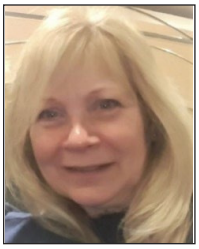
The Ongoing Challenge of Assessing Thinking for All Learners: Examples of Evaluation Tasks for Grade 9



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Walid Khneisser is a recent graduate of Lakehead University. He advocates for the use of thinking classrooms over traditional classrooms, to foster knowledge and fundamental understanding of mathematical concepts. He believes in supporting growth in mathematical understanding, rather than the rote application of formulas. Walid Khneisser is also fascinated by learning about using visual manipulatives to make sense of abstract mathematical concepts.

With the transition to the Grade 9 destreamed Mathematics course in Ontario now in full swing, Ontario teachers are continuing to work to authentically enact the vision of the new course (McDougall et al., 2023).

One area that is always especially challenging during phases of curriculum implementation is the revisioning and redesigning of assessment and evaluation methods. The *Growing Success* document (Ontario Ministry of Education [OME], 2010) reminds us that "the primary purpose of assessment and evaluation is to support student learning" (p. 6). Methods of assessment and evaluation need to be reconsidered in light of the goals of the destreamed course. How can assessment and evaluation include allowing multiple ways for students to demonstrate their learning and understanding? How are we to find ways to do such assessments for a destreamed range of student understanding? What options are there to assess *more* than skills and procedures?

It is critically important that assessment and evaluation methods echo what we are professing to *value* in learning, and whether the idea of assessing thinking is to be included. If we truly want students to think, to show their understanding in multiple ways, and to solve relevant, real-world problems that have meaning for them, then we must *value* that in our assessment and "e-*value*-ation."

I have, for a long time, been an advocate of tasks as a viable evaluation method (Atiya et al., 2018) and have used this method with Grades 9 and 10 students under the previous curriculum, with positive results (Kajander, 2002). The removal of the stress of a time limit, as well as the opportunity this creates for students to actually *do* problem solving, allows for a much richer evaluation.

I have found the use of a learning task/evaluation task pair to be especially helpful in clarifying to students what is expected of them, and providing them with opportunities to improve (OME, 2010). For students who have had less experience with task-based evaluation of problem-based learning, it has a different feel, and they can initially find it confusing. This article will provide some background, and then provide a sample pair of tasks, ready for classroom use.

Learning Tasks and Evaluation Tasks

In this article, the benefit of having two parallel tasks, which share curriculum Expectations, but involve a different context or a different aspect of the same context, will be explored. The first task, which we refer to as a "Learning Task," may be done with students working alone or in pairs or small groups. The teacher may give substantive feedback in the moment, and also provide detailed feedback on a required written product. It is not graded, but rather, provides the student(s) the opportunity to experience working on a problem-solving task, using a given set of curriculum Expectations (including the process Expectations), with teacher support and feedback for the purpose of improving. Students can work with peers, ask the teacher questions, and get substantive, constructive feedback, to subsequently improve their understanding and demonstrate this on the subsequent task, which we will call the Evaluation Task. As well, as students are working on the Learning Task, teachers can be observing the mathematical processes, in the moment. The Evaluation Task can also use a subset of the Learning Task Expectations, but shouldn't attempt to evaluate more of them than were addressed in the Learning Task. The mathematical processes (Strand A: Representing, Reasoning, Problem-Solving, etc) can be front and centre in

these tasks, and remembering the other details of Strand A, socio–emotional learning goals, is also important. Engagement is enhanced when students see the tasks as relevant and interesting, and they are empowered to see the value and use of the mathematics they have learned in addressing real problems in their lives. While this strand does not need to be graded, it should still be a consideration in task design and feedback to students.

The use of a task-specific rubric allows students to demonstrate their understanding in various ways, and at a range of levels. If the tasks are rich enough, then extended research or high-ceiling opportunities are helpful to keep high-performing students engaged and learning, and rubrics can also reflect this. The rubric should be given to students with the Evaluation Task, to ensure evaluation is transparent. Afterwards, once the tasks have been used in a given semester, exemplars of student work can be kept and provided to future students to illustrate examples of levels of performance.

Practical Considerations

The reality of many classrooms is that students work at different paces and are sometimes absent. For this reason, in my own classroom practice, I found it helpful to have the two tasks (Learning Task and Evaluation Task) printed on different colours of paper. That way, I could see at a glance who was working on what. Giving consideration to the timing, so that the teacher can provide the feedback in a timely manner before the student moves on to the Evaluation Task without too much delay, is beneficial. Another option is to have an in-between day, where students are simply building skills and fluency by practising techniques with textbook problems. When some students are behind in the required classroom work, teachers have to make a judgment call about what to prioritize and what to leave off; it may be the case that at times, some of this skills practice is omitted for students working more slowly. Such decisions will be influenced by one's values and priorities; the general idea here is that *understanding* precedes fluency.

A pair of sample tasks is provided for use with the Grade 9 destreamed course. They were designed by a teacher candidate, in a curriculum and instruction course in secondary mathematics, as part of our course's culminating activity. We would be delighted to receive feedback on the tasks from anyone who tries them out, and welcome suggestions for improvement. The Evaluation Task that follows is situated geographically in Thunder Bay—but of course, it can be adjusted to any region.

Sample Learning and Evaluation Tasks – Strands B., C., and E.

MTH1W – Grade 9 Mathematics

Summary of Strands: B. Number, C. Algebra, E. Geometry and Measurement

Theme: Climate Change

Amount of Time Per Task: 70 minutes (Learning Task), 210 minutes (Evaluation Task)

Expectations in bold type in the following list are found in both the Learning and Evaluation Tasks. Expectations not highlighted are only found in the Learning Task.

Throughout this course, in connection with the learning in the other strands, students will:

A2 Making Connections
make connections between mathematics and various knowledge systems, their lived experiences, and various real-life applications of mathematics, including careers;

B3 Number Sense and Operations
apply an understanding of rational numbers, ratios, rates, percentages, and proportions, in various mathematical contexts, and to solve problems;

B3.5 pose and solve problems involving rates, percentages, and proportions in various contexts, including contexts connected to real-life applications of data, measurement, geometry, linear relations, and financial literacy;

C1 Algebraic Expressions and Equations;

C1.2 create algebraic expressions to generalize relationships expressed in words, numbers, and visual representations, in various contexts;

C1.3 compare algebraic expressions, using concrete, numerical, graphical, and algebraic methods to identify those that are equivalent, and justify their choices;

C1.5 create and solve equations for various contexts, and verify their solutions;

C3 Application of Relations
represent and compare linear and non-linear relations that model real-life situations, and use these representations to make predictions;

C3.3 compare two linear relations of the form $y = ax + b$ graphically and algebraically, and interpret the meaning of their point of intersection in terms of a given context;

E1.3 solve problems involving different units within a measurement system and between measurement systems, including those from various cultures or communities, using various representations and technology, when appropriate;

E1.5 solve problems involving the side-length relationship for right triangles in real-life situations, including problems that involve composite shapes.

Grade 9 Learning Task

How Green Are Electric Vehicles?

Although Carbon Dioxide (CO_2) is not emitted when electric motors are running, the electricity used by Electric Vehicles (EVs) may generate CO_2 during their production, and the amounts depend on which sources of energy from which the electricity originates. The more fossil fuels are used to generate electricity, the more CO_2 will result.

1) A mid-sized Tesla Model 3 electric vehicle generates 8100 kilograms of CO_2 to manufacture. While electric motors do not emit CO_2 when they run, CO_2 can be emitted during the generation of electricity that EVs draw from the electrical grid and store in their batteries. In the United States, 23% of electricity comes from coal-fired plants. From this electricity source, the Tesla Model 3 will still emit 72.7g of CO_2 per kilometer. A similar gasoline vehicle, the Toyota Corolla, generates 5500 kilograms of CO_2 to manufacture, and emits 192.4 of CO_2 per kilometer.
   a) Which vehicle results in more CO_2 during manufacturing? How much more?
   b) Assuming both vehicles have an average lifespan of 280 000 kilometres, how much CO_2 does each vehicle produce during its lifetime, including manufacturing?
   c) How many kilometers does the Tesla 3 Model have to drive before it becomes cleaner than a Toyota Corolla in terms of its CO_2 emissions?
   d) The Tesla Model 3 emits 72.7g of CO_2 per kilometer on a grid where 23% of its electricity comes from coal. How much would it emit if only 10% of its electricity came from coal (and assuming there are no emissions from any other source on the grid)?
2) The carbon intensity of electricity is the rate at which CO_2 is released per unit of electricity generated, and can be expressed in grams of CO_2 per kilowatt hours (g CO_2/kWh) per kilometer. The map above displays the carbon intensity of each province.
   a) Which provinces have the lowest CO_2 emitting energy in Canada?
   b) A Tesla Model X is travelling from point A in Saskatchewan to point B in Nunavut. The car first travels 300 km east to point C in Manitoba, using the Saskatchewan power grid, and emits 163.3g CO_2/km. At point C it recharges its batteries and emits 0.5g /km as it travels an additional 400 km north to point B. Using the Saskatchewan power grid, the car emits 163.3g CO_2/km during the entire trip. How would this change if the car is recharged in Manitoba?
   c) If the car had travelled from point A to point B in a straight line, using the Saskatchewan power grid, how much more CO_2 would have been emitted?

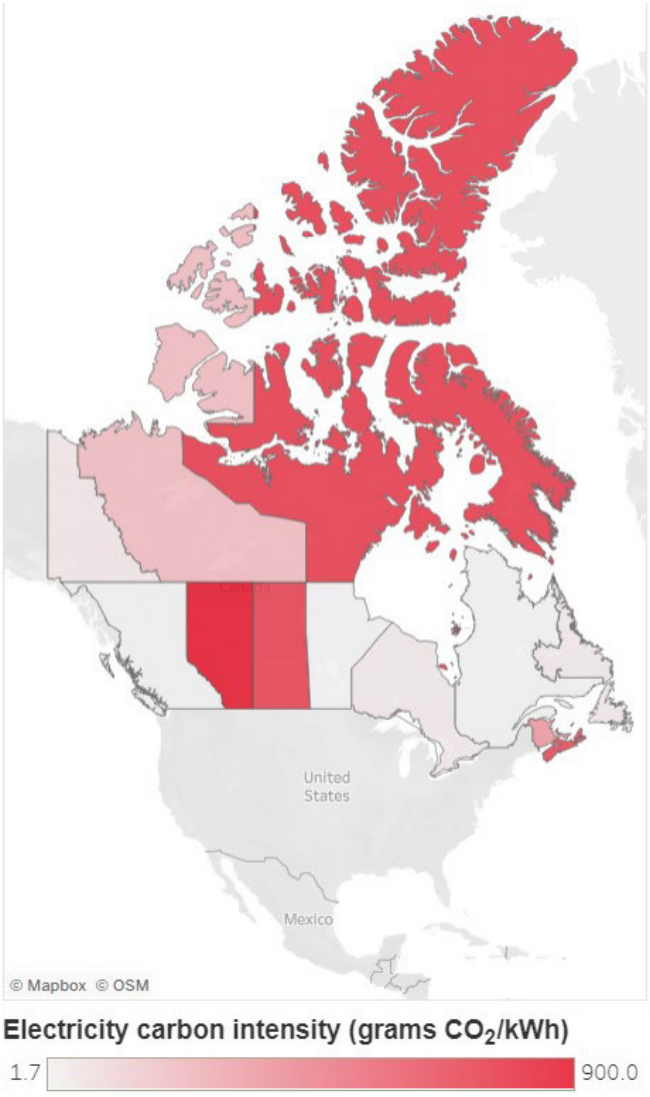


Figure 1: *Carbon intensity of electricity production*

Grade 9 Assessment Task

The total amount of greenhouse gases, such as carbon dioxide (CO_2), produced by human actions is known as a carbon footprint.

One of the highest rates in the world, the average carbon footprint of a person in Canada is 14.2 tonnes per year. The

average carbon footprint across the globe is closer to 4 tonnes per year. By 2050, the average worldwide carbon footprint must fall to under 2 tonnes per year to have the best chance of preventing a rise in global temperatures of 2°C.

Individual carbon footprint reduction from 16 tonnes to 2 tonnes takes time! We can start to have a significant impact by making minor adjustments to our behaviour, such as eating less meat, booking fewer connecting flights, and line-drying our clothes.

Task

Stevan lives in Thunder Bay. He wants a ride from Westfort in Fort William to Chapples Park. He can take an Uber, a Lyft, or use public transportation. When checking the routes on his phone, shown in Figure 2, he finds the CO_2 emissions per kilometre of each ride. Additionally, Stevan finds that the Lyft would emit another 285 grams of CO_2 on the way to pick him up.

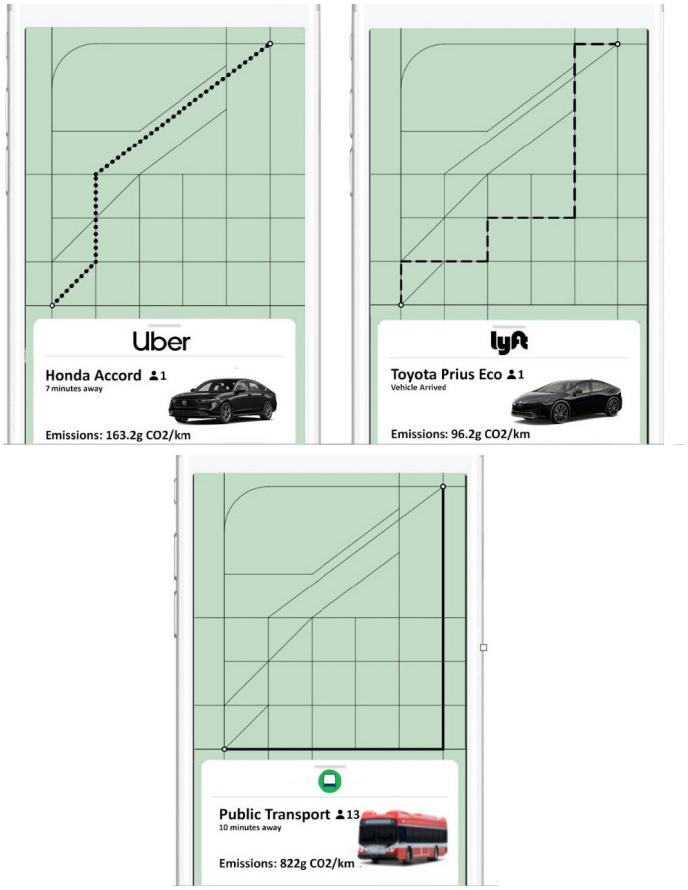


Figure 2: *Ride options*

1. What is the total amount of CO_2 that would be emitted by each ride?
2. At what point does the Uber's emissions exceed the Lyft's CO_2 emissions?
3. Which ride will result in the lowest amount of emissions per passenger?
4. Which ride should Stevan take to minimize his carbon footprint? Explain how you know.

To assist with choosing which ride Stevan should take, he laid out all three routes on a grid. Each unit, or two centimeters, on the grid represent 1 kilometer.

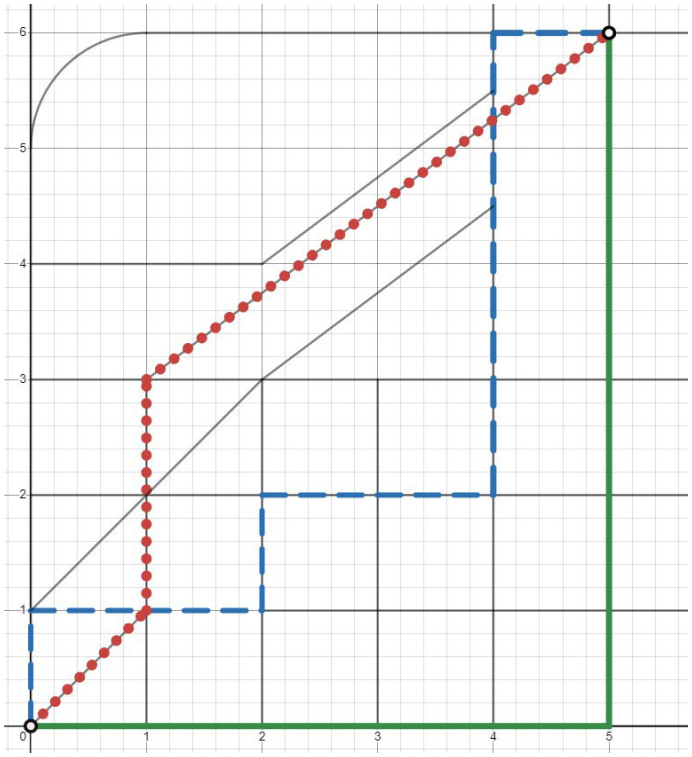


Figure 3: *Different routes*

Presentation

Your final product should include the following information:

- A thorough explanation of the steps you took to solve the problem
- The calculations you made, presented in a clear and concise manner
- All calculations rounded to 2 decimal places
- If the length of the routes on the grid were measured using a ruler, clearly indicate which part was measured, its length, and the calculations you used to convert it to kilometers.
- A statement indicating when the Uber's emissions exceed the Lyft's emissions
- A conclusion that states the CO_2 emission of each ride, and the ride that results in the lowest CO_2 emissions per person, including the ride that would minimize Stevan's carbon footprint, along with an explanation of which ride Stevan should take to minimize his carbon footprint

RUBRIC				
Student Name: _____				
Expectations	**Level 1**	**Level 2**	**Level 3**	**Level 4**
Knowledge / Understanding	• Demonstrates limited understanding of the relationship between CO2 emissions per kilometer and distance travelled.	• Demonstrates some understanding of the relationship between CO2 emissions per kilometer and distance travelled.	• Demonstrates considerable understanding of the relationship between CO2 emissions per kilometer and distance travelled.	• Demonstrates thorough understanding of the relationship between CO2 emissions per kilometer and distance travelled.
Thinking	• Routes are split up to calculate distance in a limited degree. • Statements and conclusion are formed with limited degree of accuracy.	• Routes are split up in a somewhat logical fashion to calculate distance. • Statements and conclusion are formed with some degree of accuracy.	• Routes are split up in a generally logical fashion to calculate distance. • Statements and conclusion are formed with a considerable degree of accuracy.	• Routes are split up in a highly logical fashion to calculate distance. • Statements and conclusion are formed with a high degree of accuracy.
Communication	• Expresses and organizes ideas and information with limited effectiveness. • Uses mathematical language, symbols, and units with limited effectiveness.	• Expresses and organizes ideas and information with some effectiveness. • Uses mathematical language, symbols, and units with some effectiveness.	• Expresses and organizes ideas and information with considerable effectiveness. • Uses mathematical language, symbols, and units with considerable effectiveness.	• Expresses and organizes ideas and information with a high degree of effectiveness. • Uses mathematical language, symbols, and units with a high degree of effectiveness.
Application	• Demonstrates limited skill in the application of the formula.	• Demonstrates some amount of skill in the application of the formula.	• Demonstrates a considerable amount of skill in the application of the formula.	• Demonstrates a high degree of skill in the application of the formula.

Resources and Sources Used in Task Design

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