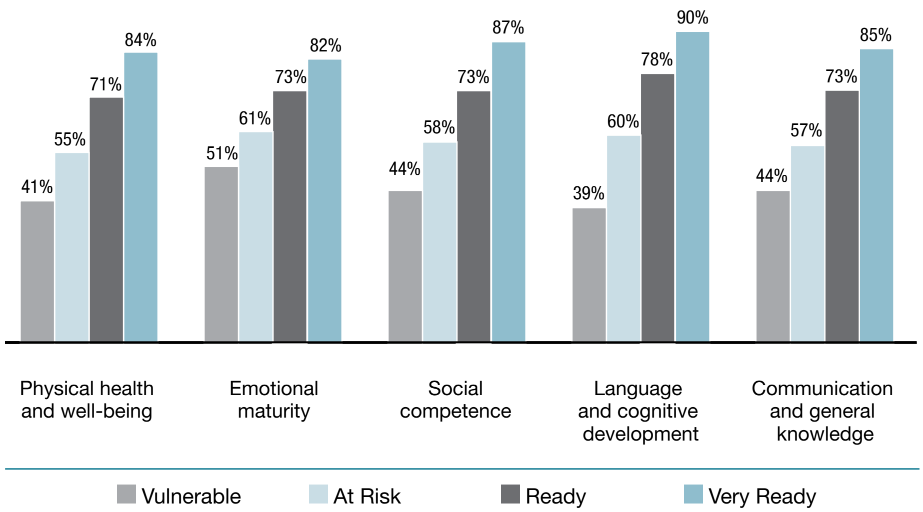
Research conducted by

Angela Hinton,
Manager, Data Management and Analysis, EQAO

Acknowledgement
This research project was a collaborative effort among EQAO staff on the Data Management and Analysis and Psychometric teams.

Relationship Between EDI Results (2005–2008) and Achievement in Grade 3 Mathematics (2008–2011)

Percentage of Students at or Above the Provincial Standard in Grade 3 Mathematics



The EQAO mathematics results for Grade 3 students presented above show that students who were "ready" or "very ready" in kindergarten outperformed their "vulnerable" and "at risk" peers on this assessment. This is a recurring theme in all the cohort-tracking results presented in this bulletin. It should also be noted that a substantial percentage of students identified as "vulnerable" or "at risk" in kindergarten did achieve the provincial standard in Grade 3 mathematics.

STUDENT OUTCOMES IN MATHEMATICS: GRADE 3 TO GRADE 6

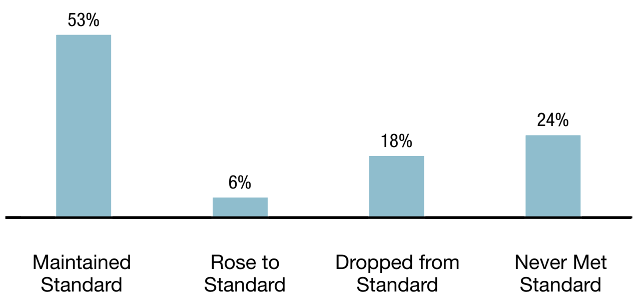
The following are observations about the 118 666 students whose EQAO assessment results for Grade 3 in 2008–2009 and for Grade 6 in 2011–2012 could be linked:

- Just over half of the students (53%) met the provincial standard in both Grades 3 and 6. An additional 6% of the students rose to the standard from Grade 3 to Grade 6 (for a total 59%).
- One-quarter of the students (24%) did not meet the standard in Grade 3 and also did not in Grade 6.

This is a concern, since not meeting the standard in the primary and junior grades is a predictor of difficulties in later grades, as will be seen in the next sections of this bulletin.

Percentage of Students in the Cohort Grade 3 (2008–2009) and Grade 6 (2011–2012)

Number of students in the cohort: 118 666



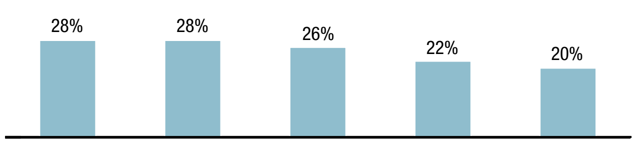
Maintained Standard: Met the provincial standard in both Grades 3 and 6

Rose to Standard: Did not meet the standard in Grade 3 but met it in Grade 6

Dropped from Standard: Met the standard in Grade 3 but not in Grade 6

Never Met Standard: Met the standard in neither Grade 3 nor Grade 6

Students in the Cohort Who Did Not Meet the Provincial Standard in Grade 3 but Did Meet It in Grade 6 Over Time



Grade 3	2005	2006	2007	2008	2009
Grade 6	2008	2009	2010	2011	2012
Number of students	10 793	10 609	9772	8585	6923

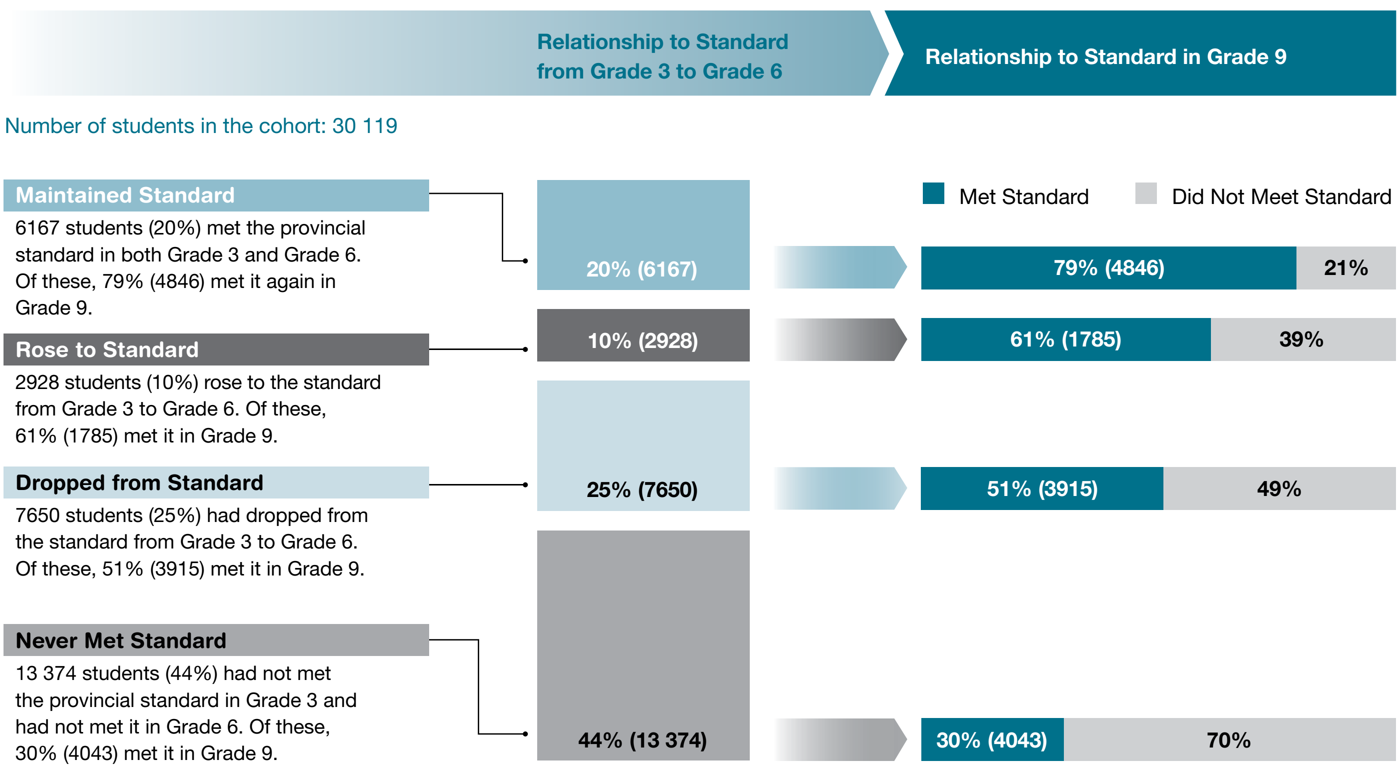
The graph above presents the results of an analysis for five cohorts of students who did not meet the standard in mathematics in Grade 3. It shows the percentages of these students who did meet the standard in Grade 6. This percentage has decreased by eight percentage points over the past four years.

STUDENT OUTCOMES IN MATHEMATICS: GRADE 3 TO GRADE 6 TO GRADE 9

The graphs on the following two pages show how students who were in the Grade 9 applied and academic mathematics courses in 2011–2012 performed compared to their results when they were in Grade 3 in 2005–2006 and Grade 6 in 2008–2009. The percentages are based on the number of students who could be tracked, including those who participated, were exempted or did not provide enough work to be scored.

- Of the 41 799 students enrolled in the Grade 9 applied course in 2011–2012, 30 119 (72%) were tracked from Grades 3 and 6.
- Of the 97 741 students enrolled in the Grade 9 academic course in 2011–2012, 80 270 (82%) were tracked from Grades 3 and 6.

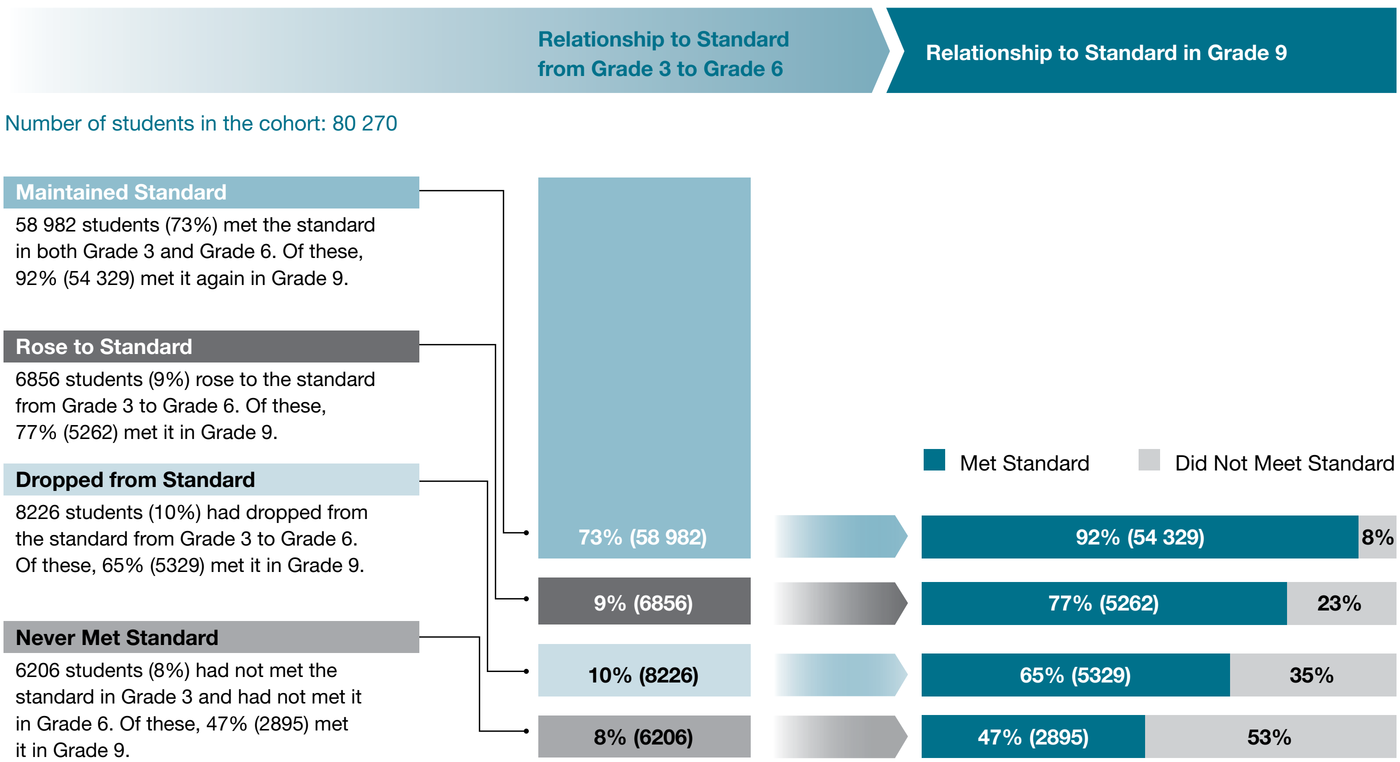
Student Outcomes in Mathematics from Grade 3 (2005–2006) to Grade 6 (2008–2009) to Grade 9 Applied (2011–2012)



Overall slightly more than half of the students enrolled in the Grade 9 applied mathematics course did not meet the provincial standard (52%, or 15 530 students). The majority of these students (60%, or 9331 students) had not met the provincial standard in mathematics in Grade 3 and also had not in Grade 6.

However, half the students who had dropped from achieving the standard from Grade 3 to 6 (51%, or 3915 students), recovered and met the standard in Grade 9, and a small proportion of students who had not met the standard in Grade 3 and also had not in Grade 6 (30%, or 4043 students) did meet it in Grade 9.

Student Outcomes in Mathematics from Grade 3 (2005–2006) to Grade 6 (2008–2009) to Grade 9 Academic (2011–2012)

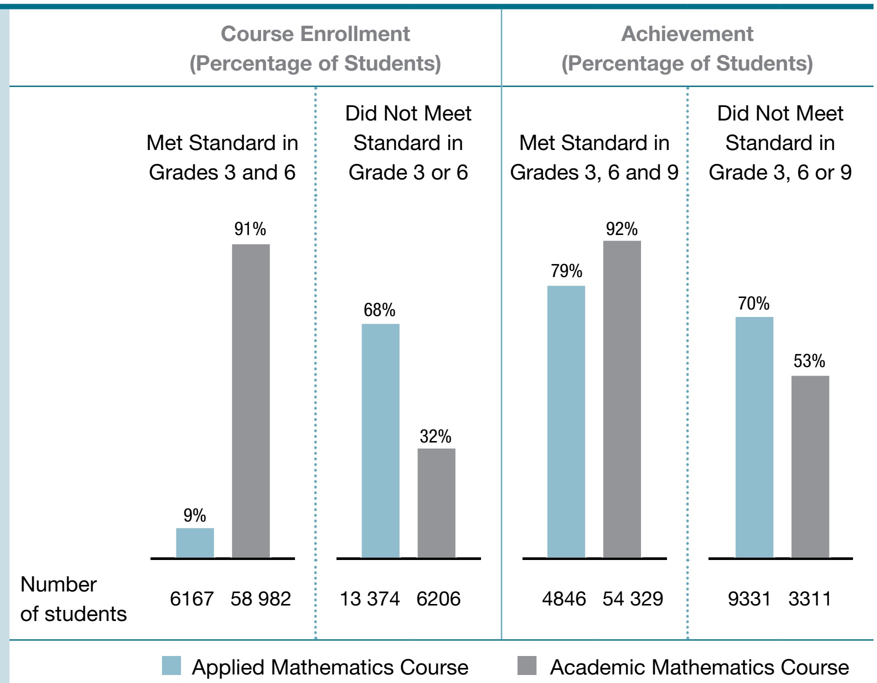


The majority of the students enrolled in the Grade 9 academic mathematics course met the provincial standard on the assessment (84%, or 67 815 students). A larger proportion of students who had met the provincial standard in both Grades 3 and 6 or in Grade 6 only met the standard in Grade 9 (88%, or 59 591 students).

Of the students who had not met the standard in Grade 3 and also had not in Grade 6, slightly more than half (53%, or 3311 students) had not met the standard in Grade 9; one-third of the students who had dropped from achieving the standard from Grade 3 to 6 (35%, or 2897 students) did not meet the standard again in Grade 9.

SUMMARY FOR 2011–2012 STUDENT COHORT: PERCENTAGE OF STUDENTS

The graphs to the right demonstrate a clear relationship between student outcomes in mathematics in the early grades, subsequent course selection and success in meeting the provincial standard in Grade 9. Almost all students who had met the provincial standard in Grades 3 and 6 enrolled in the academic course (91%), whereas most students who had not met the standard enrolled in the applied course (68%). More students in the academic than in the applied course continued to experience success in meeting the provincial standard in Grade 9 (92% vs. 79%) and, conversely, more students in the applied than in the academic course did not meet the provincial standard (70% vs. 53%).



APPLIED MATHEMATICS: A MORE DETAILED LOOK

Gender

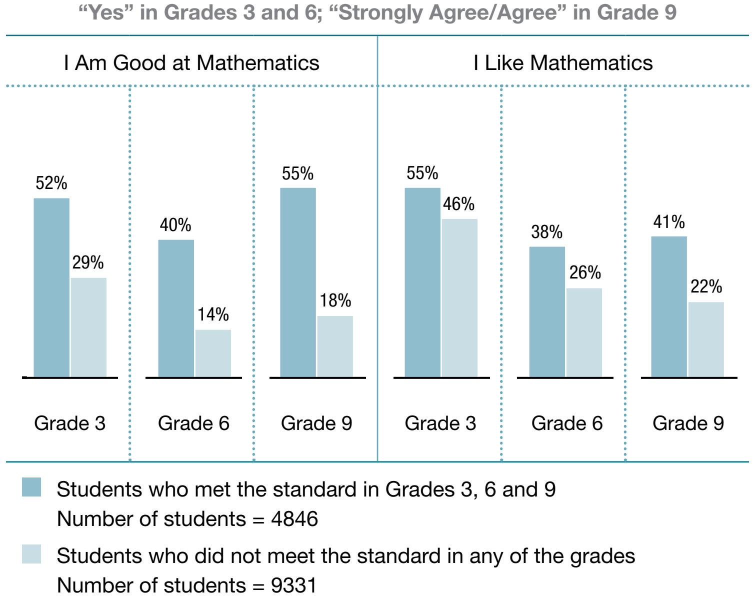
More male (55%, or 16 590 students) than female students (45%, or 13 529 students) enrolled in the Grade 9 applied mathematics course, a pattern that has been consistent over the previous two student cohorts.

Special Education Needs

Slightly more than one-third of students (36%, or 10 744 students) who enrolled in the applied mathematics course had special education needs, and 4512 (42%) of these students had not met the standard in mathematics at any time in their schooling. Note that this is an improvement from 46% for the 2010–2011 student cohort.

Attitudes About Mathematics from Grade 3 to Grade 6 to Grade 9 Applied: 2011–2012

"Yes" in Grades 3 and 6; "Strongly Agree/Agree" in Grade 9



Attitudes

Students who met the provincial standard for mathematics on all three assessments

- had more positive attitudes about mathematics than those who did not meet the standard (see the graph above);

- had slightly less positive perceptions about their mathematics ability in Grade 6 than in Grades 3 and 9 and
- liked mathematics slightly more in Grade 3 than in Grades 6 and 9.

Students who did not meet the provincial standard for mathematics on any of the assessments

- had less positive attitudes about mathematics than those who met the standard (see the graph on page 6);
- had much less positive perceptions of their mathematics ability and liked mathematics much less after Grade 3 and
- were less likely to connect new mathematics concepts to previous knowledge (only 23% of Grade 9 students responded "often" or "very often").

ACADEMIC MATHEMATICS: A MORE DETAILED LOOK

Gender

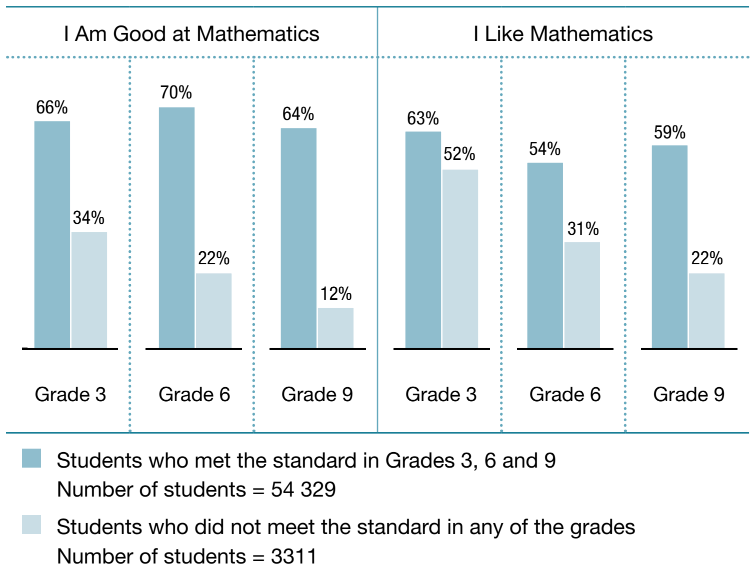
Slightly more female (52%, or 41 469 students) than male students (48%, or 38 801 students) enrolled in the academic mathematics course, a pattern that has been consistent over the previous two student cohorts.

Special Education Needs

A very small proportion of students in the academic mathematics course had special education needs (5%, or 4383 students), and most of these students met the provincial standards except for a minority (11%, or 487 students) who did not meet the standard at any grade level (3, 6 or 9).

Attitudes About Mathematics from Grade 3 to Grade 6 to Grade 9 Academic: 2011–2012

"Yes" in Grades 3 and 6; "Strongly Agree/Agree" in Grade 9



Attitudes

Students who met the provincial mathematics standard on all three assessments

- had more positive attitudes about mathematics than those who did not meet the standard (see the graph above);
- had similar attitudes toward mathematics at all grade levels and
- connected new mathematics concepts to previous knowledge (53% of Grade 9 students responded "often" or "very often").

Students who did not meet the provincial mathematics standard on any of the assessments

- had less positive attitudes about mathematics than those who did meet the standard (see the graph above);
- had much less positive perceptions of their mathematics ability and liked mathematics much less after Grade 3 and
- did not connect new math concepts to previous knowledge (only 27% of such Grade 9 students responded "often" or "very often").

SUMMARY

Cohort studies provide important information about student performance and engagement throughout the students' time in the school system. The data presented in this bulletin are consistent with previous evidence that

- early learning experiences make a difference in student outcomes in mathematics;
- meeting the provincial standard in primary- and junior-level mathematics is a good predictor of higher achievement levels in secondary school mathematics courses;
- students in applied mathematics courses with special education needs continue to be disadvantaged and
- there is a strong relationship between student attitudes toward mathematics and achievement.

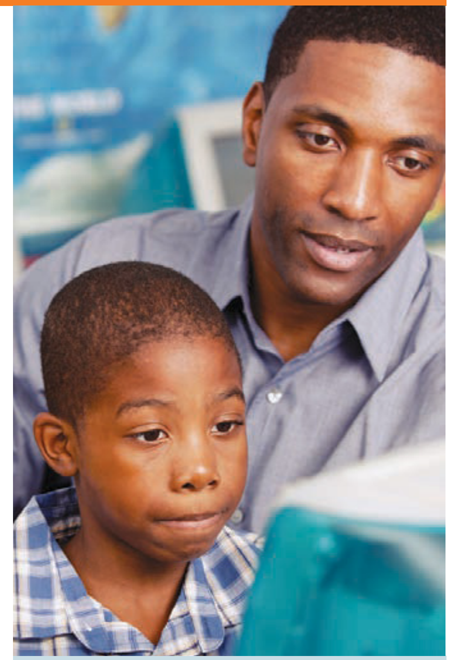
IMPLICATIONS

- Early and ongoing intervention to support students who are at risk in kindergarten or the primary or junior level can help them meet the provincial standard in mathematics in later grades.
- Use of assessment data and detailed tracking of students through the grades provides evidence of where resources and interventions may be most beneficial in supporting student success.
- Continued development of differentiated instructional strategies can assist in maximizing the effectiveness of teaching.[3, 4]
- The need for ongoing attention to the diverse learning needs of students in the applied mathematics course is indicated by the large proportion of students who had not met the standard in previous grades.
- More attention to students with special needs in applied mathematics courses is warranted.
- Promoting positive attitudes is important. Students who are taught mathematics in an engaging way that builds positive attitudes will likely achieve better results. Also, students with opportunities to succeed in mathematics may develop more confidence and achieve better results.

Education Quality and Accountability Office

EQAO

2 Carlton Street, Suite 1200,
Toronto ON M5B 2M9
Telephone: 1-888-327-7377
Web site: www.eqao.com



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EQAO RESEARCH

Tracking Student Achievement in Mathematics Over Time in English-Language Schools

Grade 3 (2006) to Grade 6 (2009) to Grade 9 (2012) Cohort

Angela Hinton
Education Quality and Accountability Office

MARCH 2014

About the Education Quality and Accountability Office

The Education Quality and Accountability Office (EQAO) is an independent provincial agency funded by the Government of Ontario. EQAO's mandate is to conduct province-wide tests at key points in every student's primary, junior and secondary education and report the results to educators, parents and the public.

EQAO acts as a catalyst for increasing the success of Ontario students by measuring their achievement in reading, writing and mathematics in relation to *Ontario Curriculum* expectations. The resulting data provide a gauge of quality and accountability in the Ontario education system.

The objective and reliable assessment results are evidence that adds to current knowledge about student learning and serves as an important tool for improvement at all levels: for individual students, schools, boards and the province.

About EQAO Research

EQAO undertakes research for two main purposes:

- to maintain best-of-class practices and to ensure that the agency remains at the forefront of large-scale assessment and
- to promote the use of EQAO data for improved student achievement through the investigation of means to inform policy directions and decisions made by educators, parents and the government.

EQAO research projects delve into the factors that influence student achievement and education quality, and examine the statistical and psychometric processes that result in high-quality assessment data.

EQAO RESEARCH

Education Quality and Accountability Office, 2 Carlton Street, Suite 1200, Toronto ON M5B 2M9, 1-888-327-7377, www.eqao.com

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Introduction

The Education Quality and Accountability Office (EQAO) is responsible for the development, administration, scoring and reporting of individual student results and aggregate school, board and provincial census assessment results in Ontario. EQAO administers curriculum-based assessments of reading, writing and mathematics to students at the end of the primary (Grade 3) and junior (Grade 6) divisions and mathematics in Grade 9 for both academic and applied courses. EQAO also administers the Ontario Secondary School Literacy Test (OSSLT), which is a secondary school graduation requirement that is typically taken by students when they are in Grade 10.

EQAO regularly tracks the achievement of students as they progress from one provincial assessment to the next (e.g., Grade 3 to Grade 6, three years later, and then to Grade 9, six years later). EQAO began tracking students from Grade 3 to 6 in 2008 and from Grade 3 to 6 to 9 in 2011.

The purpose of this study was to examine mathematics achievement, contextual and attitudinal data for a cohort of students from Grade 3 to Grade 9 (academic and applied courses). The results can be used to examine the impact of achievement early in a student's journey through elementary school on achievement in the higher grades. Longitudinal analysis of student performance provides principals and teachers, district policy makers and staff, Ministry of Education staff, researchers and the public with important insights into students' progress at key points during their schooling. In addition, this study includes information on the special education needs status of students and their attitudes toward mathematics (whether they like mathematics and their ability in mathematics). Since gender differences in mathematics were small, these data are not included in this report. In Grade 9, gender differences in achievement results in the two courses are confounded by the observation that a larger portion of male students than female students were enrolled in the applied mathematics course. Gender data are presented in the tables in the appendix.

This study examined the progress of students from Grade 3 in 2006, to Grade 6 in 2009, to Grade 9 in 2012, using the results from the mathematics component of the primary and junior assessments and the Grade 9 Assessment of Mathematics. The specific questions addressed were:

- Are the pathways of achievement over time for students who were in the Grade 9 academic mathematic course in 2012 the same as for those who were in the Grade 9 applied course in 2012?
- Are there differences between the academic and applied achievement pathways for students with special education needs?
- Are there differences in attitudes and perceptions between students in the academic achievement pathways and those in the applied achievement pathways?

Following presentation of the data and analyses procedures, each of the three questions will be addressed in separate sections.

Data

Using the unique Ontario Education Number (OEN), the mathematics achievement results on the EQAO assessments were first linked for students in Grade 3 in 2006 and in Grade 6 in 2009. The final matched sample included students from this matching who also had Grade 9 mathematics achievement results for either the academic or the applied course. The resulting matched sample was used for all analyses.

Table 1 shows the numbers of tracked students for the Grade 9 academic and applied courses. For example, of the 98 819 students enrolled in the Grade 9 academic course in 2012, 80 270 (81%) were matched across the three grades. The corresponding numbers for the applied course were 43 174 and 30 119 (70%).

Table 1:
Number of Tracked Students in the Cohort, by Grade 9 Course Selection

Grade 9 Mathematics course enrolment	Students included in results for Grade 9 Assessment of Mathematics in 2012	Students with results for all three assessments	Percentage of all tracked students in Grade 9 mathematics
Academic Mathematics	98 819	80 270	81%
Applied Mathematics	43 174	30 119	70%

The following data were analyzed for all matched students:
- student outcomes on each assessment;
- student background data; and
- student responses to two questionnaire items that asked about attitude toward mathematics and ability in mathematics.

Analyses

The first analysis involved comparing the percentage of tracked students in each achievement category for each grade to the corresponding percentage of students in the provincial population to determine how well the sample of tracked students represented the full population.

The second analysis involved creating four student pathways to represent students' progress through Grades 3 to 6 according to whether or not they met the provincial standard for each assessment. The four student pathways represented students who

- met the provincial mathematics standard in both Grade 3 and Grade 6 (maintained the standard);
- did not meet the standard in Grade 3 but did in Grade 6 (rose to the standard);
- met the standard in Grade 3 but did not in Grade 6 (dropped from the standard); and
- did not meet the standard in either Grade 3 or Grade 6 (never met the standard).

A parallel set of pathways were used to describe progress from Grade 6 to Grade 9. Tracking progress from Grade 3 to Grade 6 to Grade 9 requires eight pathways; students in each of the four pathways above for Grade 3 to Grade 6 who then did or did not meet the standard in Grade 9. The percentages of students were calculated for these pathways for pairs of consecutive assessment grades (i.e., Grade 3 to Grade 6 and Grade 6 to Grade 9), and across the three grades. Separate analyses were conducted for the academic and applied courses in Grade 9. Percentages were determined separately for students with special education needs. In addition, distributions of student responses to two questionnaire items were compared for the different pathways.

Results

The results are presented in four parts. Part 1 deals with the representativeness of the matched sample in relation to the full provincial population of students. Part 2 deals with the distribution of students across the different pathways (percentage of students represented by each pathway). The results for pairs of successive assessment grades are presented first, followed by the results for the eight pathways for tracking assessment results for students from Grade 3 to Grade 6 to Grade 9. Part 3 presents results parallel to those presented in Part 2 by special education needs and English language learner status. Since the gender differences in mathematics achievement results were small, these data are not included in this report. In Grade 9, gender differences in results in the two courses are confounded by the observation that more male students than female students were enrolled in the applied mathematics course. Results by gender are included in the appendix. Part 4 presents the results for the two attitude questionnaire items.

PART 1

Representativeness of Tracked Samples

Tables 2 and 3 present, respectively, the distribution of students in the tracked sample and in the provincial population in each grade in each achievement category for the three assessments. The EQAO achievement categories are as follows:

Level 4	The student has demonstrated the required knowledge and skills. Achievement surpasses the provincial standard.
Level 3	The student has demonstrated most of the required knowledge and skills. Achievement is at the provincial standard.
Level 2	The student has demonstrated some of the required knowledge and skills. Achievement approaches the provincial standard.
Level 1	The student has demonstrated some of the required knowledge and skills in limited ways. Achievement falls much below the provincial standard.
Below Level 1	The student did not demonstrate enough evidence of knowledge and understanding to be assigned Level 1.
No data	Non-exempt students for whom EQAO did not receive completed assessment booklets.
Exempt	Students who were formally exempted from participation in one or more components of the assessment.

The results suggest that the sample of tracked students at each grade is representative of the provincial population. The greatest difference between the sample and the population is in achievement category 3—1% to 5% more students are in the Level 3 category for the tracked samples than for the populations across the three assessments. For the remaining categories, the percentages are equal or within two percentage points of each other. For the main reporting variable used in the present study (percentage of students who met the provincial standard—at or above Level 3), the percentages for the matched samples are 5% higher for Grade 3 and Grade 6, 2% lower for the Grade 9 academic course and 4% higher for the Grade 9 applied course. This is not unexpected because students in the matched sample would have been in Ontario schools at least from Grades 3 to 9. Less mobile students tend to have slightly higher achievement results.

Table 2:
Distribution of Students in Tracked Samples by Achievement Category and Grade: Percentage of Students

	Grade 3 2006 (n = 110 389)	Grade 6 2009 (n = 110 389)	Grade 9 2012 Academic (n = 30 119)	Grade 9 2012 Applied (n = 80 270)
Level 4	12%	14%	12%	8%
Level 3	61%	54%	72%	40%
At or Above the Provincial Standard of Level 3	73%	68%	82%	48%
Level 2	22%	27%	11%	34%
Level 1	2%	4%	4%	12%
Below Level 1	0%	0%	0%	3%
No Data	1%	0%	1%	2%
Exempt	2%	1%	N/A*	N/A*

*N/A: Exemptions not permitted in Grade 9.

Table 3:
Distribution of Students in the Population by Achievement Category and Grade: Percentage of Students

	Grade 3 2006 (n = 132 782)	Grade 6 2009 (n = 136 075)	Grade 9 2012 Academic (n = 97 741)	Grade 9 2012 Applied (n = 41 799)
Level 4	11%	13%	13%	7%
Level 3	57%	49%	71%	37%
At or Above the Provincial Standard of Level 3	68%	63%	84%	44%
Level 2	23%	27%	11%	34%
Level 1	3%	6%	4%	13%
Below Level 1	<1%	<1%	<1%	4%
No Data	1%	1%	1%	5%
Exempt	4%	3%	N/A*	N/A*

*N/A: Exemptions not permitted in Grade 9.

PART 2

Progression in Mathematics Achievement along Pathways

The numbers and percentages of tracked students who met the provincial standard are presented first for the pathways between pairs of consecutive assessments and then for the pathways with all three assessments in Part 2.

Pathway Results from Grade 3 to Grade 6 Mathematics Assessments

Figure 1 shows the percentage of students in each pathway as they progressed from Grade 3 to Grade 6.[1]

As shown in Figure 1, of the tracked students:

- nearly three in five (59%) met the standard in both Grade 3 and Grade 6 (maintained the standard);
- nearly one in 10 (9%) did not meet the standard in Grade 3 but did in Grade 6 (rose to the standard);
- 14% met the standard in Grade 3 but did not in Grade 6 (dropped from the standard); and
- slightly less than one in five (18%) did not meet the standard in either Grade 3 or Grade 6 (never met the standard).

Another analysis of these data[2] showed that 20% of the students who had not met the standard in Grade 3 did rise to meet the standard in Grade 6, which is encouraging. EQAO also provides data for cohort tracking at the school level. Since many students are in the same school for both grades, the results provide principals and teachers with information about the progression of their students through elementary school as measured by the EQAO assessments.

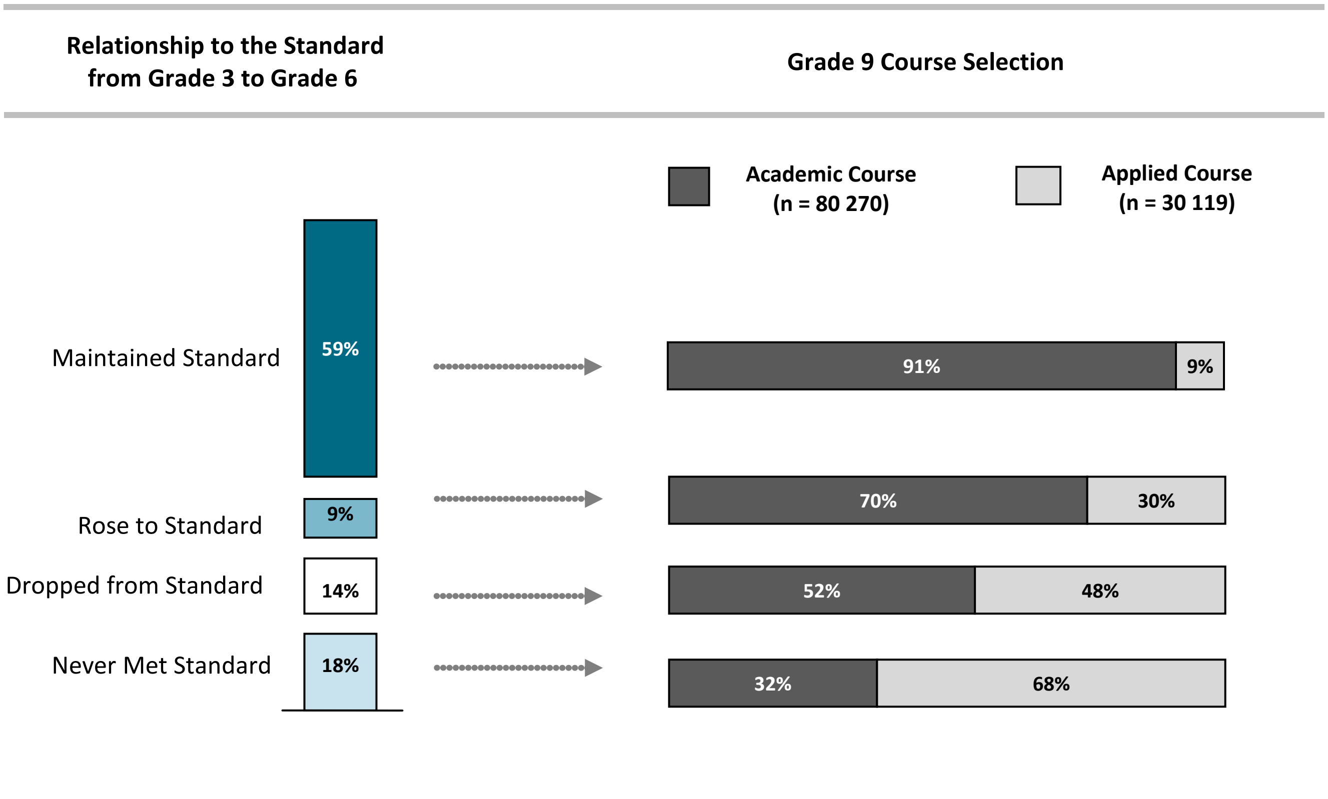
Pathway Results from Grade 6 to Grade 9 Mathematics Assessments and Grade 9 Course Selection

Of the tracked students in the cohort, 73% enrolled in the Grade 9 academic mathematics course and 27% enrolled in applied mathematics course. Figure 1 shows the course selections in terms of the four pathways.

[1] Detailed tables of results for student achievement, characteristics and attitudes can be found in the appendix.

[2] See *Highlights of the Provincial Results: Assessments of Reading, Writing and Mathematics, Primary Division (Grades 1–3) and Junior Division (Grades 4–6), and Grade 9 Assessment of Mathematics English Language Students, 2011–2012*. http://www/www.eqao.com/pdf_e/12/EQAO_PJ9_Highlights_2012.pdf)

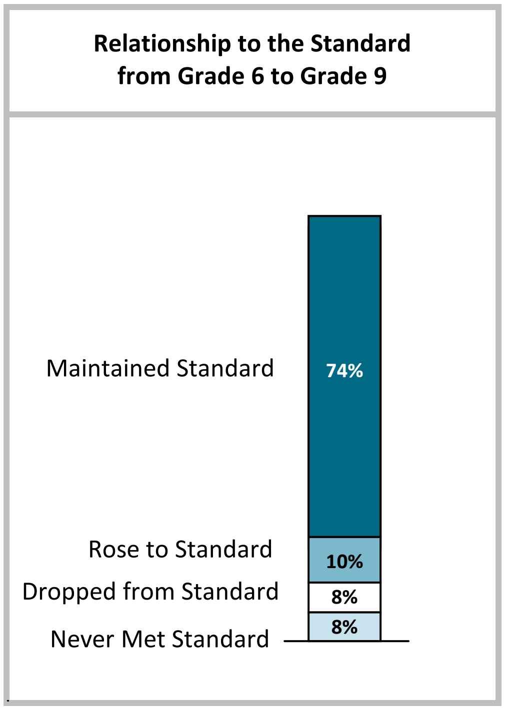
Figure 1:
Pathway Results for Tracked Students from Grade 3 (2006) to Grade 6 (2009) Mathematics Assessments and Grade 9 Course Selection (Percentage of Students)



- The vast majority (91%) of students who maintained the standard for both the Grade 3 and the Grade 6 assessments enrolled in academic mathematics in Grade 9. Successively smaller percentages of students enrolled in the academic course for the other three pathways. Of these students, 70% rose to the standard between the Grade 3 and 6 assessments, just over half (52%) dropped from the standard between the Grade 3 and 6 assessments and one-third (32%) did not meet the standard for either the Grade 3 or the Grade 6 assessments.
- A total of 9% of the students who maintained the standard for both the Grade 3 and the Grade 6 assessments enrolled in the applied course in Grade 9, and successively larger percentages of students enrolled in the applied course for the other three pathways. Specifically, 30% rose to the standard between the Grade 3 and 6 assessments, just under half (48%) dropped from the standard between the Grade 3 and 6 assessments and slightly more than two-thirds (68%) did not meet the standard for either the Grade 3 or Grade 6 mathematics assessments.

Pathway Results for Junior to Grade 9 Mathematics Assessments

Figure 2: Academic Course (n = 80 270)



Academic Course

Figure 2 shows the results of tracked students enrolled in the academic mathematics course as they progressed from Grade 6 to Grade 9.

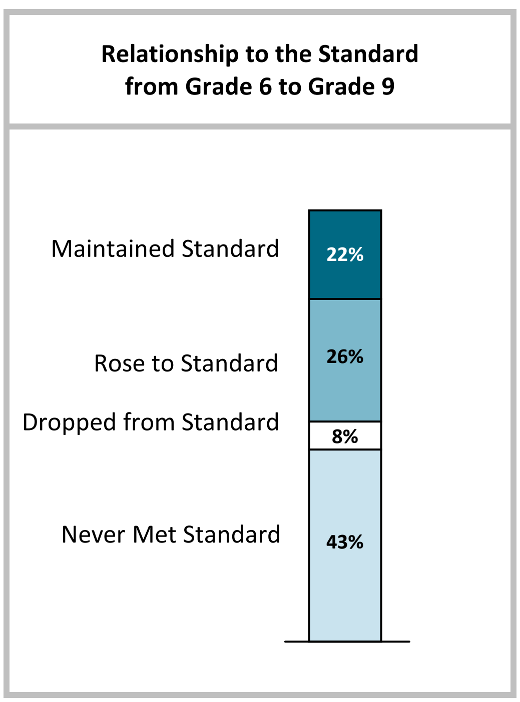
As shown, of the tracked students:

- nearly three-quarters (74%) maintained the standard on both the junior mathematics assessment and the Grade 9 academic mathematics assessment;
- one in 10 (10%) rose to the standard between the junior and Grade 9 academic mathematics assessments;
- 8% dropped from the standard between the junior and Grade 9 academic mathematics assessments; and
- 8% did not meet the standard for either assessment.

Figure 3: Applied Course (n = 30 119)

Applied Course

Figure 3 shows the results of tracked students enrolled in the applied mathematics course as they progressed from junior to Grade 9.



As shown, of the tracked students:

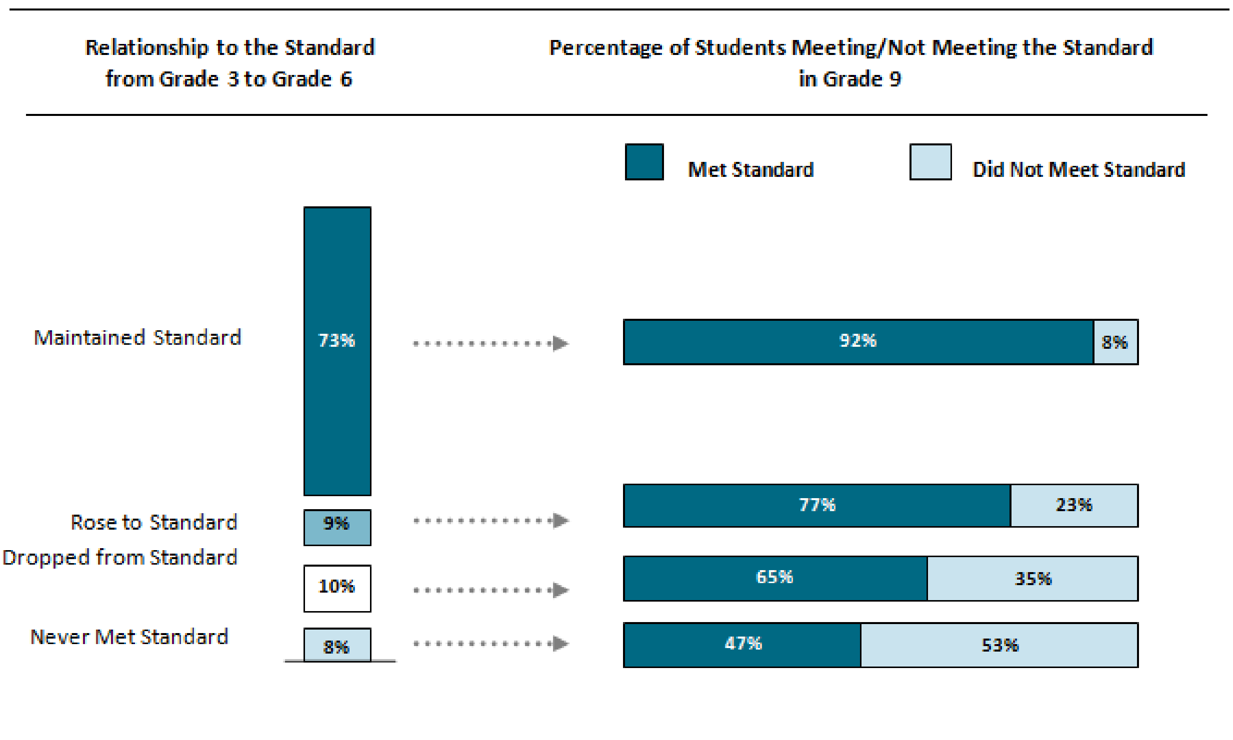
- slightly more than one in five (22%) enrolled in applied mathematics maintained the standard on both the Grade 6 assessment and the Grade 9 applied assessments;
- approximately one-quarter (26%) rose to the standard between the Grade 6 assessment and the Grade 9 applied assessments;
- slightly less than one in 10 (8%) dropped from the standard between the Grade 6 assessment and the Grade 9 applied assessments; and
- 43% did not meet the standard for either assessment.

Comparison of the percentages for the Grade 9 academic and applied pathways reveals that the percentage of students in the "maintained the standard" pathway is substantially larger for the academic assessment than for the applied assessment (74% versus 22%). Correspondingly, a substantially greater percentage of students in the applied course than in the academic course did not meet the standard in either Grade 6 or Grade 9 (43% versus 8%). Further, one in four (26%) of the students enrolled in the academic course rose to the standard from Grade 6 to Grade 9, compared to one in 10 (10%) of the students enrolled in the applied course.

Pathway Results from Primary to Junior to Grade 9 Mathematics Assessments

The pathway achievement results for the tracked students as they moved from Grade 3 to Grade 6 to Grade 9 are presented in Figure 4 for the academic course and in Figure 5 for the applied course.

Figure 4:
Pathway Results for Tracked Students from Grade 3 (2006) to Grade 6 (2009) to Grade 9 (2012) Academic Mathematics (n = 80 270)



The bars on the left of the graph show the percentage of students in each pathway for tracking achievement from Grade 3 to Grade 6. The bars on the right of the graph show the percentage of students meeting and not meeting the provincial standard in Grade 9 for students in each of these pathways. Of the tracked students in the academic course (Figure 4):

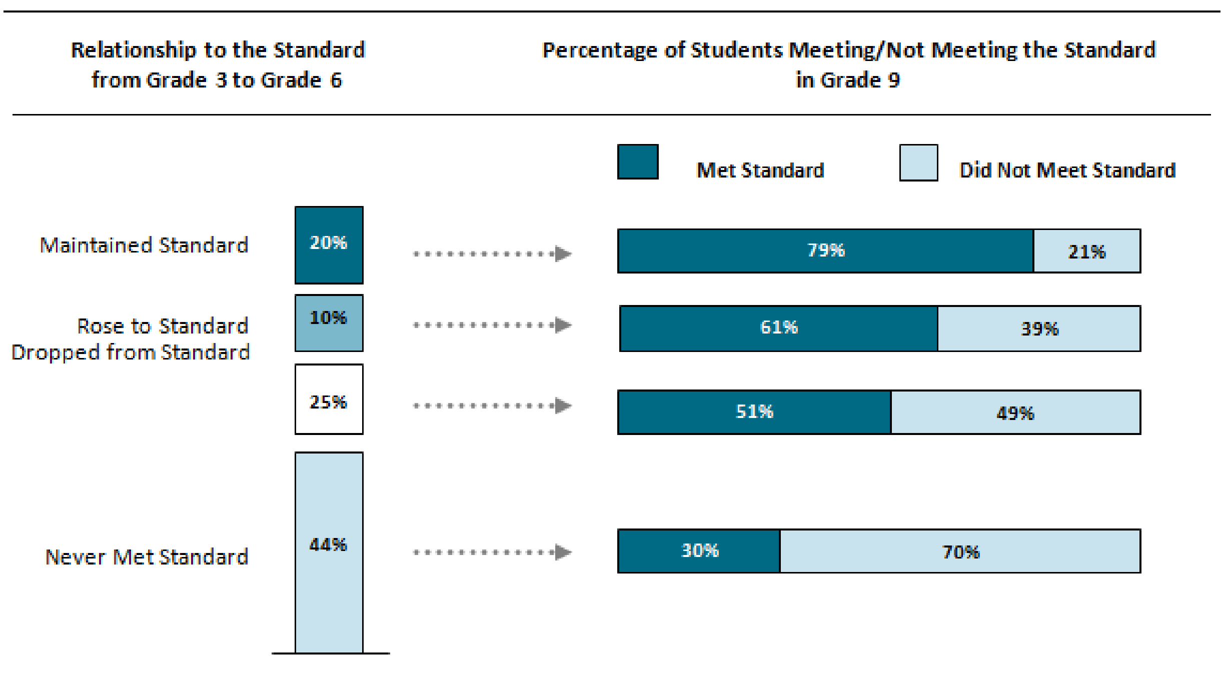
- nearly three-quarters (73%) maintained the standard from Grade 3 to Grade 6, and approximately nine in 10 (92%) of these students met the standard for the Grade 9 assessment;

- nearly one in 10 (9%) rose to the standard between Grade 3 and Grade 6, and just over three-quarters (77%) of these students met the standard for the Grade 9 assessment;
- one in 10 (10%) dropped from the standard between Grade 3 and Grade 6, and nearly two-thirds of these students (65%) met the standard for the Grade 9 assessment; and
- slightly less than one in 10 (8%) never met the standard in Grades 3 or 6, and 47% of these students met the standard for the Grade 9 assessment.

Of the tracked students in the applied course (Figure 5):

- one in five (20%) met the standard in both Grade 3 and Grade 6, and over three-quarters (79%) of these students met the standard for the Grade 9 assessment;
- one in 10 (10%) rose to the standard between Grade 3 and Grade 6, and just over three in five (61%) of these students met the standard for the Grade 9 assessment;
- one-quarter (25%) dropped from the standard between Grade 3 and Grade 6, and just over half (51%) of these students met the standard for the Grade 9 assessment; and
- 44% never met the standard in Grades 3 or 6, and less than one-third (30%) of these students met the standard for the Grade 9 assessment.

Figure 5:
Pathway Results for Tracked Students from Grade 3 (2006) to Grade 6 (2009) to Grade 9 (2012) Applied Mathematics (n = 30 119)



Discussion of the Academic and Applied Pathways
A comparison of the pathway percentages for students in the academic and applied courses showed a number of differences. First, as mentioned, there is a difference between the percentage of students who maintained the standard in Grades 3 and 6 and who enrolled in Grade 9 academic mathematics compared to those who enrolled in Grade 9 applied mathematics—91% versus 9%. Second, of the students enrolled in academic mathematics in Grade 9 who maintained the standard from Grade 3 to Grade 6, 92% met the standard in Grade 9 as opposed to 79% for the Grade 9 applied course. Third, of the students who rose to the standard from Grade 3 to Grade 6, 77% met the standard for the academic assessment and 61% met the standard for the applied course. Fourth, of the students who dropped from the standard between Grades 3 and 6, nearly two-thirds met the standard for the academic course, and just over 50% met the standard for the applied course.

In addition, 30% of the students who did not meet the standard in either Grade 3 or in Grade 6 met the standard for the Grade 9 applied assessment, and 47% met it in the academic course. It is interesting to note that these students were more likely to meet the standard in the academic course than in the applied course. A different analysis showed that some of these students did achieve high grades in their Grade 8 mathematics course, with a larger portion of them enrolling in the academic course.

Taken together, these results reveal that larger percentages of students met the standard for the Grade 9 academic course than met the standard for the applied course for all four pathways. The importance of some success, or better still, continuing success at meeting the standards in Grades 3 and 6, is evident for meeting the standards in both Grade 9 courses.

PART 3

Students with Special Education Needs and English language Learners

The pathways for students with special educational needs and English language learners are presented and discussed in Part 3. These particular groups of students were selected because of potential performance differences between the academic and applied pathways.

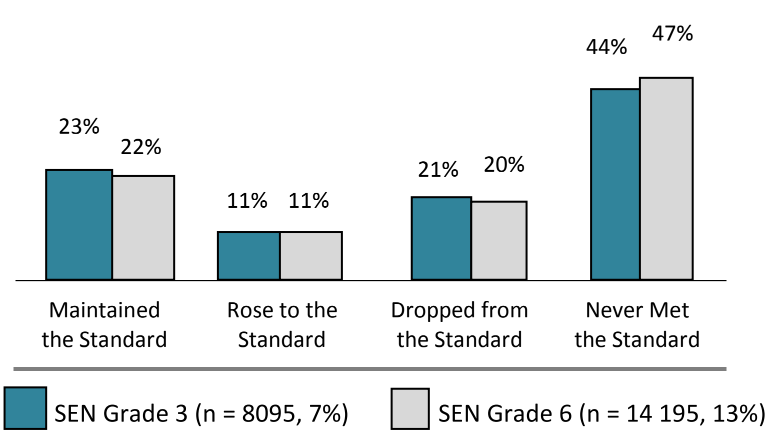
Students with Special Education Needs

The pathways for students with special educational needs are presented and discussed in this section. This group of students was selected for analysis because of the difference in the proportion of students with special education needs in the two Grade 9 courses (5% in the academic course and 36% in the applied course). Students may be identified with a special educational need in any grade, and generally the number of students identified with special educational needs increases through the elementary grades. Since the percentage of students identified with special educational needs is larger in Grade 6 than in Grade 3, the achievement pathways were generated for two groups of students—students identified with special education needs by the end of Grade 3, and students identified with special education needs by the end of Grade 6. Most of the students in the first group were also in the second group.

Pathway Results from Primary to Junior Mathematics Assessments

Figure 6 shows the results for students with special education needs who were tracked from the Grade 3 to Grade 6 assessments. The percentage of students identified with special education needs increased from 7% in Grade 3 to 13% in Grade 6.

Figure 6: Pathway Results for Students Tracked from Grade 3(2006) to Grade 6 (2009), Mathematics Assessments by Students with Special Education Needs (SEN)



As shown in Figure 6, of the students with special education needs:

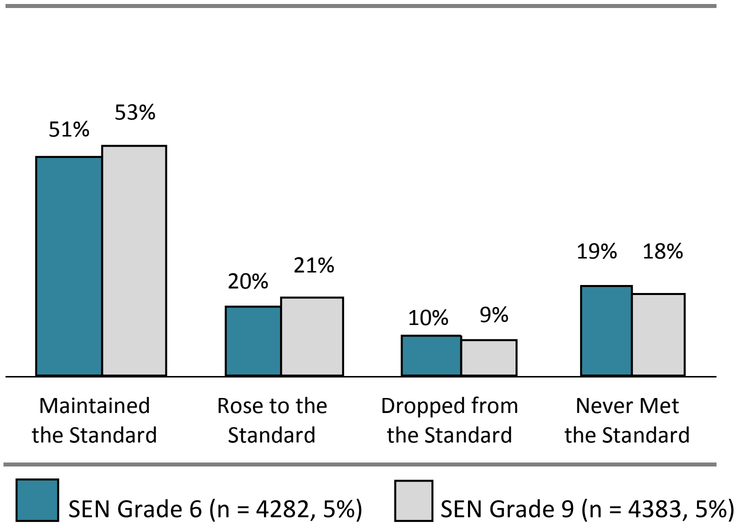
- nearly equal percentages met the standard for the Grade 3 and Grade 6 assessments (23% and 22%), which are much smaller than for the overall tracked sample (59%) presented in Figure 1;
- equal percentages rose to the standard between the Grade 3 and Grade 6 assessments (11%), which is similar to the overall tracked sample (9%);
- nearly equal percentages dropped from the standard between the Grade 3 and Grade 6 assessments (21% and 20%), which are higher than for the overall tracked sample (14%); and
- a greater percentage of Grade 6 than Grade 3 students did not meet the standard on either assessment (47% and 44%), which are much larger than for the overall tracked sample (18%).

Pathway Results from Junior to Grade 9 Mathematics Assessments

The mathematics achievement pathways for tracked students from Grade 6 to Grade 9 are provided in Figures 7 and 8 for the academic and applied courses, respectively. There is a slight increase in the number of students with special education needs who wrote the Grade 9 academic assessment compared to the number of students with special education needs who wrote the Grade 6 assessment (4282 versus 4383; see Figure 7). In contrast, there was a significant increase in the number of students with special education needs who wrote the Grade 9 applied mathematics assessment compared to those who wrote the assessment in Grade 6 (9913 versus 10 744; see Figure 8). Further study is needed to determine why there is such a large difference between the two Grade 9 mathematics courses.

Academic Course

Figure 7: Pathway Results for Tracked Students from Grade 6 (2006) to Grade 9 (2012), Academic Mathematics Assessments by Students with Special Education Needs

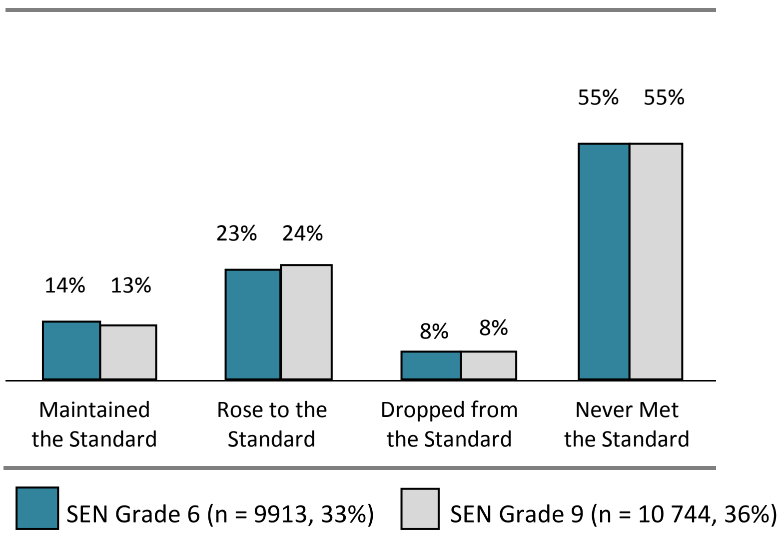


As shown in Figure 7, nearly equal percentages of students with special education needs:

- met the standard for the Grade 6 assessment and the Grade 9 academic assessment (51% and 53%);
- rose to the standard between the Grade 6 assessment and the Grade 9 academic assessment (20% and 21%);
- dropped from the standard between the Grade 6 assessment and the Grade 9 academic assessment (10% and 9%); and
- did not meet the standard on either assessment (19% and 18%).

Applied Course

Figure 8: Pathway Results for Tracked Students from Grade 6 (2006) to Grade 9 (2012), Applied Mathematics Assessments by Students with Special Education Needs



As shown in Figure 8, equal or nearly equal percentages of students with special education needs:

- met the standard for the Grade 6 assessment (14%) and the Grade 9 applied assessment (13%);
- rose to the standard between the Grade 6 assessment and the Grade 9 applied assessment (23% and 24%);
- dropped from the standard between the Grade 6 assessment and the Grade 9 applied assessment (8%); and
- did not meet the standard on either assessment (55%).

Pathway Results from Primary to Junior to Grade 9 Mathematics Assessments

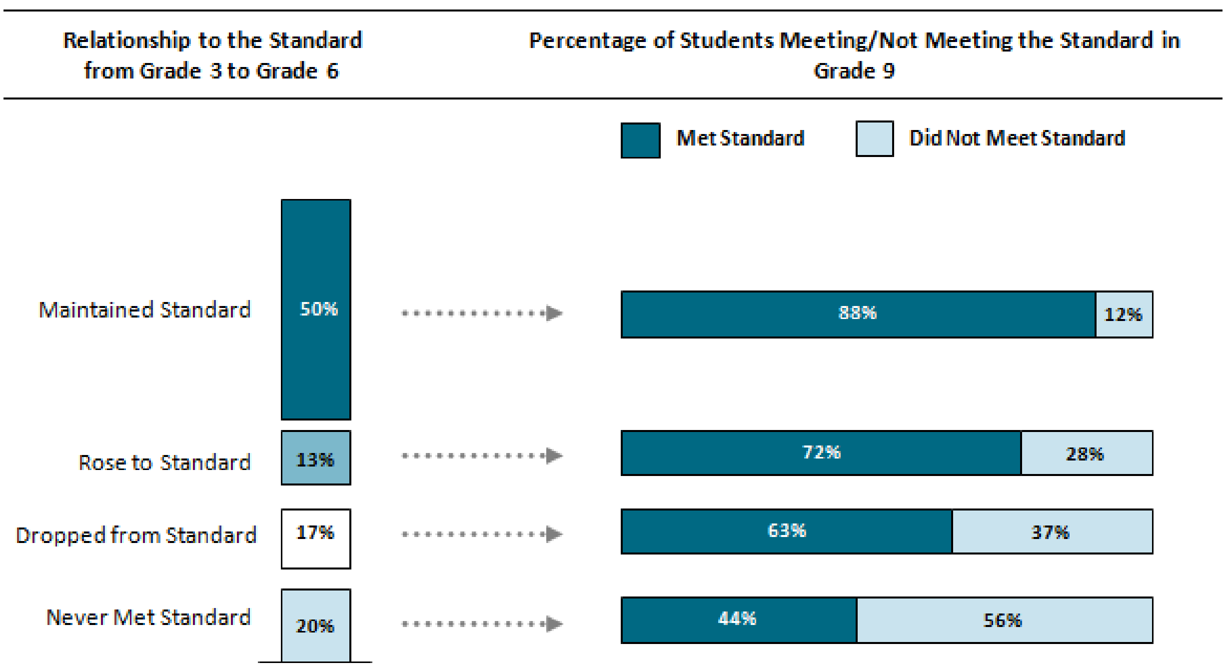
The mathematics achievement pathways for tracking students from Grade 3 to Grade 6 to Grade 9 are provided in Figures 9 and 10 for the academic and applied courses, respectively. Of the students in the tracked sample in the academic course, 5% were students with special education needs compared with 36% of the students in the tracked sample for the applied course.

Academic Course

As shown in Figure 9, of the tracked students with special education needs in the academic mathematics course:

- half (50%) met the standard for both Grade 3 and Grade 6, and nearly nine in 10 (88%) of these students met the standard for the Grade 9 assessment;
- 13% rose to the standard between Grades 3 and 6, and 72% of these students met the standard for the Grade 9 assessment;
- 17% dropped from the standard between Grades 3 and 6, and 63% met the standard for the Grade 9 assessment; and
- one in five (20%) did not meet the provincial standard in either Grade 3 or Grade 6, while 44% of these students met the standard for the Grade 9 assessment.

Figure 9:
Pathway Results for Tracked Students from Grade 3 (2006) to Grade 6 (2009) to Grade 9 (2012), Academic Mathematics Assessments by Special Education Needs (SEN n = 4383 (5%))

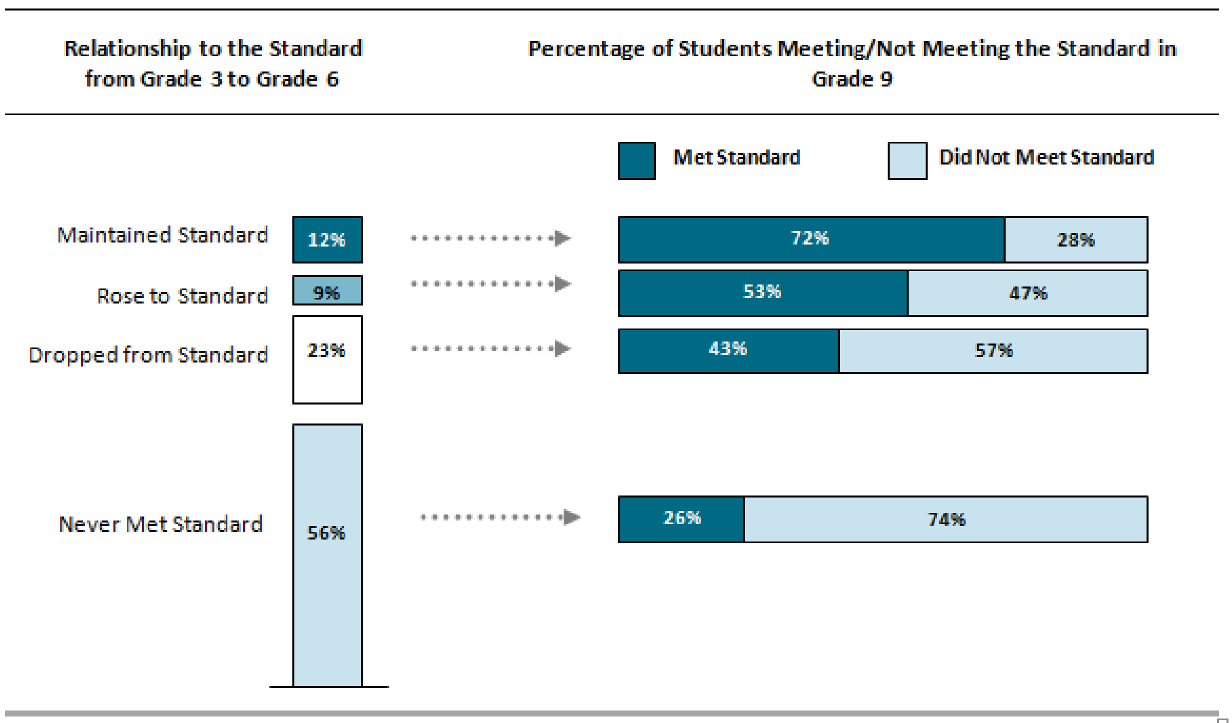


Applied Course

As shown in Figure 10, of the tracked students with special education needs in the applied mathematics course:

- 12% met the standard in both Grades 3 and 6, and 72% of these students met the standard for the Grade 9 assessment;
- nearly one in 10 (9%) rose to the standard between Grades 3 and 6, and 53% of these students met the standard in the Grade 9 assessment;
- 23% dropped from the standard between Grades 3 and 6, and 43% of these students met the standard for the Grade 9 assessment; and
- 56% did not met the standard in Grade 3 or in Grade 6, while just over one in four (26%) of these students met the standard for the Grade 9 assessment.

Figure 10:
Pathway Results for Tracked Students from Grade 3 (2006) to Grade 6 (2009) to Grade 9 (2012), Applied Mathematics Assessments by Special Education Needs (SEN n = 10 744 (36%))



Discussion of Academic and Applied Pathways for Students with Special Education Needs

Clearly, the four pathways for students with special needs in the academic course are quite different from those for students with special education needs in the applied course. First, the percentage of students with special education needs in the matched sample for the applied course is about seven times as large as that for the academic course (36% versus 5%). Second, the percentage of students with special educational needs in the matched sample for the academic course who maintained the standard between Grades 3 and 6 is four times as large as that for the applied course (50% versus 12%). Conversely, the percentage of students with special education needs in the matched sample for the academic course who did not meet the standard in Grade 3 or in Grade 6 is approximately one-third of that for the applied course (20% versus 56%). Third, the percentages of students with special education needs meeting the standard for the academic course are larger than the corresponding percentages for the applied course for all of the pathways (88% versus 72%, 72% versus 53%, 63% versus 43% and 44% versus 26%). It appears that students with special education needs enrolled in the academic course may have been able to accommodate their needs more effectively than those in the applied course or may have had less academically challenging needs than those students in the applied course.

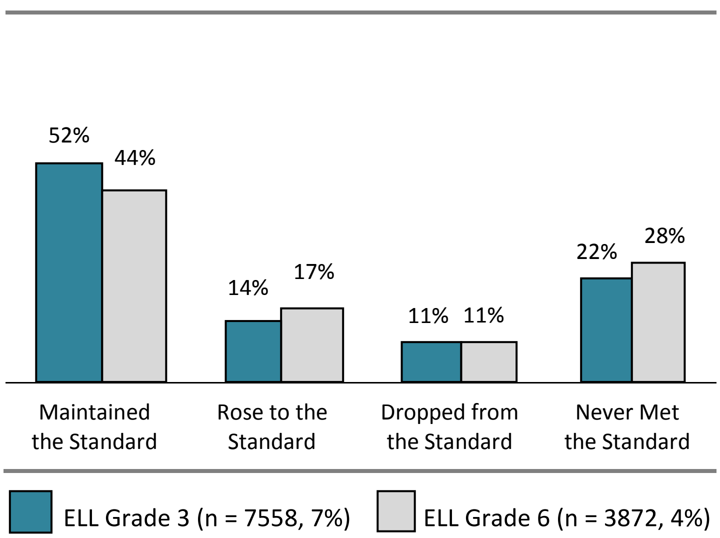
English language Learners

The pathways for English language learners are presented and discussed in this section. The expectation is that as English language learners progress through school, their English will improve to the point where they no longer have this designation. At the same time, however, newly arrived immigrants for whom English is not their first language enter school at different grade levels.

Pathway Results from Primary to Junior Mathematics Assessments

Figure 11 shows results for English language learners who were tracked from the Grade 3 to Grade 6 assessments. The percentage of English language learners declined from 7% (n = 7558) in Grade 3 to 4% (n = 3872) in Grade 6. As mentioned, it seems likely that as English language learners progress through school, they acquire sufficient English so that they no longer have this designation. The number shown here for Grade 6 would probably be smaller if newly arrived English language learners were not included.

Figure 11: Pathway Results for Tracked Students from Grade 3 (2006) to Grade 6 (2009), Mathematics Assessments by English Language Learners (ELL)



As shown in Figure 11, for English language learners:

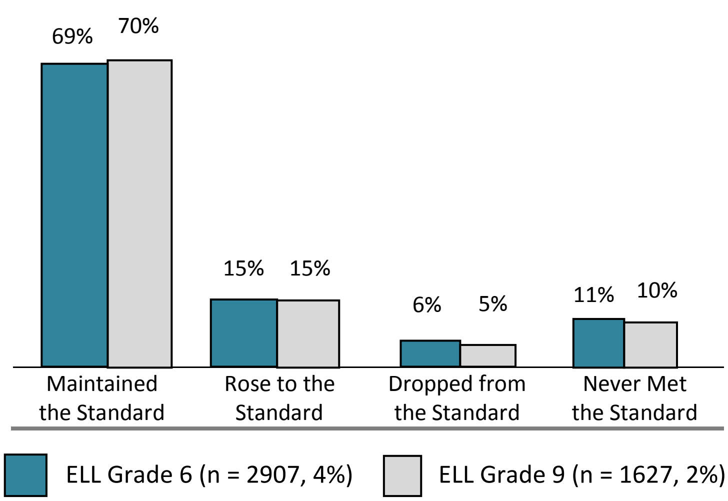
- a larger percentage met the standard for the assessment in Grade 3 than in Grade 6 (52% and 44%), and these percentages are smaller than for the overall tracked sample (59%) presented in Figure 1;
- a smaller percentage rose to the standard between Grade 3 and Grade 6 (14% and 17%), and these percentages are larger than for the overall tracked sample (9%);
- equal percentages dropped from the standard between Grades 3 and 6 (11%), which is slightly less than for the overall tracked sample (14%); and
- a larger percentage did not meet the standard in either Grade 3 or Grade 6 (22% and 28%), somewhat more than for the overall tracked sample (18%).

Pathway Results from Junior to Grade 9 Mathematics Assessments

Academic Course

Figure 12 shows results for English language learners who were tracked from the Grade 6 assessment to the Grade 9 academic assessment. The percentage of English language learners declined slightly from 4% (n = 2907) in Grade 6 to 2% (n = 1627) in Grade 9.

Figure 12: Pathway Results for Tracked Students from Grade 6 (2009) to Grade 9 (2012), Academic Mathematics Assessments by English Language Learners (ELL)



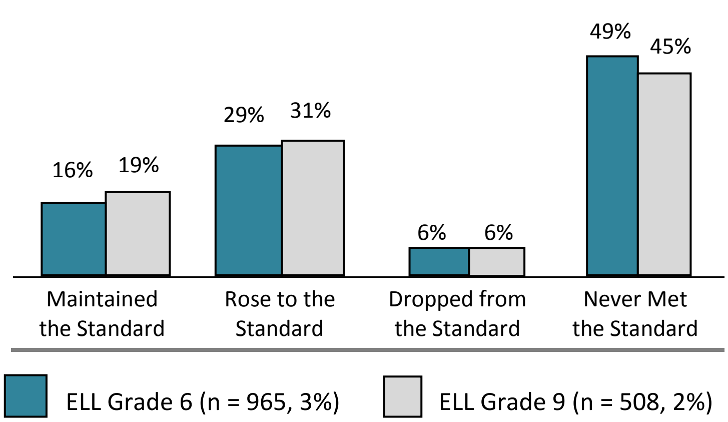
As shown in Figure 12, the percentages of students in each of the four pathways are identical for students in Grades 6 and 9 or are different by only one percentage point. These percentages were compared with those for the overall tracked sample presented in Figure 2, indicating that:

- 69% and 70% respectively met the standard for both assessments, compared with 74% for the overall tracked sample;
- 15% rose to the standard between Grade 6 and the Grade 9 academic course, compared with 10% for the overall tracked sample;
- 6% and 5% dropped from the standard between Grade 6 and the Grade 9 academic course, compared with 8% for the overall tracked sample; and
- 11% and 10% never met the standard for either assessment, compared with 8% for the overall tracked sample.

Applied Course

The percentage of the tracked sample who were English language learners and who completed the Grade 6 mathematics assessment and the Grade 9 applied mathematics assessment were 3% (n = 965) and 2% (n = 508), respectively.

Figure 13: Pathway Results for Tracked Students from Grade 6 (2009) to Grade 9 (2012), Applied Mathematics by English Language Learners (ELL)



As shown in Figure 13, of the tracked English language learners who enrolled in applied mathematics courses:

- a slightly larger percentage maintained the standard in Grade 9 (19%) than in Grade 6 (16%), compared with 22% for the overall tracked sample (see Figure 3);
- 29% and 31% rose to the standard between Grade 6 and the Grade 9 applied course, compared with 26% for the overall tracked sample;
- 6% dropped from the standard between Grade 6 and the Grade 9 applied course, compared with 8% for the overall tracked sample; and
- a greater percentage (49% and 45%) never met the standard, compared with 43% for the overall tracked sample.

Pathway Results from Primary to Junior to Grade 9 Mathematics Assessments

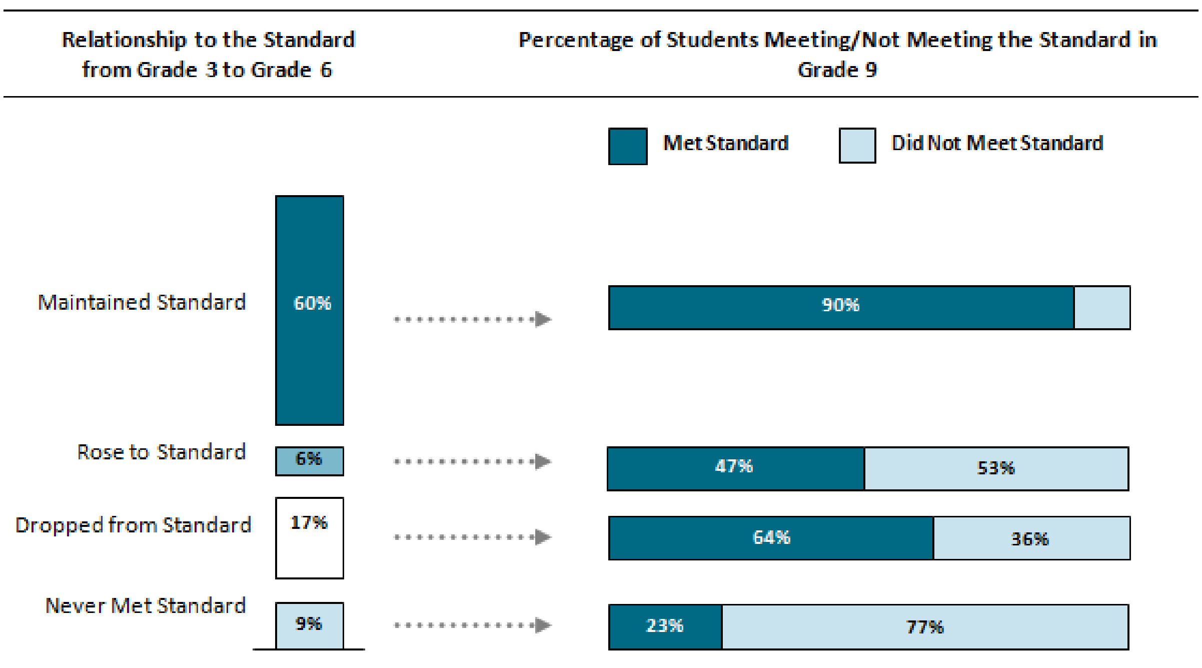
The mathematics achievement pathways for tracking students from Grade 3 to Grade 6 to Grade 9 are provided in Figures 14 and 15 for the academic and applied courses, respectively. As might be expected from the results presented, the sample sizes are small (academic course n = 1627 and applied course n = 508) for the pathways from Grade 3 to Grade 6 to Grade 9. Therefore, caution must be exercised when interpreting these results.

Academic Course

As shown in Figure 14, of the tracked English language learners in the academic mathematics course:

- three in five (60%) maintained the standard in both Grade 3 and Grade 6, and nine in 10 (90%) of these students met the standard for the Grade 9 assessment;
- 6% rose to the standard between Grades 3 and 6, and 47% of these students met the standard for the Grade 9 assessment;
- approximately one in six (17%) dropped from the standard between Grades 3 and 6, and 64% of these students met the standard for the Grade 9 assessment; and
- nearly one in 10 (9%) did not meet the provincial standard in Grade 3 or in Grade 6, while 23% of these students met the standard for the Grade 9 assessment.

Figure 14:
Pathway Results for Tracked Students from Grade 3 (2006) to Grade 6 (2009) to Grade 9 (2012), Academic Mathematics by English Language Learners (ELL n = 1 627 (2%))

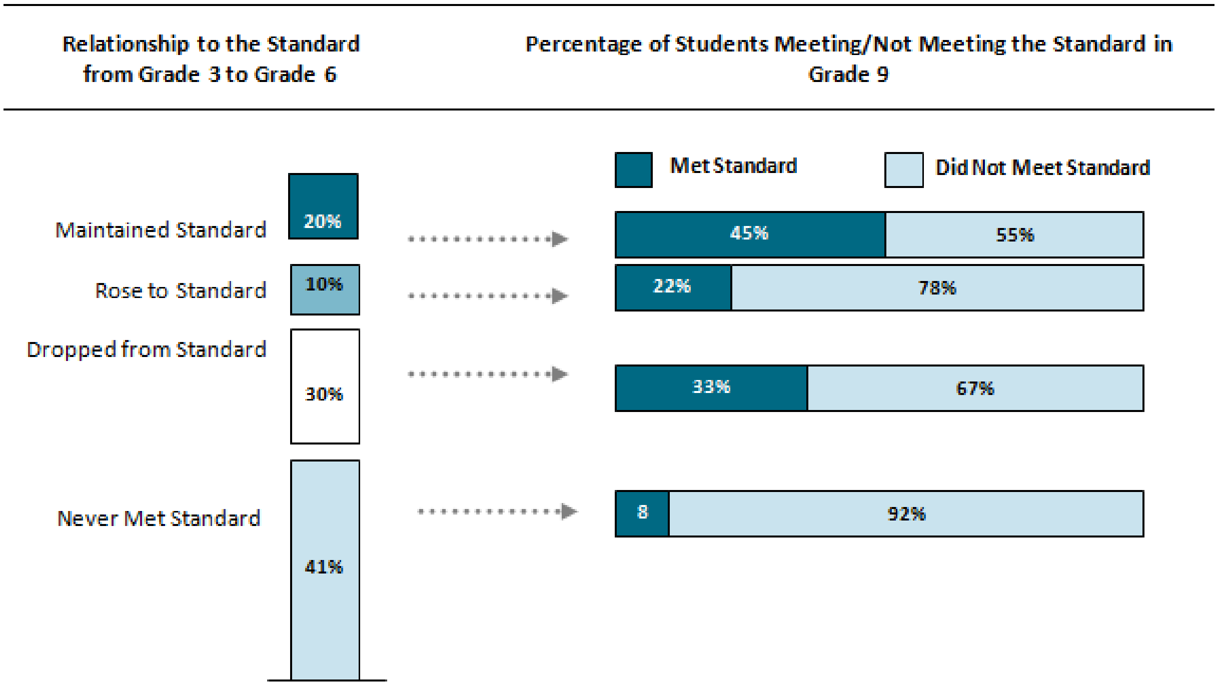


Applied Course

As shown in Figure 15, of the tracked English language learners in the applied mathematics course:

- one in five (20%) met the standard in both Grade 3 and Grade 6, and 45% of these students met the standard for the Grade 9 assessment;
- one in 10 (10%) rose to the standard between Grades 3 and 6, while slightly more than one in five (22%) of these students met the standard for the Grade 9 assessment;
- 30% dropped from the standard between Grades 3 and 6, and 33% of these students met the standard for the Grade 9 assessment; and
- 41% did not meet the standard in Grade 3 or in Grade 6, while 8% of these students met the standard for the Grade 9 assessment.

Figure 15:
Pathway Results for Tracked Students from Grade 3 (2006) to Grade 6 (2009) to Grade 9 (2012), Applied Mathematics by English Language Learners (ELL n = 508 (2%)]



Discussion of Academic and Applied Pathways for English Language Learners

Compared to results for gender and students with special education needs, the number of English language learners is small, particularly at the Grade 9 level:

- The number of tracked English language learners from Grade 3 to Grade 6 was 7558 and 3872, respectively.
- The number dropped to approximately 1600 students for the Grade 9 academic assessment and 500 students for the Grade 9 applied assessment.

Nevertheless, there are discernible differences between the pathways for students in the academic and applied courses. First, the percentage of English language learners who wrote the Grade 9 academic assessment and maintained the standard between Grades 3 and 6 is approximately three times greater than the percentage of English language learners who wrote the Grade 9 applied assessment. Consequently, the percentage of English language learners who did not meet the standard for either the Grade 3 or the Grade 6 assessment and who wrote the academic assessment is about one-quarter of the percentage of English language learners who did not meet the standards for the Grades 3 and 6 assessments and who wrote the applied assessment. Second, the percentages of English language learners in each of the four pathways who met the standard for the Grade 9 academic assessment are larger than the corresponding percentages for English language learners who met the standard for the Grade 9 applied assessment (90% versus 45%, 47% versus 22%,64% versus 33% and 23% versus 8%). It appears that English language learners who enrolled in the academic course may have been able to accommodate their needs more effectively than those in the applied course, or they may have had less academically challenging needs than those students in the applied course.

PART 4

Student Attitudes and Mathematics Achievement

Responses to the following two questions included in the student questionnaires administered to students in Grades 3, 6 and 9 at the time of the assessments were analyzed as part of this study:

1. I like mathematics.
2. I am good at mathematics.

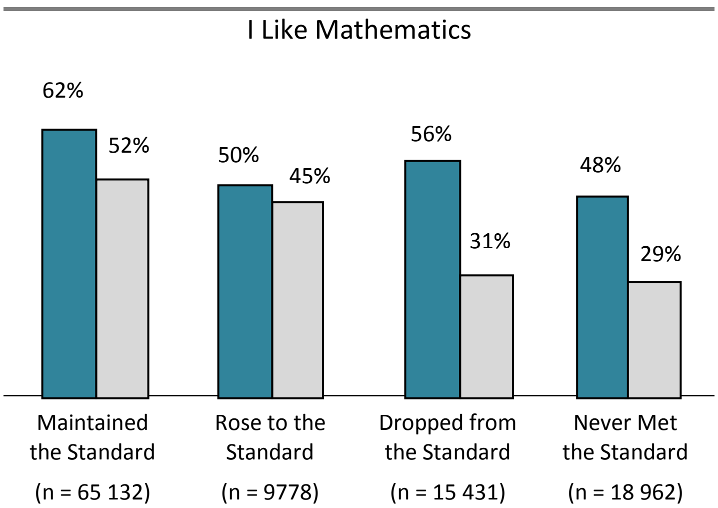
The options were "no," "sometimes" and "yes" for Grades 3 and 6 students, and a five-point Likert scale from "strongly disagree" to "strongly agree" for Grade 9. The percentages presented in the graphs in this section represent the percentage of students who answered "yes" in Grades 3 and 6 and the percentage of students who answered "agree" or "strongly agree" in Grade 9, which were considered to reflect positive attitudes. The results are presented for each of the pathways for the pairs of successive grades and then for all three grades. These results are based on the students for whom questionnaire data were available. Since not all of the tracked students responded to all questionnaire items, the sample sizes may be a little smaller than the sample sizes in Part 2. For example, while 110 839 students were in the tracked sample across the applied and academic courses, student questionnaire results are for 109 303 students.

Student Attitudes and Pathway Results from Primary to Junior Mathematics Assessments

The percentages of students in the tracked sample expressing positive attitudes for the two questionnaire items are presented in Figures 16 and 17[3] for the four pathways for tracking mathematics achievement from Grade 3 to Grade 6.

Applied Course

Figure 16:
Changes in Attitudes for Tracked Students from Grade 3 (2006) to Grade 6 (2009) Mathematics by Achievement Pathways (n = 109 303)



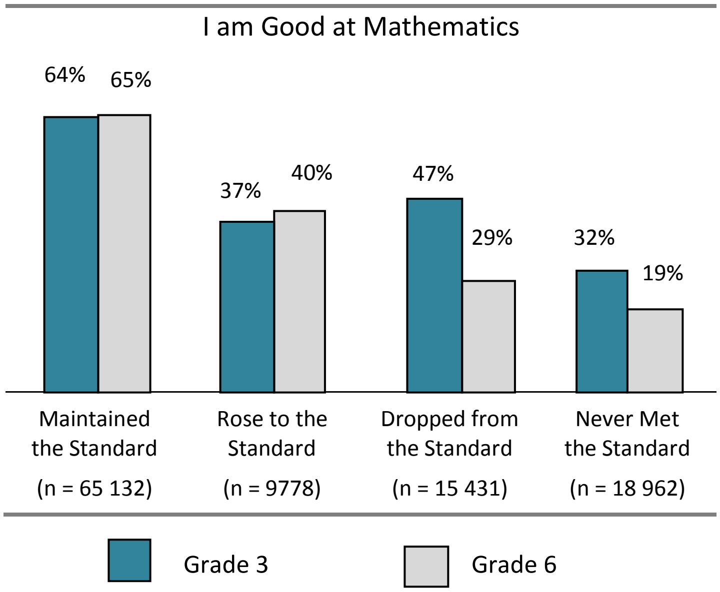
As shown in Figure 16, of the students who:

- maintained the standard, 62% in Grade 3 and 52% in Grade 6 responded that they liked mathematics;
- rose to the standard, 50% in Grade 3 and 45% in Grade 6 responded that they liked mathematics;
- dropped from the standard, 56% in Grade 3 and 31% in Grade 6 responded that they liked mathematics (a decrease of 25%); and
- never met the standard, 48% in Grade 3 and 29% in Grade 6 responded that they liked mathematics (a decrease of 19%).

[3] Detailed tables of results for student achievement, characteristics and attitudes can be found in the appendix.

Figure 17:

Changes in Attitudes for Tracked Students from Grade 3 (2006) to Grade 6 (2009) Mathematics by Achievemer Pathways (n = 109 303)



As shown in Figure 17, of the students who:

- maintained the standard, nearly equal percentages of students in Grade 3 (64%) and in Grade 6 (65%) indicated they were good at mathematics;
- rose to the standard, only 37% in Grade 3 and 40% in Grade 6 indicated they were good at mathematics;
- dropped from the standard, about half (47%) in Grade 3 and 29% in Grade 6 indicated they were good at mathematics; and
- never met the standard, only about one-third (32%) in Grade 3 and 19% in Grade 6 indicated they were good at mathematics.

I like mathematics: The results reveal that there is a clear drop in the percentage of students who like mathematics between Grades 3 and 6, particularly for those students who did not meet the standard in Grade 6. Approximately four in 10 Grade 3 students and six in 10 Grade 6 students indicated that they do not like mathematics. Further research is needed to determine why larger percentages of students did not express positive attitudes.

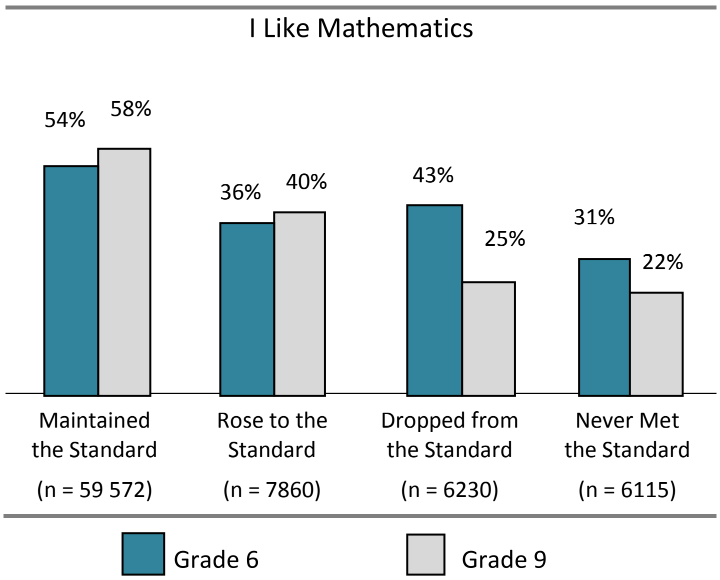
I am good at mathematics: The results suggest that many students do not perceive themselves as being good at math. The percentage of students who said they were good at math exceeded 60% only for the students who met the standard in both Grade 3 and Grade 6. The percentages for the other three pathways were, with one exception, no greater than 40%. As for the other questionnaire item, more research is needed to determine why elementary students do not perceive themselves as being good at math.

Student Attitudes and Pathway Results from Junior to Grade 9 Mathematics Assessments

The percentages of students in the tracked sample expressing positive attitudes for the two questionnaire items for the four pathways for tracking mathematics achievement from Grade 6 to Grade 9 are presented in Figures 18 and 19 for the academic course and in Figures 20 and 21 for the applied course. The percentages for the students when they were in Grade 6 are not the same as the Grade 6 percentages when they were paired with the Grade 3 students. This is due to some students not responding to the items and students being divided into two groups for this analysis—students enrolled in the Grade 9 academic course and those in the applied course.

Academic Course

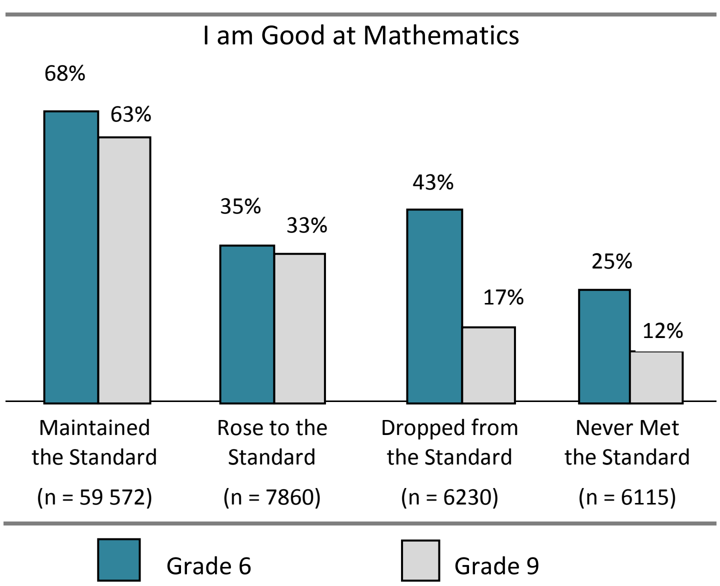
Figure 18:
Changes in Attitudes for Tracked Students from Grade 6 (2009) to Grade 9 (2012) Mathematics by Achievement Pathways for Academic Course



As shown in Figure 18, of the students who:

- maintained the standard for the Grade 6 assessment and the Grade 9 academic assessment, 54% in Grade 6 and 58% in Grade 9 indicated they liked mathematics;
- rose to the standard, 36% in Grade 6 and 40% in Grade 9 indicated they liked mathematics;
- dropped from the standard, 43% in Grade 6 and only 25% in Grade 9 indicated they liked mathematics; and
- never met the standard, 31% in Grade 6 and 22% in Grade 9 indicated they liked mathematics.

Figure 19:
Changes in Attitudes for Tracked Students from Grade 6 (2009) to Grade 9 (2012) Mathematics by Achievement Pathways for Academic Course



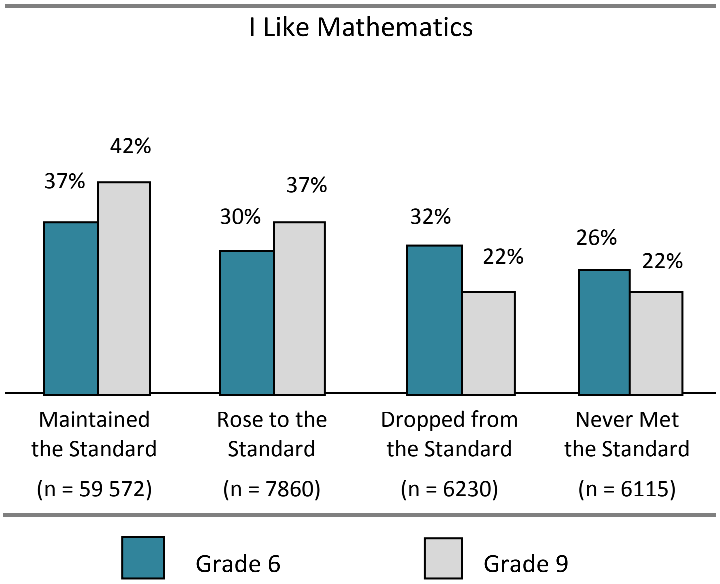
As shown in Figure 19, of the students who:

- maintained the standard for the Grade 6 assessment and the Grade 9 academic assessment, 68% of Grade 6 students and 63% in Grade 9 indicated they were good at mathematics;
- rose to the standard, nearly equal percentages of Grade 6 (35%) and Grade 9 (33%) students indicated they were good at mathematics;
- dropped from the standard, 43% in Grade 6 and only 17% in Grade 9 indicated they were good at mathematics; and
- never met the standard, only a quarter (25%) of the Grade 6 students and 12% in Grade 9 indicated they were good at mathematics.

Applied Course

The pathway results for the two attitude items for the tracked students between the Junior and Grade 9 applied mathematics assessments are reported in Figures 20 and 21.

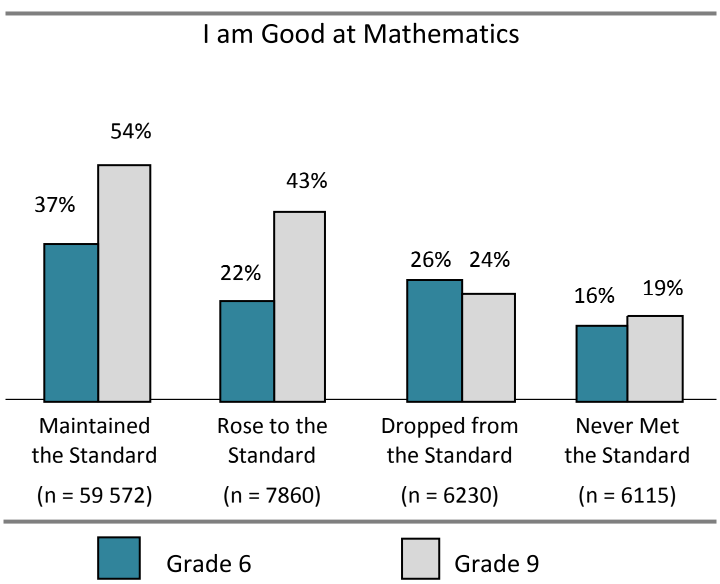
Figure 20:
Changes in Attitudes for Tracked Students from Grade 6 (2009) to Grade 9 (2012) Mathematics by Achievement Pathways for Applied Course



As shown in Figure 20, of the students who:

- maintained the standard for the Grade 6 assessment and the Grade 9 applied assessment, 37% in Grade 6 and 42% in Grade 9 indicated they liked mathematics;
- rose to the standard, 30% in Grade 6 and 37% in Grade 9 indicated they liked mathematics;
- dropped from the standard, 32% in Grade 6 and 22% in Grade 9 indicated they liked mathematics; and
- never met the standard, 26% in Grade 6 and 22% in Grade 9 indicated they liked mathematics.

Figure 21:
Changes in Attitudes for Tracked Students from Grade 6 (2009) to Grade 9 (2012) Mathematics by Achievement Pathways for Applied Course



As shown in Figure 21, of the students who:

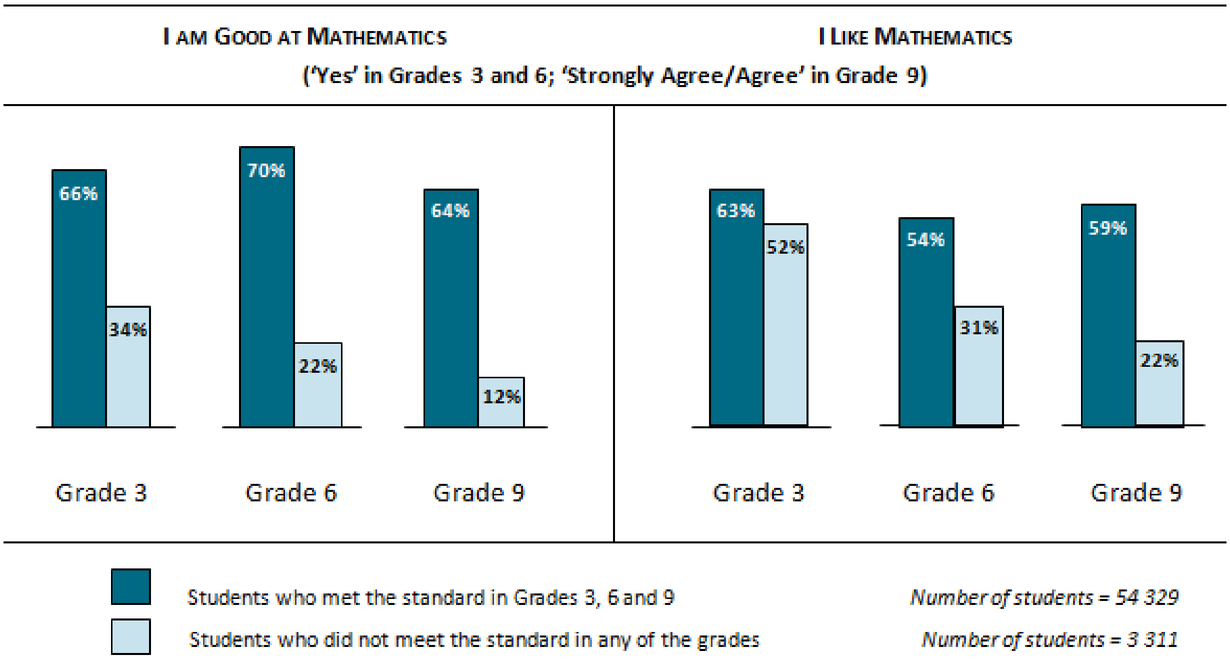
- maintained the standard for the Grade 6 assessment and the Grade 9 applied assessment, 37% in Grade 6 and 54% in Grade 9 indicated they were good at mathematics;
- rose to the standard, 22% in Grade 6 and 43% in Grade 9 indicated they were good at mathematics;
- dropped from the standard, nearly equal percentages of students indicated they were good at mathematics (Grade 6, 26% and Grade 9, 24%); and
- never met the standard, a greater percentage of students in Grade 9 than in Grade 6 indicated they were good at mathematics (19% versus 16%).

Pathway Results from Primary to Junior to Grade 9 Academic and Applied Mathematics Assessments

The presentation of responses to the two attitude items for the tracked students from Grade 3 to Grade 6 to the Grade 9 academic and applied courses are limited to two pathways—students who met the standard at all three grade levels and students who did not meet the standard in Grade 3, Grade 6 or Grade 9 (never met the standard). The percentages of students who provided positive responses for these two pathways are presented in Figure 22 for the academic course and in Figure 23 for the applied course. Percentages are reported for student responses when they were in each of the three grades.

Academic Course

Figure 22:
Changes in Attitudes for Tracked Students from Grade 3 (2006) to Grade 6 (2009) to Grade 9 (2012), Academic Course for Met the Standard and Never Met the Standard Pathways



As shown in Figure 22, of the 54 329 **students who met the standard** for the three assessments,

- nearly two-thirds (66%) in Grade 3 indicated they were good at mathematics;
- seven of 10 (70%) in Grade 6 indicated they were good at mathematics; and
- just under two-thirds (64%) in Grade 9 indicated they were good at mathematics.

Further, of the **students who met the standards** for the three assessments,

- slight less than two-thirds (63%) in Grade 3 indicatec they liked mathematics;
- 54% in Grade 6 indicated they liked mathematics; and
- nearly three in five (59%) in Grade 9 of the students indicated they liked mathematics.

In contrast, of the 3311 **students who did not meet the standard** in any of the three assessments,

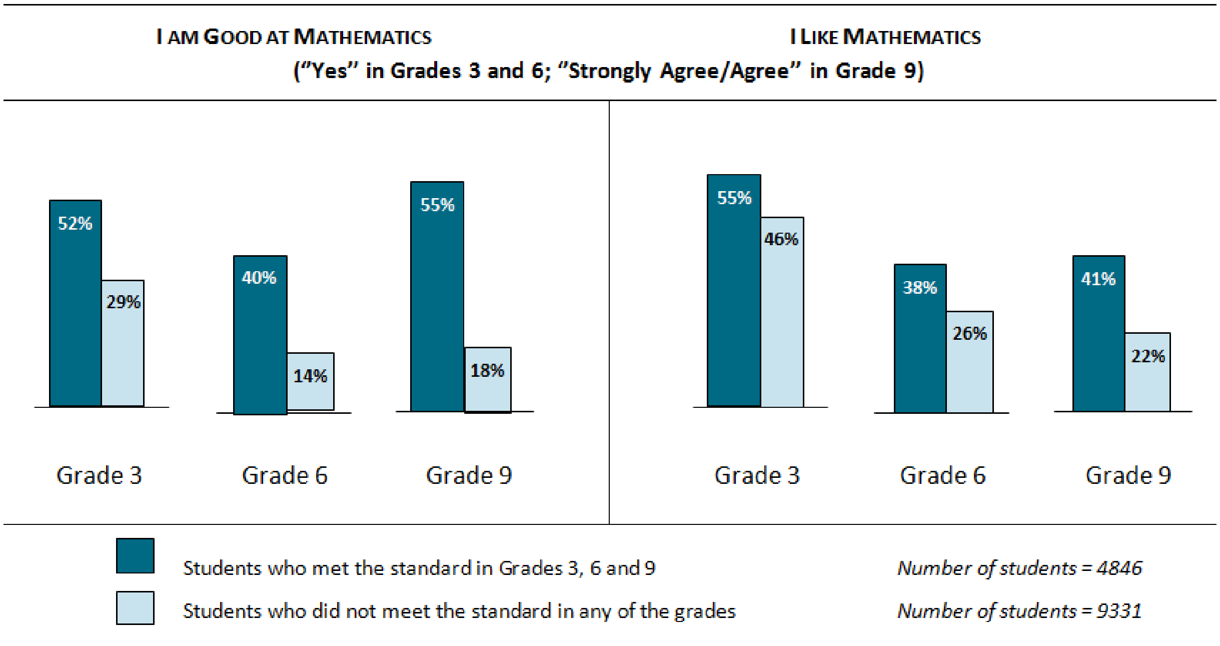
- nearly one-third (34%) in Grade 3 indicated they were good at mathematics;
- just over one in five (22%) in Grade 6 indicated they were good in mathematics; and
- just over one in 10 (12%) in Grade 9 indicated they were good at mathematics.

Further, of the **students who did not meet the standard** in any of the three assessments,

- just over half (52%) in Grade 3 indicated they liked mathematics;
- just over three in 10 (31%) in Grade 6 indicated they liked mathematics; and
- just over one in five (22%) in Grade 9 indicated they liked mathematics.

Applied Course

Figure 23:
Changes in Attitudes for Tracked Students from Grade 3 (2006) to Grade 6 (2009) to Grade 9 (2012), Applied Course for Met the Standard and Never Met the Standard Pathways



As shown in Figure 23, of the 4846 **students who met the standard** for the three assessments,

- slightly more than half (52%) in Grade 3 indicated they were good at mathematics;
- two in five (40%) in Grade 6 indicated they were good at mathematics; and
- 55% in Grade 9 indicated they were good at mathematics.

Further, of the students who met the standards for the three assessments,

- 55% in Grade 3 indicated they liked mathematics;
- slightly less than two in five (38%) in Grade 6 indicated they liked mathematics; and
- slightly more than two in five (41%) in Grade 9 indicated they liked mathematics.

In contrast, of the 9331 **students who did not meet the standard** in any of the three assessments,

- nearly one in three (29%) in Grade 3 indicated they were good at mathematics;
- 14% in Grade 6 indicated they were good in mathematics; and
- slightly less than one in five (18%) in Grade 9 indicated they were good at mathematics.

Further, of the **students who did not meet the standard** in any of the three assessments,

- 46% in Grade 3 indicated they liked math
- slightly less than three in 10 (26%) in Grade 6 indicated they liked mathematics; and
- just over one in five (22%) in Grade 9 indicated they liked mathematics.

Discussion of Attitude Items

The percentages of students who indicated they were good at mathematics and who liked mathematics were higher for students in the academic course than in the applied course for students who met the standard at all three grades. The differences between the percentages of positive responses for students in the two courses were smaller for students who never met the standard; in some cases, the percentages were slightly larger for students in the applied course than for those in the academic course. There was a large decrease in the percentage of positive responses for students who did not meet the standard as they progressed from Grades 3 to 9, with larger decreases occurring between Grades 3 and 6 than between Grades 6 and 9; in one case there was a slight increase from Grade 6 to Grade 9.

Taken together, these results reflect the complexity of assessing attitudes and the stability of attitudes toward mathematics across grades. While is it is clear that students who have experienced higher levels of achievement have a greater tendency to express positive attitudes than those with lower levels of achievement, it is also clear that many students who have met the standard at all three grade levels do not say they are good at mathematics or that they like mathematics. A variety of factors likely affect the relationship between achievement and attitudes. Further research is needed to explore these complex interactions and explain the results presented above.

Summary

Since every student in Ontario has an Ontario Education Number and they all participate in the EQAO assessments in Grades 3, 6 , 9 and 10, it is possible to track the progress of students as they move through their school career. This makes it possible to report detailed achievement, contextual and attitudinal data for each school and board, as well as the province as a whole; to analyze data for sub-groups of students and cohorts of students; and to track achievement as students progress from Grade 3 to Grade 9. Schools and boards can thus examine the long-term impact of their teaching and learning programs and modify initiatives to meet the specific needs of individual students and groups of students for maximum effectiveness. This provides valuable information and insight for educators in their objective to ensure student learning and success in their schools.

This study examined the progress of student achievement in mathematics from Grade 3 to Grade 6 to the Grade 9 academic and applied mathematics courses. As well, student responses to two items of a student questionnaire in each of these grades were analyzed.

The findings provide evidence that students who met the provincial standards on the EQAO assessments in the early grades were more likely to meet the standards in later grades and to enroll in the academic course in Grade 9 than those who did not. As well, a larger percentage of students in the academic program met the standard for the Grade 9 academic assessment than did students in the applied program who met the standard for the Grade 9 applied program. It is also important to note that many students who did not meet the standards in Grades 3 and 6 did meet them in Grade 9. In addition, the results indicated that a slightly larger percentage of male students than female students met the standard for the Grade 9 applied assessment.

Students with special education needs and English language learners were less likely than other students in the tracked sample to meet the standards in all grades, but this difference was lowest for students enrolled in the academic course in Grade 9. However, for all groups, success in meeting the standards in later grades was strongly related to meeting the standard in earlier grades. Consequently, effort needs to be given to improving mathematics achievement in elementary school so that students have an appropriate and strong foundation that will enable them to be more successful at meeting expected standards in secondary school.

The results also highlight the strong relationship between achievement and student attitudes. Of particular note is the sharp decrease in the percentage of positive responses among students who did not meet the provincial standard as they progressed through the grades. This further emphasizes the importance of directed attention to students who do not meet the standard in Grade 3. If students begin to feel that they cannot do well in mathematics, it is possible they may decrease their efforts in mathematics class. *The Ontario Curriculum* cites the importance of student attitudes and how they relate to success in mathematics.[4] Educators may wish to augment classroom instruction with activities designed to help students discover the pleasure in learning and doing mathematics and in persisting to solve challenging problems. Highlighting the relevance of mathematics in day-to-day life and the importance of mathematics and science in the global marketplace may help students see the value in developing their mathematics skills. Scaffolding learning activities may also help weaker students achieve success in stages, thereby increasing their confidence as they experience success in small increments.

Implications for Improvement Planning

EQAO has provided schools, boards and the province with cohort data since 2008–2009. With the launch of an interactive reporting application in 2012, new cohort reports were introduced for elementary schools, and for secondary schools in 2013. This enables principals and their teams to explore the progress of students as they move from Grade 3 to Grade 9. Tracking results through the grades provides evidence about where resources and interventions need to be focused for schools, boards and the province.

These results suggest that identifying student needs early and providing support makes a difference. Directed attention to students who do not meet the provincial standards should be a priority in all school improvement planning. Many students who did not meet the standard in the early grades did so in later grades. Students with special education needs have been identified as being less likely to meet the standards at all grade levels. It remains the responsibility of those currently in the field to address this issue both within schools and with those who provide external support. It is clear that for system-wide improvement to occur on these fronts, new approaches at the local-school level, school-board level and public-policy level must be considered.

Next steps:

- Provide early and ongoing interventions to support students who are at risk in kindergarten or the primary or junior level to help them meet the provincial mathematics standards in later grades.
- Use assessment data and detailed tracking of students through the grades to provide evidence of where resources and interventions may be most beneficial in supporting student success.
- Continue development of differentiated instructional strategies to maximize the effectiveness of teaching.
- Provide focused attention to students with special education needs.
- Investigate further the relationship between student attitudes and achievement in mathematics.
- Ensure that mathematics is presented in a way that is engaging and promotes the importance and relevancy of mathematics to student's future success.

[4] *The Ontario Curriculum, Grades 1–8: Mathematics*, 2005, p. 26.

APPENDIX: TABLES OF RESULTS

Note: A larger proportion of females than males were enrolled in the academic course; this must be taken into consideration when interpreting all gender data for Grade 9. When achievement results are combined across the two courses, an overall larger percentage of females than males met the standard.

Table 1: Number of Tracked Students in the Cohort, by Grade 9 Course Selection

Grade 9 Mathematics Course Enrolment	Students Included in the Results for Grade 9 Assessment of Mathematics 2011–2012	Students with Results for all Three Assessments	Percentage of all Tracked Students in Grade 9 Mathematics
Applied Mathematics	43 174	30 119	70%
Academic Mathematics	98 819	80 270	81%
Total	141 993	110 389	78%

Table 2: Student Characteristics from Grade 3 to Grade 6, for All Students and by Mathematics Summary Achievement, in English language Schools

	All Students (n = 110 389)	Maintained the Standard (n = 65 149)	Rose to the Standard (n = 9 784)	Dropped from the Standard (n = 15 876)	Never Met the Standard (n = 19 580)
Demographic Category	**# (%)**	**# (%) Within Demographic Category**			
Male[5]	55 391 (50%)	32 526 (59%)	4 583 (8%)	8 672 (16%)	9 610 (17%)
Female[5]	54 998 (50%)	32 623 (59%)	5 201 (9%)	7 204 (13%)	9 970 (18%)
English language learners Grade 3	7 558 (7%)	3 963 (52%)	1 087 (14%)	841 (11%)	1 667 (22%)
English language learners Grade 6	3 872 (4%)	1 700 (44%)	677 (17%)	417 (11%)	1 078 (28%)
Students with special education needs Grade 3	8 095 (7%)	1 873 (23%)	899 (11%)	1 737 (21%)	3 586 (44%)
Students with special education needs Grade 6	14 195 (13%)	3 176 (22%)	1 581 (11%)	2 832 (20%)	6 606 (47%)

Table 3: Student Characteristics from Grade 6 to Grade 9, for All Students and by Mathematics Summary Achievement, in English language Schools, Applied Course

	All Students (n = 30 119)	Maintained the Standard (n = 6 631)	Rose to the Standard (n = 7 958)	Dropped from the Standard (n = 2 464)	Never Met the Standard (n = 13 066)
Demographic Category	**# (%)**	**# (%) Within Demographic Category**			
Male[5]	16 590 (55%)	3 832 (23%)	4 622 (28%)	1 326 (8%)	6 810 (41%)
Female[5]	13 529 (45%)	2 799 (21%)	3 336 (25%)	1 138 (8%)	6 256 (46%)
English language learners Grade 6	965 (3%)	153 (16%)	281 (29%)	61 (6%)	470 (49%)
English language learners Grade 9	508 (2%)	94 (19%)	157 (31%)	28 (6%)	229 (45%)
Students with special education needs Grade 6	9 913 (33%)	1 369 (14%)	2 303 (23%)	769 (8%)	5 472 (55%)
Students with special education needs Grade 9	10 744 (36%)	1 429 (13%)	2 613 (24%)	812 (8%)	5 890 (55%)

[5] Based on students for whom gender data were available.

Table 4: Student Characteristics from Grade 6 to Grade 9, for All Students and by Mathematics Summary Achievement, in English language Schools, Academic Course

	All Students (n = 80 270)	Maintained the Standard (n = 59 591)	Rose to the Standard (n = 8 224)	Dropped from the Standard (n = 6 247)	Never Met the Standard (n = 6 208)
Student Questionnaire Responses	**# (%)**	**# (%) Within Achievement Category**			
Male[6]	38 801 (48%)	29 156 (75%)	4 074 (10%)	2 795 (7%)	2 776 (7%)
Female[6]	41 469 (52%)	30 435 (73%)	4 150 (10%)	3 452 (8%)	3 432 (8%)
English language learners Grade 6	2 907 (4%)	1 993 (69%)	425 (15%)	170 (6%)	319 (11%)
English language learners Grade 9	1 627 (2%)	1 141 (70%)	242 (15%)	78 (5%)	166 (10%)
Students with special education needs Grade 6	4 282 (5%)	2 189 (51%)	848 (20%)	430 (10%)	815 (19%)
Students with special education needs Grade 9	4 383 (5%)	2 337 (53%)	870 (20%)	410 (9%)	766 (17%)

[6] Based on students for whom gender data were available.

Table 5: Student Characteristics from Grade 3 to Grade 6 to Grade 9, for All Students and by Mathematics Summary Achievement, in English language Schools, Applied Course[7]

	All Students (n = 30 119)	Sustained Strength (n = 4 846)	Increasing Strength (n = 1 321	Returning Strength (n = 1 785)	New Strength (n = 1 143)	New Difficulty (n = 3 915)	Returning Difficulty (n = 3 735)	Increasing Difficulty (n = 4 043)	Sustained Difficulty (n =9 331)
Demographic Category	**# (%)**	**# (%) Within Demographic Category**							
Male[8]	16 590 (55%)	2 876 (17%)	761 (5%)	956 (6%)	565 (3%)	2 410 (15%)	2 157 (13%)	2 212 (13%)	4 653 (28%)
Female[8]	13 529 (45%)	1 970 (15%)	560 (4%)	829 (6%)	578 (4%)	1 505 (11%)	1 578 (12%)	1 831 (14%)	4 678 (35%)
English language learners Grade 3	1 476 (5%)	139 (9%)	40 (3%)	105 (7%)	52 (4%)	157 (11%)	112 (8%)	292 (20%)	579 (39%)
English language learners Grade 6	965 (3%)	80 (8%)	18 (2%)	73 (8%)	43 (4%)	97 (10%)	74 (8%)	184 (19%)	396 (41%)
English language learners Grade 9	508 (2%)	45 (9%)	11 (2%)	49 (10%)	17 (3%)	56 (11%)	39 (8%)	101 (20%)	190 (37%)
Students with special education needs Grade 3	5 594 (19%)	467 (8%)	182 (3%)	284 (5%)	257 (5%)	551 (10%)	764 (14%)	761 (14%)	2 328 (42%)
Students with special education needs Grade 6	9 913 (33%)	849 (9%)	318 (3%)	520 (5%)	451 (5%)	906 (9%)	1 202 (12%)	1 397 (14%)	4 270 (43%)
Students with special education needs Grade 9	10 744 (36%)	900 (8%)	345 (3%)	529 (5%)	467 (4%)	1 062 (10%)	1 378 (13%)	1 551 (14%)	4 512 (42%)

Table 6: Student Characteristics from Grade 3 to Grade 6 to Grade 9, for All Students and by Mathematics Summary Achievement, in English language Schools, Academic Course[7]

	All Students (n = 80 270)	Sustained Strength (n = 54 329)	Increasing Strength (n = 4 653)	Returning Strength (n = 5 262)	New Strength (n = 1 594)	New Difficulty (n = 5 329)	Returning Difficulty (n = 2 897)	Increasing Difficulty (n = 2 895)	Sustained Difficulty (n = 3 311)
Demographic Category	**# (%)**	**# (%) Within Demographic Category**							
Male[8]	38 801 (48%)	26 753 (69%)	2 136 (6%)	2 403 (6%)	659 (2%)	2 748 (7%)	1 357 (3%)	1 326 (3%)	1 419 (4%)
Female[8]	41 469 (52%)	27 576 (66%)	2 517 (6%)	2 859 (7%)	935 (2%)	2 581 (6%)	1 540 (4%)	1 569 (4%)	1 892 (5%)
English language learners Grade 3	6 082 (8%)	3 586 (59%)	198 (3%)	803 (13%)	127 (2%)	391 (6%)	181 (3%)	416 (7%)	380 (6%)
English language learners Grade 6	2 907 (4%)	1 515 (52%)	87 (3%)	478 (16%)	83 (3%)	166 (6%)	80 (3%)	259 (9%)	239 (8%)
English language learners Grade 9	1 627 (2%)	878 (54%)	42 (3%)	263 (16%)	36 (2%)	96 (6%)	48 (3%)	146 (9%)	118 (7%)
Students with special education needs Grade 3	2 501 (3%)	1 069 (43%)	155 (6%)	269 (11%)	89 (4%)	263 (11%)	159 (6%)	226 (9%)	271 (11%)
Students with special education needs Grade 6	4 282 (5%)	1 760 (41%)	249 (6%)	429 (10%)	181 (4%)	437 (10%)	287 (7%)	411 (10%)	528 (12%)
Students with special education needs Grade 9	4 383 (5%)	1 940 (44%)	252 (6%)	397 (9%)	158 (4%)	482 (11%)	279 (6%)	388 (9%)	487 (11%)

7 **Sustained Strength**: maintained the standard from Grade 3 to Grade 6 and met the standard in Grade 9; **Increasing Strength**: rose to the standard from Grade 3 to Grade 6 and met the standard in Grade 9; **Returning Strength**: dropped from the standard from Grade 3 to Grade 6 and met the standard in Grade 9; **New Strength**: never met the standard in Grade 3 and Grade 6 and met the standard in Grade 9; **New Difficulty**: maintained the standard from Grade 3 to Grade 6 and did not meet the standard in Grade 9; **Returning Difficulty**: rose to the standard from Grade 3 to Grade 6 and did not meet the standard in Grade 9; **Increasing Difficulty**: dropped from the standard from Grade 3 to Grade 6 and did not meet the standard in Grade 9; **Sustained Difficulty**: never met the standard in Grade 3 and Grade 6 and did not meet the standard in Grade 9.

8 Based on students for whom gender data were available.

Table 7: Student Attitudes from Grade 3 to Grade 6, for All Students and by Mathematics Summary Achievement, in English language Schools

	All Students (n = 109 303)	Maintained the Standard (n = 65 132)	Rose to the Standard (n = 9 778)	Dropped from the Standard (n = 15 431)	Never Met the Standard (n = 18 962)
Student Questionnaire Responses	**# (%)**	**# (%) Within Achievement Category**			
I like math[9] Grade 3	62 879 (57%)	40 303 (62%)	4 932 (50%)	8 514 (56%)	9 130 (48%)
I like math[9] Grade 6	48 452 (44%)	33 759 (52%)	4 351 (45%)	4 793 (31%)	5 549 (29%)
I am good at math[9] Grade 3	58 372 (54%)	41 377 (64%)	3 660 (37%)	7 282 (47%)	6 053 (32%)
I am good at math[9] Grade 6	54 447 (50%)	42 566 (65%)	3 902 (40%)	4 409 (29%)	3 570 (19%)

Table 8: Student Attitudes from Grade 6 to Grade 9, for All Students and by Mathematics Summary Achievement, in English language Schools, Applied Course

	All Students (n = 29 526)	Maintained the Standard (n = 6 636)	Rose to the Standard (n = 7 768)	Dropped from the Standard (n = 2 472)	Never Met the Standard (n = 12 650)
Student Questionnaire Responses	**# (%)**	**# (%) Within Achievement Category**			
I like math[9] Grade 6	8 897 (30%)	2 488 (37%)	2 318 (30%)	801 (32%)	3 290 (26%)
I like math[10] Grade 9	8 764 (30%)	2 776 (42%)	2 838 (37%)	519 (22%)	2 631 (22%)
I am good at math[9] Grade 6	6 821 (23%)	3 437 (37%)	1 778 (22%)	644 (26%)	1 962 (16%)
I am good at math[10] Grade 9	9 736 (34%)	3 560 (54%)	3 351 (43%)	555 (24%)	2 270 (19%)

Table 9: Student Attitudes from Grade 6 to Grade 9, for All Students and by Mathematics Summary Achievement, in English language Schools, Academic Course

	All Students (n = 79 777)	Maintained the Standard (n = 59 572)	Rose to the Standard (n = 7 860)	Dropped from the Standard (n = 6 230)	Never Met the Standard (n = 6 115)
Student Questionnaire Responses	**# (%)**	**# (%) Within Achievement Category**			
I like math[9] Grade 6	39 555 (50%)	32 155 (54%)	2 820 (36%)	2 666 (43%)	1 914 (31%)
I like math[10] Grade 9	40 630 (51%)	34 681 (58%)	3 140 (40%)	1 487 (25%)	1 322 (22%)
I am good at math[9] Grade 6	47 626 (60%)	40 712 (68%)	2 740 (35%)	2 675 (43%)	1 499 (25%)
I am good at math[10] Grade 9	41 674 (53%)	37 289 (63%)	2 618 (33%)	1 025 (17%)	742 (12%)

[9] Response categories: Yes; Sometimes; No. Percentages reflect students who responded “yes.”

[10] Response categories: Strongly agree; Agree; Undecided; Disagree; Strongly disagree. Percentages reflect students who responded “Strongly agree” or “Agree.” NB: For these questions, the majority of Grade 9 students’ positive responses fall in the “Agree” category, as opposed to the “Strongly agree” category.

Table 10: Student Attitudes from Grade 3 to Grade 6 to Grade 9, for All Students and by Mathematics Summary Achievement, in English language Schools, Applied Course[11]

Student Questionnaire Responses	All Students (n = 29 526)	Sustained Strength (n = 4 845)	Increasing Strength (n = 1 791)	Returning Strength (n = 3 843)	New Strength (n = 3 925)	New Difficulty (n = 1 328)	Returning Difficulty (n = 1 144)	Increasing Difficulty (n = 3 667)	Sustained Difficulty (n =8 983)
	# (%)	# (%) Within Achievement Category							
I like math[12] Grade 3	14 790 (50%)	2 688 (55%)	842 (47%)	2 045 (53%)	1 868 (48%)	679 (51%)	551 (48%)	1 985 (54%)	4 132 (46%)
I like math[12] Grade 6	8 897 (30%)	1 837 (38%)	651 (36%)	1 152 (30%)	1 166 (30%)	436 (33%)	365 (32%)	955 (26%)	2 335 (26%)
I like math[13] Grade 9	8 764 (30%)	2 009 (41%)	767 (43%)	1 387 (36%)	1 451 (37%)	267 (22%)	252 (23%)	755 (22%)	1 876 (22%)
I am good at math[12] Grade 3	11 392 (39%)	2 514 (52%)	637 (36%)	1 760 (46%)	1 294 (33%)	629 (47%)	356 (31%)	1 557 (42%)	2 645 (29%)
I am good at math[12] Grade 6	6 821 (23%)	1 931 (40%)	506 (28%)	986 (26%)	792 (20%)	392 (30%)	252 (22%)	696 (19%)	1 266 (14%)
I am good at math[13] Grade 9	9 736 (34%)	2 651 (55%)	909 (51%)	1 707 (44%)	1 644 (42%)	298 (24%)	257 (23%)	718 (21%)	1 552 (18%)

Table 11: Student Attitudes from Grade 3 to Grade 6 to Grade 9, for All Students and by Mathematics Summary Achievement, in English language Schools, Academic Course[11]

Student Questionnaire Responses	All Students (n = 79 777)	Sustained Strength (n = 54 314)	Increasing Strength (n = 5 258)	Returning Strength (n = 5 072)	New Strength (n = 2 788)	New Difficulty (n = 4 645)	Returning Difficulty (n = 1 585)	Increasing Difficulty (n = 2 849)	Sustained Difficulty (n = 3 266)
	# (%)	# (%) Within Achievement Category							
I like math[12] Grade 3	48 089 (60%)	34 136 (63%)	2 718 (52%)	2 859 (56%)	1 418 (51%)	2 800 (60%)	821 (52%)	1 625 (57%)	1 712 (52%)
I like math[12] Grade 6	39 555 (50%)	29 471 (54%)	2 684 (51%)	1 790 (35%)	1 030 (37%)	2 015 (43%)	651 (41%)	896 (31%)	1 018 (31%)
I like math[13] Grade 9	40 630 (51%)	31 975 (59%)	2 706 (52%)	1 989 (39%)	1 151 (41%)	1 063 (24%)	424 (27%)	597 (21%)	725 (22%)
I am good at math[12] Grade 3	46 980 (59%)	35 698 (66%)	2 060 (39%)	2 592 (51%)	1 016 (36%)	2 536 (55%)	607 (38%)	1 373 (48%)	1 098 (34%)
I am good at math[12] Grade 6	47 626 (60%)	38 119 (70%)	2 593 (49%)	1 938 (38%)	802 (29%)	2 124 (46%)	551 (35%)	789 (28%)	710 (22%)
I am good at math[13] Grade 9	41 674 (53%)	34 781 (64%)	2 508 (48%)	1 756 (35%)	862 (31%)	747 (17%)	278 (18%)	352 (13%)	390 (12%)

[11] **Sustained Strength**: maintained the standard from Grade 3 to Grade 6 and met the standard in Grade 9; **Increasing Strength**: rose to the standard from Grade 3 to Grade 6 and met the standard in Grade 9; **Returning Strength**: dropped from the standard from Grade 3 to Grade 6 and met the standard in Grade 9; **New Strength**: never met the standard in Grade 3 and Grade 6 and met the standard in Grade 9; **New Difficulty**: maintained the standard from Grade 3 to Grade 6 and did not meet the standard in Grade 9; **Returning Difficulty**: rose to the standard from Grade 3 to Grade 6 and did not meet the standard in Grade 9; **Increasing Difficulty**: dropped from the standard from Grade 3 to Grade 6 and did not meet the standard in Grade 9; **Sustained Difficulty**: never met the standard in Grade 3 and Grade 6 and did not meet the standard in Grade 9.

[12] Response categories: Yes; Sometimes; No. Percentages reflect students who responded “yes.”

[13] Response categories: Strongly agree; Agree; Undecided; Disagree; Strongly disagree. Percentages reflect students who responded “Strongly agree” or “Agree.” NB: For these questions, the majority of Grade 9 students’ positive responses fall in the “Agree” category, as opposed to the “Strongly agree” category.

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Education Quality and Accountability Office, 2 Carlton Street, Suite 1200, Toronto ON M5B 2M9, 1-888-327-7377, www.eqao.com

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Education Quality and Accountability Office
2 Carlton Street, Suite 1200, Toronto ON M5B 2M9
Telephone: 1-888-327-7377 I Website: www.eqao.com

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