

Summary of Results and Strategies for Teachers, 2012–2013

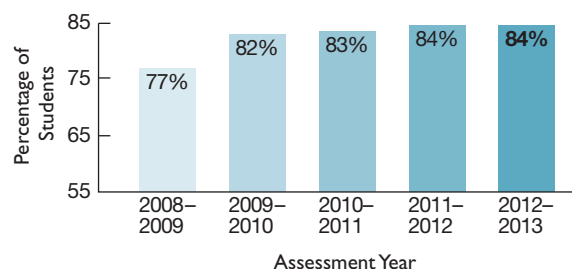
GRADE 9 ASSESSMENT OF MATHEMATICS

ACADEMIC COURSE Comparison of Provincial Results Over Time^{*†}

	2008–2009	2009–2010	2010–2011	2011–2012	2012–2013
	# = 100 992	# = 101 268	# = 99 278	# = 97 741	# = 97 158
Level 4	8%	10%	11%	13%	13%
Level 3	69%	72%	72%	71%	71%
Level 2	15%	12%	12%	11%	10%
Level 1	6%	5%	4%	4%	4%
Below Level 1	<1%	<1%	<1%	<1%	<1%
No Data	1%	1%	1%	1%	1%
At or Above the Provincial Standard [‡]	77%	82%	83%	84%	84%

- There were 97 158 Grade 9 students enrolled in the academic course at the time of the 2012–2013 assessment.
- The Grade 9 assessment is based on *The Ontario Curriculum, Grades 9 and 10: Mathematics* (revised 2005).

Percentage of All Students at or Above the Provincial Standard (Levels 3 and 4) Over Time



Observations

- Over the past five years, the percentage of students taking academic mathematics who performed at or above the provincial standard has increased (by seven percentage points, from 77% to 84%).
- In 2012–2013, the percentage of students performing at or above the provincial standard is the same as in the previous year in academic mathematics.

* Refer to the EQAO Web site (www.eqao.com) for data from previous years.

† Because percentages in tables and graphs are rounded, and because graphs do not show all reporting categories, percentages may not add up to 100.

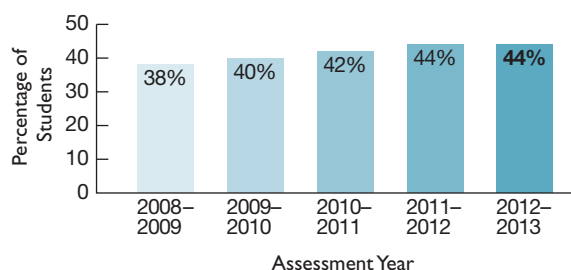
‡ These percentages are based on the actual number of students and cannot be calculated simply by adding the rounded percentages of students at Levels 3 and 4.

APPLIED COURSE Comparison of Provincial Results Over Time^{*†}

	2008–2009	2009–2010	2010–2011	2011–2012	2012–2013
	# = 48 482	# = 47 566	# = 44 095	# = 41 799	# = 39 881
Level 4	5%	7%	7%	7%	8%
Level 3	33%	34%	35%	37%	36%
Level 2	35%	35%	35%	34%	35%
Level 1	14%	14%	14%	13%	13%
Below Level 1	7%	6%	5%	4%	5%
No Data	6%	5%	5%	5%	4%
At or Above the Provincial Standard [‡]	38%	40%	42%	44%	44%

- There were 39 881 Grade 9 students enrolled in the applied course at the time of the 2012–2013 assessment.
- The Grade 9 assessment is based on *The Ontario Curriculum, Grades 9 and 10: Mathematics* (revised 2005).

Percentage of All Students at or Above the Provincial Standard (Levels 3 and 4) Over Time



Observations

- Over the past five years, the percentage of students taking applied mathematics who performed at or above the provincial standard has increased by six percentage points, from 38% to 44%.
- In 2012–2013, the percentage of students performing at or above the provincial standard is the same as in 2011–2012 in applied mathematics.

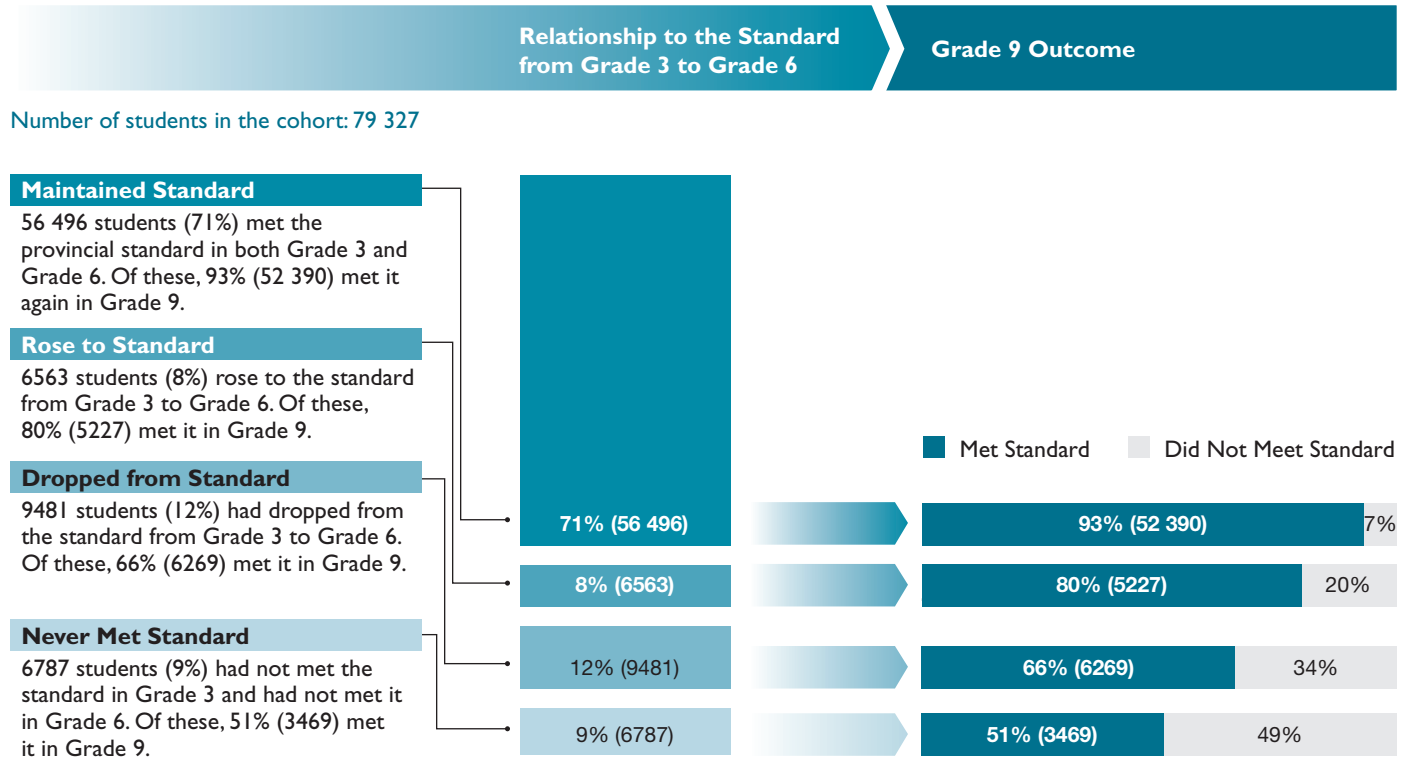
* Refer to the EQAO Web site (www.eqao.com) for data from previous years.

† Because percentages in tables and graphs are rounded, and because graphs do not show all reporting categories, percentages may not add up to 100.

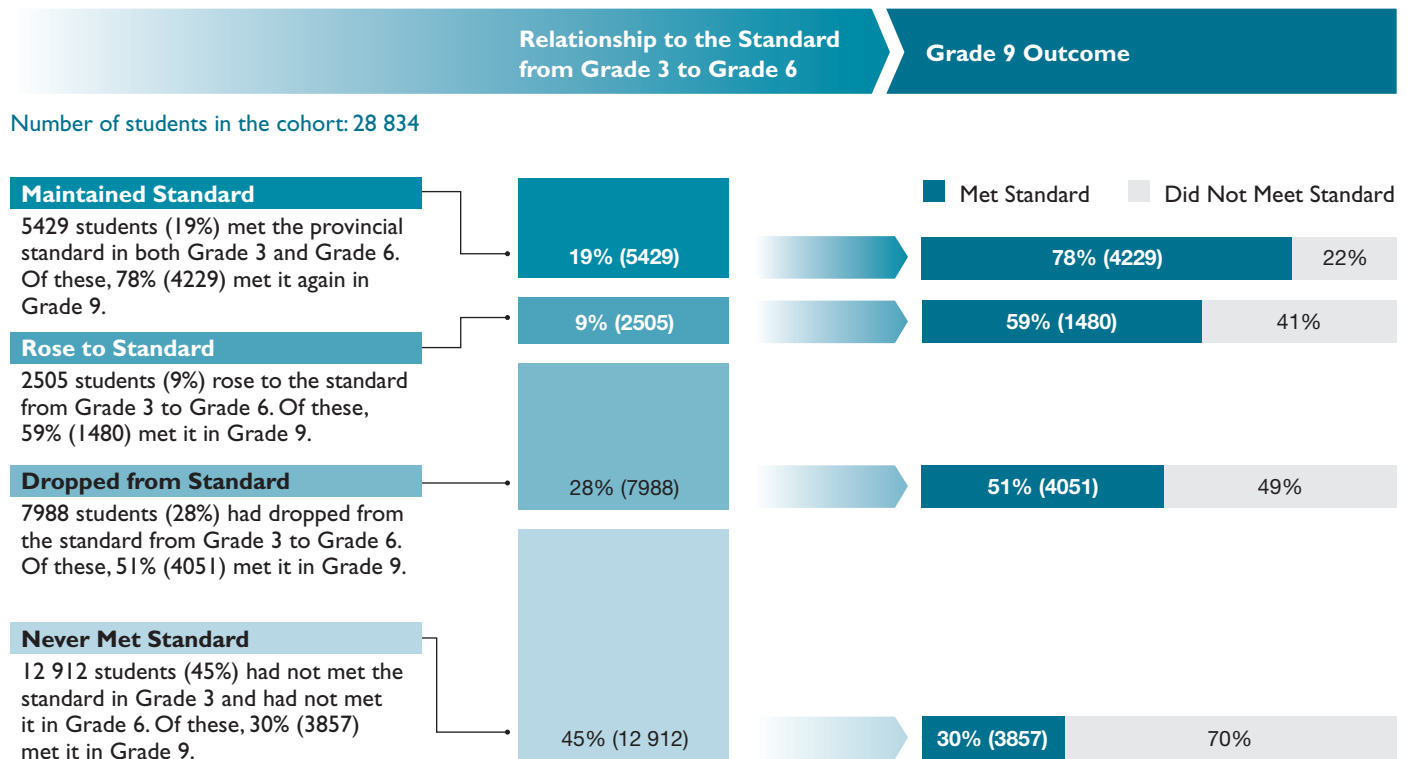
‡ These percentages are based on the actual number of students and cannot be calculated simply by adding the rounded percentages of students at Levels 3 and 4.

TRACKING PROGRESS IN MATH FROM GRADE 3 TO GRADE 6 TO GRADE 9

ACADEMIC COURSE



APPLIED COURSE



OBSERVATIONS AND STRATEGIES FOR IMPROVEMENT: MATHEMATICS

In June 2013, EQAO released a study on how selected student and teacher variables influence the achievement of students, in both academic and applied courses, on the Grade 9 Assessment of Mathematics. A few of the influential factors of a student's success on the assessment include counting EQAO's Assessment of Mathematics as part of the class mark and the amount of homework a student completes. Other factors that affect a student's success on the assessment and the implications for practice can be found in the research paper posted on EQAO's public Web site: http://www.eqao.com/Research/pdf/E/Comparative_Examination_Influence_Factors_Achievement_G9Math_en.pdf.

The following observations and suggested strategies for improvement are meant to assist educators in helping students develop and demonstrate their knowledge and skills in mathematics. The suggestions are based on an analysis of students' performance on the Grade 9 Assessment of Mathematics, Winter and Spring 2013, for both the academic and applied courses, and on feedback from teachers who scored the assessment.

The released questions can be found in the student assessment booklets and scoring guides (2012–2013) on the EQAO Web site, www.eqao.com.

For more information on the knowledge of content and the cognitive processes that students are required to demonstrate on the assessment, see the Grade 9 Assessment of Mathematics *Framework* on the EQAO Web site.

For more information on the terms in bold print, refer to the list of resources at the end of this section.

GRADE 9: ACADEMIC COURSE	
Observations	Strategies for Improvement
General Observations As with last year, students performed better overall on multiple-choice than open-response questions. Overall, males continued to perform slightly better than females across all strands, cognitive skills and question types; however, performance in the Analytic Geometry strand was comparable. Overall, students continued to perform best on the questions mapped to the cognitive skill Knowledge and Understanding and had the least success on questions mapped to the cognitive skill Thinking. Students with special education needs continued to perform more than five percentage points lower than the general population on all strands, cognitive skills and question types. The performance of students with special education needs matched that of the general population in its pattern of relative strengths and weaknesses. English language learners performed approximately the same overall as the general population except on questions mapped to the Linear Relations and Measurement and Geometry strands, where they performed slightly less well.	Incorporate EQAO's sample assessment questions as students learn various curriculum expectations. Continue to provide students with opportunities to answer, discuss and create multiple-choice questions and consider common errors and misconceptions. Engage students in learning through dialogue. Create a responsive mathematics learning environment to encourage participation of all students in class discussions. Use strategies that require all group members to share ideas and communicate using mathematical terminology (e.g., timed retell, inside-outside circle). Continue to integrate the mathematical process expectations into student learning associated with all the strands. Emphasize the process Problem Solving by teaching students to develop, select, apply and compare a variety of problem-solving strategies as they pose and solve problems and conduct investigations. See the Four-Step Problem-Solving Model. Continue to differentiate instruction by utilizing various effective instructional and assessment strategies to appeal to the various ways in which students learn and demonstrate their learning. Review the allowed accommodations listed in EQAO's <i>Grade 9 Assessment of Mathematics Guide for Accommodations and Special Provisions</i> and assign them to eligible students individually. Provide the students with these accommodations throughout the course.

GRADE 9: ACADEMIC COURSE (continued)	
Observations	Strategies for Improvement
	Collaboratively build classroom word walls and use them regularly to provide visual clues and references for students as well as to help build connections between key words and terminology in the Grade 9 mathematics curriculum.
Number Sense and Algebra Overall, on both the winter and the spring administrations, students continued to demonstrate the greatest strength on the questions mapped to this strand. Students performed least well on the multiple-choice questions in this strand mapped to Application, including a question involving proportional reasoning in a context. Scorers of the open-response question involving ratios and rates reported that students who performed less well had difficulty dealing with the multiple units present in the question.	Continue to provide opportunities for students to explore integer and algebraic concepts with and without the use of manipulatives to aid in visualizing abstract concepts. Present students with many opportunities to use proportional reasoning in questions with a context involving multiple unit conversions in more than one step. Integrate the mathematical process expectations, specifically the process Problem Solving, by having students incorporate and consider units as they solve problems.
Linear Relations This year, students performed best on the questions in this strand mapped to the cognitive skill Knowledge and Understanding, with or without a context. However, students performed least well on questions in this strand overall. Students had difficulty with the multiple-choice and open-response questions requiring the calculation of the initial value in a partial variation. Scorers of the open-response question requiring students to determine the initial value and rate of change noted that some students treated the partial variation as a direct variation by using one given point to determine a rate. Scorers of the open-response question requiring students to graph a given relationship noted that students had difficulty determining an appropriate scale on the graph to accommodate the data.	Continue to provide students with opportunities to investigate linear relations in a variety of contexts. Require students to apply their mathematical tools and make plans when solving problems. Have students consider partial variations across various contexts, including those with negative rates of change and those whose initial value is unknown. Consolidate mathematical terminology (e.g., direct variation, partial variation) as it pertains to this strand by using word walls and other graphic organizers. Require students to consider the range of data that must be accommodated prior to determining an appropriate scale for a graph. Continue to provide students with opportunities to graph linear relations presented in different representations (tables, equations, descriptions).
Analytic Geometry (Academic Only) This year, students performed best on multiple-choice questions in this strand that involved identifying the graph of a given relationship. Students performed less well on questions involving the application of the rate of change. Students had difficulty with the determination of slope in the open-response questions. Scorers of the open-response questions reported the following common errors: the scale was not considered on the graph, a single point was used to determine a slope, the rise and run were inverted in the formula and negative slopes were not recognized.	Continue to provide students with realistic situations that can be modelled by linear relations. Provide opportunities to determine and apply slope across problems involving the cognitive skill Thinking, and provide examples in which graphs with axes that have different scales are given. Encourage students to consider if answers are reasonable when scales on the axes are significantly different. Continue to use the reading and writing strategies outlined in <i>Think Literacy: Cross-Curricular Approaches, Grades 7–12; Mathematics, Grades 7–9</i> to teach students to organize the information in problems (e.g., by using graphic organizers) to aid in solving them.

GRADE 9: ACADEMIC COURSE (continued)	
Observations	Strategies for Improvement
Measurement and Geometry Students performed well on multiple-choice questions mapped to curriculum expectations involving geometry in this strand. Students performed least well on multiple-choice questions mapped to curriculum expectations involving measurement and the cognitive skill Thinking. These questions required students to make a plan to solve the problem, including the initial use of the Pythagorean theorem in at least one of the questions.	Continue to integrate the acquisition of knowledge and skills from other strands into Measurement and Geometry contexts to enrich learning across all strands. Provide students with additional problems where critical dimensions are omitted but can be determined using the Pythagorean theorem or other properties. Ensure students understand when to use the Pythagorean theorem in problems by embedding questions requiring its use with those that do not require it.

GRADE 9: APPLIED COURSE

Observations	Strategies for Improvement
General Observations Students continued to perform slightly better on multiple-choice than open-response questions in the spring administration, but in the winter administration there was no appreciable difference. Overall, males performed slightly better than females across all strands, cognitive skills and question types; however, performance was comparable in the winter administration on questions mapped to the Number Sense and Algebra strand and in the spring administration on open-response questions and on multiple-choice questions mapped to the cognitive skill Knowledge and Understanding. Again this year, students performed best on questions mapped to the cognitive skill Knowledge and Understanding and had the least success with questions mapped to the cognitive skill Application. As with last year, English language learners and students with special education needs performed approximately equally well overall, and both continued to perform less well than the general population on all strands, cognitive skills and question types. Trends in their performances continue to be consistent with those of the general population.	Incorporate EQAO's sample assessment questions as students learn various curriculum expectations. Discuss common errors and misconceptions in multiple-choice and open-response questions. Engage students in learning through dialogue. Create a responsive mathematics learning environment to encourage participation of all students in class discussions. Use strategies that require all group members to share ideas and communicate using mathematical terminology (e.g., timed retell, inside-outside circle). Continue to differentiate instruction by utilizing various effective instructional and assessment strategies to appeal to the various ways in which students learn and demonstrate their learning. Review the allowed accommodations listed in EQAO's <i>Grade 9 Assessment of Mathematics Guide for Accommodations and Special Provisions</i> and assign them to eligible students individually. Provide the students with these accommodations throughout the course. Collaboratively build classroom word walls and use them regularly to provide visual clues and references for students as well as to help build connections between key words and terminology in the Grade 9 mathematics curriculum.
Number Sense and Algebra This year, students writing the spring administration performed best on questions mapped to this strand. Overall, students were successful on the open-response question involving proportional reasoning and the open-response and multiple-choice questions involving substituting into a given formula and solving for an unknown. Students did not perform well on the multiple-choice questions involving an algebraic equation or establishing a proportion in a given context where the unknown value is in the denominator. Scorers of the open-response question requiring students to use proportional reasoning noted that some students determined an inverse rate and then were unable to complete the problem successfully.	Continue to allow students opportunities to explore integer and algebraic concepts with and without the use of manipulatives to aid in visualizing abstract concepts and developing conceptual understanding. Provide students with opportunities to work with proportions where the placement of the unknown value is varied (numerator, denominator and on either side of the proportion). Continue to integrate the mathematical process expectations into student learning associated with all the strands. Emphasize the process Representing by having students consider units when determining values in a proportion.

GRADE 9: APPLIED COURSE (continued)	
Observations	Strategies for Improvement
Linear Relations This year, students writing the winter administration performed best on questions mapped to this strand. Students were most successful on the multiple-choice questions that involved representing a given description as a graph or table of values or simple interpretations of a graph. Students who answered multiple-choice questions in this strand incorrectly often selected an option that showed they considered only part of the given information. Students performed least well on the open-response questions in this strand requiring the interpretation of points on a graph and the determination of an equation for a relationship where the initial value was not given. Scorers noted that some students had difficulty describing the meaning of points, the initial value and the rate of change in a situation.	Continue to provide students with opportunities to make connections between linear relations presented in different representations (tables, equations, descriptions). Provide students with strategies and tools to help them identify pertinent information contained in the question, such as highlighting or underlining key words and values. In multiple-choice questions, have students consider other options before selecting a response. In a responsive mathematics learning environment, encourage students to share incorrect answers and the rationale for their answers in order to highlight common misconceptions, omissions and errors. Continue to provide students with various contexts and different representations of linear relations (tables, graphs, equations, descriptions) and require them to determine the rate of change and initial value. Encourage students to demonstrate a clear and concise interpretation of the points in the relationship, the rate of change and the initial value. Connect learning and terminology from previous years to the terminology in the Grade 9 curriculum to ensure a deeper understanding (e.g., how a pattern rule for a number pattern that does not start at zero and involves addition or subtraction relates to a partial variation).
Measurement and Geometry This year, students writing both administrations performed least well on the questions mapped to this strand. Students performed well on the open-response question involving the area of a composite shape. Students did not perform well on the multiple-choice question requiring them to apply the Pythagorean theorem to find the length of the hypotenuse. Students also had difficulty in finding the volume of a composite figure. In questions mapped to curriculum expectations involving geometry, students performed well on the multiple-choice question in which students could have used the exterior angle theorem in a single step to solve for a missing value as opposed to the questions where multiple steps were required. Scorers of the open-response questions noted that students often incorrectly determined which two angles were equal in an isosceles triangle or incorrectly applied a property of parallel lines or a property of interior or exterior angles of a triangle.	Continue to integrate the learning of concepts and skills from other strands (e.g., exponents, square roots) into Measurement and Geometry contexts to enrich learning across all strands. Provide various contexts for students to practise the application of the Pythagorean theorem and the calculation of volumes of composite figures. Allow students to investigate using premade sketches in dynamic geometry software and manipulatives to help them consolidate various properties of angles. Encourage students to manipulate diagrams to see the impact of changes to the measures of angles, including special cases, and to consider the reasonableness of their answers.

LIST OF RESOURCES: GRADE 9

If you are reading the version of this document found on the EQAO Web site, www.eqao.com, please use the hyperlinks to the listed resources.

GRADE 9: ACADEMIC AND APPLIED COURSES

Conceptual understanding

- Ministry of Education of Ontario. (2005). The link between procedural knowledge and conceptual understanding. In *Education for all: The report of the expert panel on literacy and numeracy instruction for students with special education needs, kindergarten to Grade 6* (p. 74). Available at <http://www.edu.gov.on.ca/eng/document/reports/speced/panel/speced.pdf>

Differentiated instruction

- Ministry of Education of Ontario. (2005). Differentiated instruction. In *Targeted implementation and planning supports for revised mathematics (TIPS4RM), Grades 7, 8, 9 applied and 10 applied: Developing mathematical literacy* (pp. 23, 36–47). Available at <http://www.edu.gov.on.ca/eng/studentssuccess/lms/files/tips4rm/TIPS4RMDevMathLit.pdf>
- Ministry of Education of Ontario. (2005). Differentiated instruction. In *Education for all: The report of the expert panel on literacy and numeracy instruction for students with special education needs, kindergarten to Grade 6* (pp. 14–15). Available at <http://www.edu.gov.on.ca/eng/document/reports/speced/panel/speced.pdf>
- Ministry of Education of Ontario. (n.d.). *Professional learning guide: Differentiated instruction*. Available at <http://www.edu.gov.on.ca/eng/studentssuccess/lms/differentiatedInstruction.pdf>
- Literacy and Numeracy Secretariat (Producer). (2006, March 29). *Differentiated instruction: Continuing the conversation* [Webcast]. Available at <http://www.curriculum.org/secretariat/march29.shtml>
- Literacy and Numeracy Secretariat (Producer). (2008, May 26). *Differentiating mathematics instruction* [Webcast]. Available at <http://www.curriculum.org/secretariat/may28.shtml>
- Literacy and Numeracy Secretariat. (2008, September). *Differentiating mathematics instruction* (Capacity Building Series: Secretariat Special Edition 7). Available at <http://www.edugains.ca/resourcesELL/Monographs/DifferentiatingMathematicsInstruction.pdf>

English language learners

- Ministry of Education of Ontario. (2005). *Many roots, many voices: Supporting English language learners in every classroom: A practical guide for Ontario educators*. Available at <http://www.edu.gov.on.ca/eng/document/manyroots/manyroots.pdf>
- Ministry of Education of Ontario. (2005). Developing mathematical literacy for all: A focus on English language learners. In *TIPS for English language learners in mathematics, Grades 7, 8, 9 applied and 10 applied*. Available at <http://www.edu.gov.on.ca/eng/studentssuccess/lms/files/ELLMath4All.pdf>

Four-Step Problem-Solving Model

- Ministry of Education of Ontario. (2005). *The Ontario curriculum, Grades 1–8: Mathematics*. Available at <http://www.edu.gov.on.ca/eng/curriculum/elementary/math18curr.pdf>

Graphic organizers

- Ministry of Education of Ontario. (2004). In *Think Literacy: Cross-Curricular Approaches, Grades 7–12: Mathematics, Grades 7–9* (pp. 20, 24–26, 30–32). Available at <http://www.edu.gov.on.ca/eng/studentssuccess/thinkliteracy/files/ThinkLitMath.pdf>
- Ministry of Education of Ontario. (2005). Graphic organizers. In *Targeted implementation and planning supports for revised mathematics (TIPS4RM), Grades 7, 8, 9 applied and 10 applied: Developing mathematical literacy* (p. 25). Available at <http://www.edu.gov.on.ca/eng/studentssuccess/lms/files/tips4rm/TIPS4RMDevMathLit.pdf>

Inside-outside circle

- Ministry of Education of Ontario, TVOntario. (2006). *Inside-outside circle*. Available at http://eworkshop.on.ca/edu/pdf/Mod36_coop_inside-outside.pdf

Learning through dialogue

- Literacy and Numeracy Secretariat. (2012, November 8). *Conversations for learning* [Webcast]. See *Lucy West on learning through dialogue: Student voice & classroom discourse*. Available at <http://www.curriculum.org/content/30/conversations-for-learning>

GRADE 9: ACADEMIC AND APPLIED COURSES (continued)**Manipulatives (concrete materials)**

- Ministry of Education of Ontario. (2004). Making available and using a rich array of manipulatives. In *Leading math success: Mathematical literacy, Grades 7–12: The report of the expert panel on student success in Ontario* (pp. 48–50). Available at <http://www.edu.gov.on.ca/eng/document/reports/numeracy/numeracyreport.pdf>
- Ministry of Education of Ontario. (2004). Embedding manipulatives into instructional practice. In *Leading math success: Mathematical literacy, Grades 7–12: The report of the expert panel on student success in Ontario* (p. 58). Available at <http://www.edu.gov.on.ca/eng/document/reports/numeracy/numeracyreport.pdf>
- Ministry of Education of Ontario. (2005). Concrete materials. In *Targeted implementation and planning supports for revised mathematics (TIPS4RM), Grades 7, 8, 9 applied and 10 applied: Developing mathematical literacy* (p. 22). Available at <http://www.edu.gov.on.ca/eng/studentssuccess/lms/files/tips4rm/TIPS4RMDevMathLit.pdf>
- Ministry of Education of Ontario. (n.d.). *Manipulatives and technologies: Their role in teaching and learning mathematics* [Slide presentation]. Available at <http://www.edu.gov.on.ca/eng/studentssuccess/lms/files/Manipulatives.ppt>
- Ministry of Education of Ontario. (n.d.). *Professional learning guide: Manipulatives*. Available at <http://www.edu.gov.on.ca/eng/studentssuccess/lms/manipulatives.pdf>

Mathematical processes

- Ministry of Education of Ontario. (n.d.). Descriptions of the mathematical processes, the role of the student and suggested instructional strategies to support their teaching and learning. In *Targeted implementation and planning supports for revised mathematics (TIPS4RM): Mathematical processes*. Available at <http://www.edugains.ca/resources/LearningMaterials/MathProcesses/MathProcessesPackage.pdf>

Problem-solving strategies

- Ministry of Education of Ontario. (2005). Problem solving. In *Targeted implementation and planning supports for revised mathematics (TIPS4RM). Mathematical processes* (p. 2). Available at <http://www.edu.gov.on.ca/eng/studentssuccess/lms/files/tips4rm/TIPS4RMPProcesses.pdf>
- Ministry of Education of Ontario. (2006). Problem-solving strategies. In *A guide to effective instruction in mathematics, kindergarten to Grade 6: Volume 2: Problem solving and communication* (pp. 38–44). Available at http://www.eworkshop.on.ca/edu/resources/guides/Guide_Math_K_6_Volume_2.pdf

Proportional reasoning

- Ministry of Education of Ontario (2010). Big ideas and questioning, K–12: Proportional reasoning. In Math GAINS. Available at http://www.edugains.ca/resources/LearningMaterials/ContinuumConnection/BigIdeasQuestioning_ProportionalReasoning.pdf
- Ministry of Education of Ontario (2012). Paying attention to proportional reasoning, K–12. Available at <http://www.edu.gov.on.ca/eng/teachers/studentssuccess/ProportionReason.pdf>

Responsive mathematics learning environment

- Ministry of Education of Ontario (2011). Design of responsive mathematics learning environment. In *Paying attention to mathematics education, K–12*. Available at <http://www.edu.gov.on.ca/eng/teachers/studentssuccess/FoundationPrincipals.pdf>

Sample assessment questions

- “Student Assessment Booklets and Scoring Guides” in the “Educator Resources” section of the Education Quality and Accountability Office Web site: <http://www.eqao.com/Educators/Secondary/09/09.aspx?Lang=E&gr=09>

Students with special education needs

- Ministry of Education of Ontario. (2005). *Education for all: The report of the expert panel on literacy and numeracy instruction for students with special education needs, kindergarten to Grade 6*. Available at <http://www.edu.gov.on.ca/eng/document/reports/spced/panel/spced.pdf>
- Literacy and Numeracy Secretariat. (2008, May 2). High-yield strategies to improve student learning [Webcast]. Available at <http://www.curriculum.org/secretariat/may2.shtml>

Timed retell

- Ministry of Education of Ontario. (2004). Pair work: Timed retell. In *Think Literacy: Cross-Curricular Approaches, Grades 7–12: Mathematics, Grades 7–9* (pp. 100–101). Available at <http://www.edu.gov.on.ca/eng/studentssuccess/thinkliteracy/files/ThinkLitMath.pdf>

GRADE 9: ACADEMIC AND APPLIED COURSES (continued)**Word walls**

- Ministry of Education of Ontario. (2004). Getting ready to read: Extending vocabulary (Creating a word wall). In *Think Literacy: Cross-Curricular Approaches, Grades 7–12: Mathematics, Grades 7–9* (pp. 22–25). Available at <http://www.edu.gov.on.ca/eng/studentssuccess/thinkliteracy/files/ThinkLitMath.pdf>
- Ministry of Education of Ontario. (2005). *Education for all: The report of the expert panel on literacy and numeracy instruction for students with special education needs, kindergarten to Grade 6*. Available at <http://www.edu.gov.on.ca/eng/document/reports/speced/panel/speced.pdf>
- Ministry of Education of Ontario. (2006). Math word wall. In *A guide to effective instruction in mathematics, kindergarten to Grade 6: Volume 2: Problem solving and communication* (p. 78). Available at http://eworkshop.on.ca/edu/resources/guides/Guide_Math_K_6_Volume_2.pdf

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