Ideas for assessment in the context of High School Mathematics

Growing success

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Introduction

How do we apply the policies in the Growing Success document to our instruction and assessment?

What does planning of instruction and assessment look like for Mathematics?

What does assessment *for* learning and assessment *as* learning look like in Mathematics?

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Seven Fundamental Principles

Practices and Procedures are:

1) fair, transparent and equitable for all students
2) support all students
3) are carefully planned to relate to the curriculum expectations and learning goals, and as much as possible to the interests, learning styles and preferences, needs and experiences of all students;

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Seven Fundamental Principles (continued)

4) are communicated clearly to students and parents at the beginning of the school year or course and at other appropriate points

5) are ongoing and varied in nature, and administered over a period of time to provide multiple opportunities for students

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Seven Fundamental Principles (continued)

6) provide ongoing descriptive feedback that is clear, specific, meaningful and timely

7) develop students' self-assessment skills

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"AS", "FOR", or "OF" learning

- The different phrases denote different uses we have for assessments
- Assessment *as* learning - we help students monitor progress, set goals, reflect on their learning
- Assessment *for* learning - we provide feedback and coaching
- Assessment *of* learning – we use assessments as ways of providing evaluative statements about the level of achievement of students

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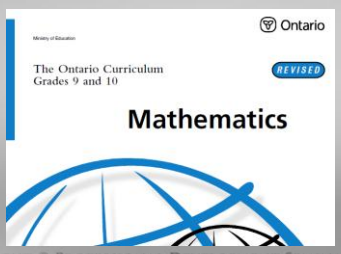
Planning Instruction and Assessment

Assessment *as* learning and Assessment *for* learning – which specific expectations will be used for these kinds of assessment?



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Examining the curriculum document

Trigonometry

Overall Expectations

By the end of this course, students will:

- use their knowledge of ratio and proportion to investigate similar triangles and solve problems related to similarity;
- solve problems involving right triangles, using the primary trigonometric ratios and the Pythagorean theorem;
- solve problems involving acute triangles, using the sine law and the cosine law.

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Planning Instruction and Assessment

- Which specific expectations will represent the overall expectation of similar triangles in our Assessment OF Learning?
- Now look at the others – how can they be used for assessment AS learning, or FOR learning?

Specific Expectations

Investigating Similarity and Solving Problems Involving Similar Triangles

By the end of this course, students will:

- verify, through investigation (e.g., using dynamic geometry software, concrete materials), the properties of similar triangles (e.g., given similar triangles, verify the equality of corresponding angles and the proportionality of corresponding sides);
- describe and compare the concepts of similarity and congruence;
- solve problems involving similar triangles in realistic situations (e.g., shadows, reflections, scale models, surveying) (***Sample problem:*** Use a metre stick to determine the height of a tree, by means of the similar triangles formed by the tree, the metre stick, and their shadows.).

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Examining the curriculum document

Solving Problems Involving the Trigonometry of Right Triangles

By the end of this course, students will:

- determine, through investigation (e.g., using dynamic geometry software, concrete materials), the relationship between the ratio of two sides in a right triangle and the ratio of the two corresponding sides in a similar right triangle, and define the sine, cosine, and tangent ratios (e.g., $\sin A = \frac{opposite}{hypotenuse}$);
- determine the measures of the sides and angles in right triangles, using the primary trigonometric ratios and the Pythagorean theorem;
- solve problems involving the measures of sides and angles in right triangles in real-life applications (e.g., in surveying, in navigating, in determining the height of an inaccessible object around the school), using the primary trigonometric ratios and the Pythagorean theorem.

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Examining the curriculum document

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Examining the curriculum document

Solving Problems Involving the Trigonometry of Acute Triangles

By the end of this course, students will:

- explore the development of the sine law within acute triangles (e.g., use dynamic geometry software to determine that the ratio of the side lengths equals the ratio of the sines of the opposite angles; follow the algebraic development of the sine law and identify the application of solving systems of equations [student reproduction of the development of the formula is not required]);
- explore the development of the cosine law within acute triangles (e.g., use dynamic geometry software to verify the cosine law; follow the algebraic development of the cosine law and identify its relationship to the Pythagorean theorem and the cosine ratio [student reproduction of the development of the formula is not required]);
- determine the measures of sides and angles in acute triangles, using the sine law and the cosine law (***Sample problem:*** In triangle ABC, $\angle A = 35°$, $\angle B = 65°$, and AC = 18 cm. Determine BC. Check your result using dynamic geometry software.);
- solve problems involving the measures of sides and angles in acute triangles.

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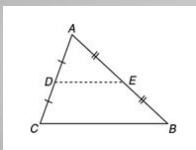
Achievement of Curriculum Expectations can have some overlap with Learning Skills

- Organization
- Self-Regulation



- plan and implement a multi-step strategy that uses analytic geometry and algebraic techniques to verify a geometric property (e.g., given the coordinates of the vertices of a triangle, verify that the line segment joining the midpoints of two sides of the triangle is parallel to the third side and half its length, and check using dynamic geometry software; given the coordinates of the vertices of a rectangle, verify that the diagonals of the rectangle bisect each other).

It is important to decide, when planning, which expectations will be assessed for learning, and how learning skills will be assessed.

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Developing Learning Goals and Identifying Success Criteria

In the spirit of the Growing Success document, **what** is being assessed, and **how** it is being assessed needs to be communicated and discussed with students.

The WHAT:

Quiz: e.g. List of topics

Assignment: e.g. Rubric or checklist

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Identifying Success Criteria

The HOW:

Teachers can ensure that students understand the success criteria by using clear language that is meaningful to the students and by directly involving them in identifying, clarifying, and applying those criteria in their learning.

e.g. after developing a solution in class, talk about what parts of the solution are essential for the student to demonstrate knowledge of the concept.

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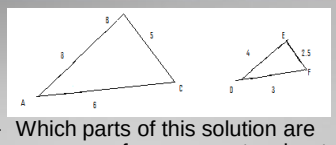
An example from similar triangles:

Determine if the following triangles are similar:



$\frac{AB}{DE} = \frac{8}{4} = 2$

$\frac{AC}{DF} = \frac{6}{3} = 2$

$\frac{BC}{EF} = \frac{5}{2.5} = 2$

$\frac{AB}{DE} = \frac{AC}{DF} = \frac{BC}{EF}$

$\therefore \Delta ABC \approx \Delta DEF$

- Which parts of this solution are necessary for you as a teacher to assess the student's understanding?
- If a student's concluding statement does not state the vertices in that order, could they be right?
- When would they be wrong? Which parts of the solution would they get wrong?

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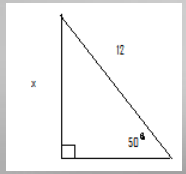
Discussion with students clarifies the concept and helps them understand math as problem-solving rather than memorization

Another example:

What mark should a student get if they use sine law to solve this right angled triangle?



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Success criteria can be used to:

- have a common understanding of the "analytic scheme" used to assess a student's solution
- Create checklists or rubrics (quite similar to our "analytic scheme")
- Create an exit card

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Assessment *for* learning, and Assessment *as* learning can be determined using:

Products, Observation and Conversations

- Our assessment of our students' achievement is usually a "triangulation" of our information from these various sources
- Giving students varied opportunities to demonstrate their learning increases our confidence in our assessment of their learning

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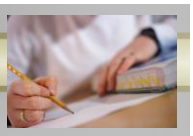
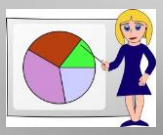
Student Product



- Quizzes, tests and assignments
- Presentations (not necessarily projects)
- Student self-assessments



Descriptive feedback on student product can be written or done as class discussion or conferencing with students.

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Examples of Student Product

Exit Card

Students can assess their own answer

e.g. Determine the value of x in the equation $13 = 3x - 2$

(Find the solution, check your answer, and give yourself a mark out of three based on our checklist)

Math Journals

Students can describe what they understand

e.g. If your friend missed today's class, and called you on the phone to ask you how to graph a line such as $y = 2x - 7$, how would you describe the process? Be as specific as possible.

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Observations

- Individualized tasks for students
- Students doing group work
- Listen to students as they perform peer assessment

<u>These observations can:</u>

- shape further instruction
- shape assessments

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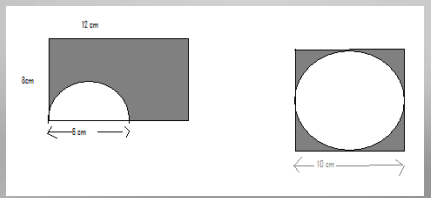
Example of Individualized Tasks

Distribute pieces of paper with different shapes, with different areas shaded. Ask students to find the shaded area.

You can observe how the students work independently



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Conversations

When do conversations happen?

- Questions from students during class discussions
- Conferencing with students
- Circulating while students work in groups

<u>These conversations can:</u>

- provide instant feedback
- shape further lessons
- shape assessments

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Assessment of Learning

- We can ensure students have multiple opportunities to demonstrate their learning
- We can ensure that students have varied opportunities to demonstrate their learning
- We can ensure that students understand the success criteria (what is being assessed and how it is being assessed)
- We can ensure that students have had detailed descriptive feedback to help them improve

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What did we discuss today?

- **<u>Planning of Instruction and Assessment</u>** based on curriculum expectations
- **<u>what</u>** is being assessed, and **<u>how</u>** it is being assessed needs to be communicated and discussed with students
- We determine student achievement based on **<u>products, observations and conversations</u>**

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Teachers love to learn

Teachers are also encouraged to take an "assessment *for* learning and *as* learning" approach to their own professional learning … working collaboratively with peers … and reflecting on their progress towards achieving their goals.

We are doing this now by sharing our thoughts and best practices.

Questions or Comments?

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