Differentiating Mathematics Tasks Based on Student Readiness
Facilitator's Guide

Why was this resource developed?

The *Differentiating Mathematics Tasks Based on Student Readiness Facilitator's Guide* is intended to support the facilitator in leading a 3-part professional learning series that:

- increases teachers' Content Knowledge for Teaching Mathematics (CKT-M);
- provides teachers with opportunities to practise selected professional practices related to differentiating instruction;
- develops awareness of factors that were considered by the teacher in the M.J. Hobbs DI video in differentiating mathematics instruction based on student readiness.

What will facilitators find in this resource?

The sessions outlined in this resource provide opportunities to attend thoughtfully to unscripted video footage and to use these records of practice to deepen understanding of how to support development of adolescents' mathematics problem-solving skills.

The goal is to encourage educators to 'pause and ponder' the following:

- indicators, in the *Guide for Administrators and Other Facilitators of Teachers' Learning for Mathematics Instruction,* and their relevance to differentiated instruction
- protocols for analysing classroom video
- connections between class profiles and contexts, and differentiated instructional tasks
- structures and strategies for learning activities that contribute to a classroom climate where fearless listening and speaking are the norm

How does this resource use the Differentiated Instruction Educator's Package?

This 3-part professional learning series includes the 3-lesson instructional trajectory that led to the lesson featured in the M.J. Hobbs video chapter on the DI DVD. This resource helps educators understand how to establish the classroom conditions that resulted in the lesson differentiated based on student readiness level seen on the video.

How might facilitators use this resource?

The *Mathematics GAINS Professional Learning Series (Face-to-Face): DI based on Readiness – Grade 8 Proportional Problems* is designed as a set of three 75-minute workshops-in-a-bag. The sessions are designed for face-to-face interactions.

Opportunities for differentiation of the professional learning are included in each of the three sessions to so participants can experience for themselves various of the key features of differentiation.

Facilitators are invited to select and modify resources according to their role, responsibilities, goals, and time. As is the case in classrooms, knowledge of participants affects all aspects of planning for learning.

It would be possible to use the same three professional learning session outlines with a lesson trajectory and video footage for any grade.

- **Readiness**
  - What prior knowledge, skills, and experiences in intermediate mathematics do participants have?
  - How can facilitators access and link back to this?
  - What are the appropriate immediate next steps?

- **Interests**
  - In which aspects of teaching and learning mathematics are participants interested?
  - On which subjects are they focusing?
  - How do you ensure that their personal learning agendas and school/board/provincial agendas 'talk' to each other?

- **Learning Preferences**
  - How can facilitators model getting to know participants' learning styles and then demonstrate using that knowledge to provide personalized and precisely targeted professional learning opportunities?

75 min

Math Learning Goals

- Experience group problem solving.
- Experience the use of precise indicators as a lens for viewing and analysing classroom video.
- Practise supporting observations of video with evidence from the video.
- Experience differentiation of lens for observation based on choice of indicator.

Materials

- BLM 1.1- 1.5
- 3-day Grade 8 lesson trajectory on Proportional Reasoning
- SSL DI Video Clip – M.J. Hobbs

Minds On…

Whole Group → Orientation

Outline the learning goals for the 3-part professional learning series. Consider using categories such as:

- increasing CKT-M (Content Knowledge for Teaching Mathematics);
- practising professional practices;
- learning about differentiating instruction.

Place cut out cards for lesson 1 problem BLM 1.1 in 1 envelope/group.

Groups of 4 → Problem Solving

Give each group member one of the four clues to the problem on BLM 1.1 (This is the same problem as in Day 1 of the 3-day Grade 8 Lesson Trajectory.).

Preview the video to ensure that you see and hear the samples of evidence of the various indicators, remembering that the sample may show beginning to established implementation.

AforL

Assess for CKT-M/Observation/Mental Note: Groups work collaboratively to solve the problem, and briefly reflect on benefits of such group problem solving.

Whole Group → Discussion

Discuss the benefits of this type of group problem solving, and how it could support differentiated instruction.

Action!

Small Groups → Brainstorm

Distribute Indicators of Evidence Observation Guide (BLM 1.2), and randomly assign different groups different indicators to save time and increase shared accountability.

Each group brainstorms what samples of evidence for their indicator might look or sound like in a Grade 8 mathematics class that is focused on problem solving.

Possible benefits:

- reduces risk;
- scaffolds individual problem solving;
- forces collaborative problem solving;
- sets the stage for aspects of math-talk learning community such as: students explaining their mathematical thinking; being the source of mathematical ideas and taking responsibility for learning.

Large Group → Discussion

Facilitate groups reporting on their examples, guiding them to include descriptions of the actual observables from the video (BLM 1.3). Review the protocols for analysing classroom video (BLM 1.4).

Individual → Observing and Recording

Participants watch the M.J. Hobbs video and record descriptions of the evidence in the Indicators of Evidence Observation Guide (BLM 1.2).

Small Group → Analysis

Participants discuss their observations, observing appropriate protocols.

Consolidate Debrief

Whole Group → Journal

Participants find the indicators used in the Guide for Administrators and Other Facilitators of Teachers' Learning for Mathematics Instruction. Discuss and write about: the variety of types of evidence possible for the same indicator; different teacher readiness levels for certain indicators; indicators that align with participants' current professional learning activities. (See BLM 1.5.)

Practice
Observing
Differentiation
Foreshadowing

Home Activity or Further Classroom Consolidation

Select one indicator from the Guide, not used in today's observation guide, that you think might be observable in the M.J. Hobbs video. Watch this video again and record samples of evidence for your selected indicator.

Read the 3-day Grade 8 lesson trajectory from M.J. Hobbs to identify how activities on Days 1 and 2 prepare students for Day 3.

DI

1.1: Grade 8 Proportional Reasoning Group Problem (Day 1)

Time to Bake

Bejay is going on a hike with his hiking club and is planning to make and take granola bars. The recipe that he uses will feed sixteen people. He has time to shop at only one store for his ingredients.

How many granola bars can Bejay make?

Time to Bake

Bejay went to the store to buy ingredients for his granola bars. The store had plenty of sunflower seeds, honey, and yogurt, but only 260 g of rolled oats, 200 g of raisins, and no dried apples.

How many granola bars can Bejay make?

Time to Bake

Bejay's recipe for granola bars is:

480 g rolled oats
110 g sunflower seeds
100 g dried apple
4 tablespoons of honey
2 tablespoons yogurt
120 g raisins

How many granola bars can Bejay make?

Time to Bake

The recipe calls for dried apple, however the dried apple can be replaced with double the about of raisins if need be.

How many granola bars can Bejay make?

1.2: Indicators of Evidence Observation Guide

Shift from students working in isolation to establishing classroom structures and social skills that enable students to engage in cooperative learning and productive interaction and talk.	
Students increasingly engage in classroom discourse and social interaction to reorganize knowledge, make sense, and make connections.	
Shift attitudes about using tools in making sense of math and demonstrating understanding from just struggling students to all learners and to the extent indicated in the revised Ontario curriculum for mathematics.	
Students increasingly explain and articulate their mathematical thinking.	

1.3: Indicators and Samples of Evidence (Facilitator)

Shift from students working in isolation to establishing classroom structures and social skills that enable students to engage in cooperative learning and productive interaction and talk.	• Students are working in groups, collaboratively solving problems. • Minimal teacher instruction is needed, indicating that students have experience working in groups. • Presence of the anchor chart on the wall suggests that there has been ongoing work on social skills and collaborative work.
Students increasingly engage in classroom discourse and social interaction to reorganize knowledge, make sense, and make connections.	• Students are discussing and explaining their reasoning to solve their problems within the groups. • Students present their solutions to the whole class.
Shift attitudes about using tools in making sense of math and demonstrating understanding from just struggling students to all learners and to the extent indicated in the revised Ontario curriculum for mathematics.	• Students are using manipulatives and technology when solving their problems and when sharing their solutions • Students are expected to appreciate different approaches and comment on them
Students increasingly explain and articulate their mathematical thinking.	• There is student-to-student dialogue in small groups • Students explain their reasoning to the rest of the class

1.4: Video Viewing – Observation Protocols

Observation Protocols	
Observation Goals	**Guiding Principles for Observation**
Collaboratively analyzing records of practice to: **Knowledge and Understanding** • capture examples of what implementation, e.g., of literacy strategies might look, sound, and feel like **Thinking** • focus on learning, rather than teaching • refine observational skills, e.g., define a purpose and sustain a focus, attend thoughtfully and systematically • analyze elements and approaches • make connections • consider context, alternatives, and multiple perspectives • support observations with evidence **Communication** • develop shared understanding and language • use fearless talking and listening • hear all voices • monitor tone, body language, talk time **Application** • support professional reflection on personal practice • support application and transfer to own practice, personalization, contextualization, increased precision	Observations are: • used with reference to the literacy indicators (*Moving Literacies for Learning Forward: Guide for Administrators and Other Facilitators of Teachers' Learning)* • non-evaluative and non-intrusive • efficient, supportive, professional, courteous, sensitive • contextualized • focussed on the lesson goals, students' response to the lesson, and students' learning • supported by evidence • supported by development of local protocols, appropriate permissions from participating teachers, school and board administrators, students and parents, federations

1.5: Excerpt from Guide for Administrators

Indicators of Improving and Using Literacy Knowledge, Skills, and Dispositions

Equity

- A shift from high expectations in mathematics for some learners to explicit communication of high expectations for all learners and provision of strong, scaffolded support, as needed
- A shift from students working in isolation to establishing classroom structures and social skills that enable students to engage in cooperative learning, and productive interaction and talk
- The classroom becomes increasingly inclusive by: reflecting cultural knowledge and practices; supporting anti-discrimination education; appealing to both genders; and valuing knowledge, experiences and literacies all learners bring to school
- A shift from insistence on English as the sole language to acceptance of strategic use of first languages for learning

Curriculum

- A shift from lessons as a series of activities to an instructional trajectory informed by curriculum expectations
- A shift from literacy, social, and learning skills as add-ons to lessons to including these skills as integral goals with curriculum learning goals for lessons
- Increasingly thoughtful selection and use of literacy and learning strategies based on matching underlying structure and principles to concepts and skills
- Increasingly explicit support of metacognitive skill development

Learning

- A shift from rote learning and recall to developing conceptual understanding and making connections
- Students increasingly engage in classroom discourse and social interaction to reorganize knowledge, make sense, and make connections
- A shift from rigid reliance on one strategy and one modality for problem solving to flexibility in approach

Assessment and Evaluation

- The teacher increasingly gauges learning and literacy needs throughout a lesson, and uses this data during consolidation and subsequent planning
- The teacher increasingly provides precise and timely feedback, particularly oral feedback, on progress and targeted support before learning is evaluated
- Students increasingly know learning goals and criteria for assessment and have opportunities to reflect on their progress
- Increasing use of a range of assessment and evaluation tools and strategies
- A shift from individual to collaborative teacher planning, development, and scoring of assessments
- A shift from displaying only commercial products to displaying student work that illustrates a range of performances on a variety of tasks

Learning Tools

- Increasing diversity of approaches, e.g., use of tools and technologies, by all to learn, explore, and communicate understanding
- Increasing focus on problem solving and higher-order thinking by re-allocating time away from skills rendered less necessary by new technological tools
- Increasing respect for and engagement with technological knowledge and skills, and digital backgrounds students bring to school

Teaching

- The teacher increasingly draws flexibly on knowledge and depth of understanding to approach ideas differently with different students in response to their thinking
- Increasing understanding of adolescent literacy development and challenges
- Increasingly thoughtful use of literacy strategies – being explicit and systematic, understanding conditions for effective strategy instruction, modelling, and application
- A shift from fixed seating arrangements to flexible groupings based on different goals and needs
- A shift from rapid fire low-level questions to questions that engage all students in higher-order thinking
- Increasing use of a lesson structure to connect new learning with prior learning and sufficient consolidation

1.5: Excerpt from Guide for Administrators (continued)

Math – Specific Indicators

Curriculum

- A shift in focus from only standard algorithms to also include mental math and alternative algorithms
- Students increasingly take responsibility for learning of others and self. Math sense becomes the criterion for learning.*
- Increasing attention to both cognitive and affective domains – interaction, risk taking, perseverance

Learning Tools

- increasing diversity of approaches (e.g., use of tools and technologies) by all to learn, explore, andd communicate understanding

*The Math-Talk Learning Community Package containing samples of evidence along action trajectories is available at http://www.edu.gov.on.ca/eng/studentsuccess/lms/MathTalk.pdf

Teaching and Learning

- The teacher increasingly draws flexibly on knowledge and depth of understanding to approach ideas differently with different students in response to their thinking
- A shift from a singular approach to one that encourages a variety of solutions and methodologies
- A shift from teacher as questioner to students and teacher as questioners *
- Students increasingly explain and articulate their mathematical thinking *
- A shift from teacher as source of all the math ideas to students' ideas also influencing direction of lesson*
- Increasing knowledge about the challenges students are likely to encounter in learning mathematics
- A shift from teaching and practising skills before application to development of conceptual understanding through rich tasks and the Mathematical Processes before practice:

Problem Solving

Planning an approach

Collecting data connected to the problem

Selecting and applying a problem-solving strategy

Samples of student actions, instructional strategies, sample questions, and feedback are available at http://www.edu.gov.on.ca/eng/studentsuccess/lms/files/tips4rm/TIPS4RMProcesses.pdf

Reasoning and Proving

Hypothesizing and making conjectures

Making inferences, conclusions, and justifications

Reflecting

Considering data collected

Reflecting on new skills, concepts, and questions to see how they connect to prior knowledge

Selecting Tools and Computational Strategies

Knowing when and how to apply mental math skills

Knowing when and how to estimate

Using technology to explore, gather, display, manipulate, and present data

Using tools to develop understanding of new concepts, for communicating, or for performing tasks

Selecting and using different computational strategies, depending on the numbers

Connecting

Making connections between new and prior knowledge

Applying mathematics knowledge and skills to contexts outside mathematics

Making connections among various representations of the same thing

Applying strategies and references from other contexts

Representing

Selecting, forming, and using multiple appropriate representations and defending choices

Understanding that various representations can be used to appropriately represent the same thing

Understanding that there may be different variations of the same representation

Understanding the role of constants and variables

Communicating

Using correct mathematical language and vocabulary

Communicating thinking clearly, logically, and in detail

Communicating thinking orally, visually, kinesthetically, and in writing

Using various representations, e.g., words with diagrams, charts or graphs with verbal descriptions

 75 min	**Math Learning Goals** • Develop/enhance CKT-M through collaboratively solving problems • Practise sorting mathematics problems focused on the same big idea based on access for students at different readiness levels • Experience differentiation based on self-identified readiness (comfort level) • Develop awareness that implementation of DI is a journey and that we are all on a continuum • Practise finding samples of evidence of Mathematical Processes indicators in solving the problems and in the video	**Materials** • BLM 2.1, 2.2 • BLM 1.5 • cubes, pattern blocks • SSL DI video clip – M.J. Hobbs • 3-day Grade 8 lesson trajectory on Proportional Reasoning
Minds On…	**Small Group → Discussion** Share thoughts about the Home Activity from Day 1 (problem numbers removed) for each group examines the problems and places them on a continuum of easiest to most difficult (#1 – simplest… #6 – most challenging) (See BLM 2.1). They share a possible placement with rationale. **Whole Group → Self-Diagnostic and Ranking** Participants form a line based on their comfort level with differentiating instruction on the big ideas of Grade 8 proportional reasoning, discussing their placement choice with teachers on either side and position themselves appropriately (1–very uncomfortable… 6–very comfortable). Form groups of four, with a similar comfort level, from their placement on the line.	Have problems from BLM 2.1 cut out and placed in envelopes. Resources for Ratio and Proportion such as Elementary and Middle School Mathematics, John Van De Walle; Teaching Fractions and Ratios For Understanding, Susan Lamon; Making Math Meaningful, Marion Small
Action! DI	**Groups of 4 → Investigation** **Differentiate content based on self-identified comfort levels of groups:** Each group solves the problem whose question number matches the group's comfort level (BLM 2.1). They refer to the Guide, p. 3 to identify the Mathematical Processes they used to solve their problem. **Whole Group → Discussion** Focus attention on the **Action!** of Day 3, "Groups will be working on different problems based on the group's readiness level. Each student in the group receives one clue, also based on readiness level." Facilitate brainstorm responses to the question: What does a teacher need to know to plan a problem-solving lesson differentiated on student readiness? **Individual → Video Observation** Participants watch the video and record samples of evidence of the Mathematical Processes indicators. (See BLM 2.2.) **Same Groups of 4 → Discussion** Groups discuss observations, observing appropriate protocols. Circulate, ensuring that groups that identify low comfort levels have necessary support.	**Possible Responses:** • big idea of the lesson; • continuum of developing the big idea of the lesson(s); • multiple strategies to solve problems; • students' readiness; • how to pose questions that provide access for students at different readiness stages; • how to consolidate ideas; • student/class profile connected to the content of the problem.
Consolidate Debrief	**Whole Group → Discussion** Representatives from groups share their discussions. Facilitate a discussion about how the teacher in the M.J. Hobbs video differentiated instruction. Possible responses: earlier diagnostic assessment, different problems for different readiness levels, choice of tools, low risk.	
Application Reflection	**Home Activity or Further Classroom Consolidation** Read the Research into Practice monograph: "Student Interaction" available on the Literacy and Numeracy Secretariat website. Be prepared to share something from the article that connects with your thinking, and identify the ways the three Grade 8 lessons support student interaction.	http://www.edu.gov.on.ca/eng/literacynumeracy/inspire/research/Bruce.pdf

2.1: Grade 8 Proportional Reasoning Group Problem Day 3

Wii™ versus Playstation® 15% of M.J. Hobbs seventh graders own a Wii™ gaming system. How many seventh graders are at M.J. Hobbs?	***Wii™ versus Playstation®*** 25% of M.J. Hobbs seventh graders own a Playstation® gaming system. How many seventh graders are at M.J. Hobbs?
Wii™ versus Playstation® 68 M.J. Hobbs seventh graders don't own either a Wii™ nor a Playstation® gaming system. How many seventh graders are at M.J. Hobbs?	***Wii™ versus Playstation®*** No one owns both a Wii™ and a Playstation® gaming system. How many seventh graders own a Wii™ and how many own a Playstation®?

Which Cookie is Healthier? John buys four packages of cookies: oatmeal, shortbread, vanilla, and raisin. The serving size of the oatmeal cookies is 100 g and each cookie has 24.3 g of fat. Which cookie is healthier based on the amount of fat?	***Which Cookie is Healthier?*** The serving size of the raisin cookies is 25 g and each cookie has 5.9 g of fat. Which cookie is healthier based on the amount of fat?
Which Cookie is Healthier? The serving size of the vanilla cookies is 24 g and each cookie has 5.7 g of fat. Which cookie is healthier based on the amount of fat?	***Which Cookie is Healthier?*** The serving size of the shortbread cookies is 75 g and each cookie has 19.8g of fat. Which cookie is healthier based on the amount of fat?

2.1: Grade 8 Proportional Reasoning Group Problem Day 3
(continued)

Tree Planting

Phillip, Josie, Carrie, and Xu wanted to do something for the environment this summer so they decided to plant trees. Xu can plant 7 trees for every 3 that Josie plants.

How many trees can each of the teens plant in 1 minute?

Tree Planting

Josie has been planting trees with her parents the last several years so she has become fairly efficient at it and is able to plant 18 trees in 3 minutes.

Tree Planting

Phillip is able to plant half the number of trees that Josie can plant in double the amount of time and Carrie can plant 4 trees for every 2 trees that Phillip plants.

Tree Planting

The teens each get paid $40 when they have planted 20 trees.

How long will it take each of the teens to make $80?

Between Here and There

Kali is going to visit her friend Carey who lives in Ottawa. Kali realized that on the map Ottawa is 9.1 cm away from her home.

How many times does Kali have to stop for gas on her trip?

Between Here and There

Kali's fuel consumption is 5.3L/100km.

How many times does Kali have to stop for gas on her trip?

Between Here and There

The scale of the map was 1:10 000 000.

How many times does Kali have to stop for gas on her trip?

Between Here and There

Kali's car tank holds 40 L of gas.

How many times does Kali have to stop for gas on her trip?

2.1: Grade 8 Proportional Reasoning Group Problem Day 3
(continued)

Winter Play Day There are 500 students at Pine Ridge Elementary School. How many students went snowboarding?	**Winter Play Day** 75% of the students at Pine Ridge Elementary signed up for Winter Play Day. How many students participated in each event on Winter Play Day?
Winter Play Day $\frac{3}{5}$ of the students who signed up for Winter Play Day actually showed up to participate.	**Winter Play Day** 60% of the students who participated in Winter Play Day went snowboarding; 8% went skiing and the rest of the students went skating.

Patio Stones Kailee and Owen have decided to use patio stones to create a design in their front walkway. They measure the area of the walkway and determine that it is 36 units. What patio stones do Kailee and Owen have to buy? What might their patio look like?	**Patio Stones** When Kailee and Owen go to the store to buy the stones they discover that there are four shapes to choose from. There are yellow hexagons, blue rhombuses, green triangles, and red trapezoids. The green triangle is a sixth of the area of the yellow hexagon, half of the area of the blue rhombus and a third of the area of the red trapezoid. What patio stones do Kailee and Owen have to buy? What might their patio look like?
Patio Stones Owen decides that he wants yellow patio stones to cover $\frac{1}{3}$ of the total area of the design. He also wants the ratio of the area covered by the blue stones to the ratio of the area covered by the yellow stones to be 1:2. What patio stones do Kailee and Owen have to buy? What might their patio look like?	**Patio Stones** Kailee wants to have a colourful patio so she decides that she would like to have some stones of each colour. She decides that the ratio of the area covered by the green stones to that covered by the red stones should be 1:1. What patio stones do Kailee and Owen have to buy? What might their patio look like?

2.2: Mathematical Processes Indicators and Samples of Evidence Observation Guide

Problem Solving • Planning an approach • Collecting data connected to the problem • Selecting and applying a problem-solving strategy	
Reasoning and Proving • Hypothesizing and making conjectures • Making inferences, conclusions, and justifications	
Selecting Tools and Computational Strategies • Using technology to explore, gather, display, manipulate, and present data • Using tools to develop understanding of new concepts, for communicating, or for performing tasks	
Representing • Selecting, forming, and using multiple appropriate representations and defending choices	
Communicating • Using correct mathematical language and vocabulary • Communicating thinking clearly, logically, and in detail • Communicating thinking orally, visually, kinesthetically, and in writing • Using various representations, e.g., words with diagrams, charts or graphs with verbal descriptions	

75 min

Math Learning Goals

- Develop understanding of the aspects of classroom context and class profile needed to group students and to assign problems providing access for students at different readiness stages.
- Discuss and understand how group work can provide an opportunity for students to further develop their individual problem-solving knowledge and skills (cognitive apprenticeship).
- Develop awareness of the samples of evidence along implementation trajectories for the Math-Talk Learning Community indicators in the Guide.
- Experience differentiated working groups (content) based on self-identified interest.

Materials

- BLM 3.1, 3.2
- *Guide for Administrators and Other Facilitators of Teachers' Learning for Mathematics Instruction*

Minds On…

Groups of 4 → Round Robin Discussion

Participants take turns sharing something that connects with their thinking from their reading of the "Student Interaction" article. (See Session 2.) Taking turns again, they identify the ways the three Grade 8 lessons were structured to support student interaction.

Individual → Reading and Highlighting

Participants read the class profile, the class context, and the student groupings information (BLM 3.1). Each group highlights the grouping statements that they would like to discuss.

Groups of 4 → Reading/Sharing

Participants number themselves 1 to 4, and take 2-3 minutes to read the corresponding samples of evidence for one of the four indicators in the Evidence of Math-Talk Learning Community (MTLC): Action Trajectory for Teacher and Student (BLM 3.2).

Group members take turns summarizing their assigned indicator.

Participants take turns sharing, with brief elaboration, highlighted items about student groupings.

Full version of Math-Talk Learning Community available on the LMS website http://www.edu.gov.on.ca/eng/studentsuccess/lms/ResearchSynopses.pdf

Action!

Groups of 4 → Placemat

Participants identify indicators from the Facilitator's Guide that connect with differentiating instruction.

Whole Group → Discussion

Groups share the indicators they have identified.

Facilitate a discussion about aspects of differentiating instruction that the group thinks may be missing from the Guide. Ask:

- Is that aspect one that would be observable in a mathematics classroom?
- Does that aspect need to happen during teacher pre- or post-planning?
- Is there a way to re-word one of the indicators to capture that aspect?

A as L

Individual → Reflection

Participants determine where they are, personally, along the implementation trajectories for each of the four indicators of MTLC, and identify which of those indicators or which other indicator from the Guide they want to work on.

Consolidate Debrief

DI

New Small Groups → Discussion

Differentiate learning groups (content) based on participant choice of indicator.

On chart paper, learning groups identify which DI strategies they could practise to support their area of interest. If working on an indicator from the Guide other than MTLC, ask them to discuss what the four stages of implementation of this indicator might look like (similar to the MTLC trajectories). Post chart paper for participants to read on a gallery walk.

Groups determine their next steps to meet and support each other to move forward in their identified area of interest.

Application
Concept
Practice

Home Activity or Further Classroom Consolidation

Groups meet face-to-face or through Adobe Connect to work on their area of interest.

3.1: Grade 8 Class Context and Groupings

Class Profile

- The class is comprised of 28 students (16 boys and 12 girls).
- Five students in the class have IEPs: one identified with a communication learning disability (autism); one with a multiple identification of behaviour and communication, along with a diagnosis of ADHD and early mood disorder; and three identified with difficulties in both language and mathematics.
- Early in the year a multiple intelligence survey showed that a large number of students in the class are interpersonal, kinesthetic, and visual spatial learners.
- Students have been tested using the PRIME continuum diagnostic in both the Number Sense and Numeration and Patterning and Algebra strands — students range in ability from low phase two to phase five in both of these strands.
- Students are used to coming into class and getting started on their tasks without prompting.

Class Context

- The video was taken in April.
- The class was taught by their homeroom teacher for at least 120 minutes a day for a combination of mathematics and language.
- The homeroom teacher also taught this class science 120 minutes a week.
- Early in the year, to assist all students with social interaction (particularly the autistic child), there was a strong focus on creating anchor charts (TIPS Social Skills Anchor Charts http://www.edu.gov.on.ca/eng/studentsuccess/lms/files/SocialSkills.pdf) using Think/Pair/Share, Graffiti, and other strategies (*Think Literacy, Cross-Curricular Approaches, Grade 7–12*, pp. 152, 66)
- Emphasis was placed on the social skills anchor charts during group work.
- Students had many opportunities to build their learning community by working cooperatively to solve problems.
- Classroom roles and responsibilities, and noise levels were agreed to early in the year.
- Both student participation and student work were observed and assessed.
- A safe learning environment and classroom routines were established early in the year.

Considerations in Forming Student Groupings

1. Individual student readiness in the content area (assessed by a unit diagnostic, exit cards, and quizzes):
   - Students completed a diagnostic assessment prior to beginning this unit to determine their individual readiness for the given content (proportion).
   - Some students were below the expected readiness level for Grade 8.
   - Some students were well above the expected readiness level for Grade 8.
   - Groups remained the same during the two weeks of this unit on proportion.
   - If the unit had lasted longer, groups would have been readjusted using exit cards and quizzes to inform the changes.

3.1: Grade 8 Class Context and Groupings (continued)

2. Student's social skills in group settings (assessed by student interactions with others):
   - Social skills of each student were considered using learning skills assessments.
   - The autistic child in the class was comfortable working with one other particular student. Despite readiness level, these two students were placed in the same group to ensure that the autistic child would contribute to the group task. The problem was altered to meet the needs and readiness of everyone in the group.
   - The student with the multiple identification was placed in a group that was welcoming and away from other students who tended to be distractions. The problem was not altered because the readiness levels matched.

3. Individual student needs/Teacher needs:
   - Students that distracted each other were not placed in the same group.
   - A small group of students was at a readiness level just between groupings — some were placed in the slightly higher level to be challenged; some remained at the slightly lower level to gain confidence in their mathematical abilities, as appropriate.

The Groups

Group 1: Weak understanding of proportion, still having difficulty with percents.

Group 2: Developing understanding of proportion (included student with multiple identification)

Group 3: Good understanding of proportion (included student with autism)

Group 4: Good understanding of proportion

Group 5: Good understanding of proportion

Group 6: Strong understanding of rate, ratio, and proportion; working above grade level; the problems assigned to them were intended to challenge them.

**** Note:** When making groupings you cannot foresee if a student will be absent from class that day. Groupings were made assuming that all students would be present, but with some flexibility for adjustments.

Groups can function with 3 or 5 people if necessary.

When a group is small or struggling, the teacher can spend extra time with them to prompt and guide them. A group consisting of only 2 students can either be eliminated and the two students placed in other groups close to their readiness level or a third student can be moved from a group of 4 students to form two groups of 3 students.

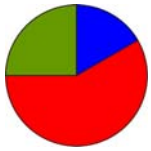
3.2: Evidence of Math-Talk Learning Community: Action Trajectory for Teacher and Student

General Descriptor	**Traditional teacher-directed classroom with brief answer responses from students.**	**Teacher beginning to pursue student mathematical thinking. Teacher plays central role in the math-talk community.**	**Teacher modeling and helping students build new roles. Some co-teaching and co-learning begins as student-to-student talk increases. Teacher begins to physically move to side or back of room.**	**Teacher as co-teacher and co-learner with students. Teacher monitors all that occurs, still fully engaged. Teacher is ready to assist, but now in more peripheral and monitoring role (coach and assister).**
Questioning Shift from teacher as questioner to students and teachers as questioners.	*Teacher is the only questioner. Short frequent questions function to keep students listening and paying attention to the teacher.* Students give short answers and respond to the teacher only. No student-student math talk.	*Teacher questions begin to focus on student thinking and focus less on answers. Teacher begins to ask follow-up questions about student methods and answers. Teacher is still the only questioner.* As a student answers a question, other students listen passively or wait their turn.	*Teacher continues to ask probing questions and also asks more open questions. She also facilitates student-to-student talk, e.g., by asking student to be prepared to ask questions about other students' work.* Students ask questions of one another's work (on the board), often at the prompting of the teacher. Students listen to one another so they do not repeat questions.	*Teacher expects students to ask one another questions about their work. The teacher's questions still may guide the discourse.* Student-to-student talk is student initiated, not dependent on the teacher. Students ask questions and listen to responses. Many questions are "Why?" questions that require justification from the person answering. Students repeat their own or other's questions until satisfied with answers.
Explaining mathematical thinking Students increasingly explain and articulate their math ideas.	*No or minimal teacher elicitation of student thinking, strategies, or explanations; teacher expects answer-focused responses. Teacher may tell answers.* No student thinking or strategy-focused explanation of work. Only answers are given.	*Teacher probes student thinking somewhat. One or two strategies may be elicited. Teacher may fill in explanations herself.* Students give information about their math thinking usually as it is probed by the teacher (minimal volunteering of thoughts). They provide *brief descriptions* of their thinking.	*Teacher probes more deeply to learn about student thinking and supports detailed descriptions from students. Teacher open to and elicits multiple strategies.* Students usually give information as it is probed by the teacher with some volunteering of thoughts. They begin to stake a position and articulate more information in response to probes. They explain steps in their thinking by providing *fuller descriptions* and *begin to defend* their answers and methods. Other students listen supportively.	*Teacher follows along closely to student descriptions of their thinking, encouraging students to make their explanations more complete; may ask probing questions to make explanations more complete. Teacher stimulates students to think more deeply about strategies.* Students describe more complete strategies: they *defend* and *justify* their answers with little prompting from the teacher. Students realize that they will be asked questions from other students when they finish, so they are motivated and careful to be thorough. Others students support with active listening.

3.2: Evidence of Math-Talk Learning Community: Action Trajectory for Teacher and Student (continued)

General Descriptor	Traditional teacher-directed classroom with brief answer responses from students.	Teacher beginning to pursue student mathematical thinking. Teacher plays central role in the math-talk community.	Teacher modeling and helping students build new roles. Some co-teaching and co-learning begins as student-to-student talk increases. Teacher begins to physically move to side or back of room.	Teacher as co-teacher and co-learner with students. Teacher monitors all that occurs, still fully engaged. Teacher is ready to assist, but now in more peripheral and monitoring role (coach and assister).
Source of mathematical ideas Shift from teacher as the source of all math ideas to students' ideas also influencing direction of lesson.	*Teacher is physically at the board, usually chalk in hand, telling and showing students how to do math.* Students respond to math presented by the teacher. They do not offer their own math ideas.	*Teacher is still the main source of ideas, though she elicits some student ideas. Teacher does some probing to access student ideas.* Some student ideas are raised in discussions but are not explored.	*Teacher follows up on explanations and builds on them by asking students to compare and contrast them. Teacher is comfortable using student errors as opportunities for learning.* Students exhibit confidence about their ideas and share their own thinking and strategies even if they are different from others. Student ideas sometimes guide the direction of the math lesson.	*Teacher allows for interruptions from students during her explanations; she lets students explain and "own" new strategies. (Teacher is still engaged and deciding what is important to continue exploring.) Teacher uses student ideas and methods as the basis for lessons and mini-extensions.* Students interject their ideas as the teacher or other students are teaching, confident that their ideas are valued. Students spontaneously compare and contrast and build on ideas. Student ideas form part of the content of many math lessons.
Responsibility for learning Students increasingly take responsibility for learning and evaluation of others and self. Math sense becomes the criterion for evaluation.	*Teacher repeats student responses (originally directed to her) for the class. Teacher responds to student answers by verifying the correct answer or showing the correct method.* Students are passive listeners; they attempt to imitate the teacher and do not take responsibility for the learning of their peers or themselves.	*Teacher begins to set up structures to facilitate students listening to and helping other students. The teacher alone gives feedback.* Students become more engaged by repeating what other students say or by helping another student at the teacher's request. This helping mostly involves students showing how *they* solved a problem.	*Teacher encourages student responsibility for understanding the mathematical ideas of others. Teacher asks other students questions about student work and whether they agree or disagree and why.* Students begin to listen to understand one another. When the teacher requests, they explain other students' ideas in their own words. Helping involves clarifying *other* students' ideas for themselves and others. Students imitate and model teacher's probing in pair work and whole-class discussions.	*The teacher expects students to be responsible for co-evaluation of everyone's work and thinking. She supports students as they help one another sort out misconceptions. She helps and/or follows up when needed.* Students listen to understand, then initiate clarifying other students' work and ideas for themselves and for others during whole-class discussions as well as in small group and pair work. Students assist each other in understanding and correcting errors.

Unit 8: Day 1: Setting the Stage for Group Work (Adjusted Day 4)



Math Learning Goals
- Develop teamwork skills through cooperative learning.
- Apply a variety of problem-solving strategies.
- Justify solutions and choice of strategies.

Materials
- BLM 8.1.1–8.1.3
- manipulatives
- chart paper
- marker

Minds On…

Individual/Pairs/Groups of 4 → Think/Pair/Share

Students individually complete a Group Work Anchor chart (BLM 8.1.1) and compare their responses with a partner. They incorporate any additional ideas into their own charts.

Groups of four brainstorm the characteristics of group work using their anchor charts.

LMS Library, My Professional Practice – Social Skills Anchor Charts

Whole Class → Discussion

Create an anchor chart that the class agrees on using the criteria:
- What does good group work look like?
- What does it sound like?

Discuss the Guidelines for Solving Group Math Problems (BLM 8.1.2).

Create and post a large version of the created anchor chart in the classroom for student reference.

Action!

Small Groups of 4 → Problem Solving

Place students into homogeneous groups using the same readiness level and other grouping considerations.

All groups work on the same problem. Assign each group member a different part of the problem (BLM 8.4.3).

A for L

Learning Skills/Observation/Mental Note: Circulate observing group work, and listening to students, consider clarifications or additions to the anchor chart that can be addressed during **Consolidate Debrief** and the next day's **Minds On…**

Grouping Considerations
- individual student readiness in the content area
- individual student needs with respect to social skills
- group dynamics, cooperative levels of each student
- IEP students, behaviour issues, students who are easily distracted by others

Consolidate Debrief

Whole Class → Discussion

Discuss the problem, its solution, and the anchor chart, calling on as many group members as possible.

Prompting questions:
- How does working on a problem in this way contribute to group work?
- What strategies did your group use to solve the problem?
- How did working in groups help you to understand your problem?
- What strategies might you use the next time you have a group problem?
- How do you know that you have the right answer?

Reflection

Home Activity or Further Classroom Consolidation

In your math journal, describe the thinking and strategies that your group used, and the role that you played to arrive at the solution to the problem. Describe what you might do differently to support your group the next time.

8.1.1: Group Work Anchor Chart

Good Group Work

 Looks Like	 Sounds Like

8.1.2: Guidelines for Solving Group Math Problems

1. Make sure each member of your group has a clue as all clues are specific and needed for the solution of the problem.

2. Read your clue and decide what information is important to the solution of your problem. Determine how your clue might be used in the solution.

3. Share your clue your group, by reading it aloud.

4. Obtain any manipulative that you think might help you to understand or solve your problem.

5. Write the important information from each clue down on chart paper.

6. Everyone in your group must participate in solving the problem.

7. Record how you solved the problem. Use pictures, words, and/or diagrams. Be prepared to share with the class. You may use manipulative models to support your presentation.

If your group agrees that it needs help ask the teacher.

Adapted from "United We Solve" Tim Erickson, eeps media

8.1.3: Group Problem Day 1

Time to Bake

Bejay is going on a hike with his hiking club and is planning to make and take granola bars. The recipe that he uses will feed sixteen people. He has time to shop at only one store for his ingredients.

How many granola bars can Bejay make?

Time to Bake

Bejay went to the store to buy ingredients for his granola bars. The store had plenty of sunflower seeds, honey, and yogurt, but only 260 g of rolled oats, 200 g of raisins, and no dried apples.

How many granola bars can Bejay make?

Time to Bake

Bejay's recipe for granola bars is:

480 g rolled oats
110 g sunflower seeds
100 g dried apple
4 tablespoons of honey
2 tablespoons yogurt
120 g raisins

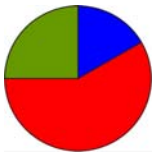
How many granola bars can Bejay make?

Time to Bake

The recipe calls for dried apple, however the dried apple can be replaced with double the about of raisins if need be.

How many granola bars can Bejay make?

Unit 8: Day 2: Group Problem – Mixing Juice (Adjusted Day 5)



Math Learning Goals

- Develop teamwork skills through cooperative learning.
- Apply a variety of problem-solving strategies.
- Solve problems involving proportions and ratios.

Materials

- manipulatives
- class anchor chart – Good Group Work
- BLM 8.2.1, 8.2.2

Minds On…

Whole Class → Discussion/Modelling

Reflect and discuss group work by referring to the anchor chart created on Day 1. Make changes, if appropriate, and stress areas of focus for today's task.

Pose the following:

> Your group is going to make an orange drink from a mix. The recipe calls for 3 scoops of mix to make 2 cups of drink. You want to make 4 cups of orange drink. How much mix do you need to use? How much would you need for 8 cups?

Share ideas on how to set up the data in a table and graph the data.

Refer to TIPS4RM Grade 8 Unit 8 Day 5 Just Graph It; p. 14

Action!

Small Groups → Problem Solving

Place students into the same groups of four on Day 1. Make adjustments for any groups that did not function well or for absent students.

To further establish the learning environment that should be established during group work all groups work on the same question (BLM 8.2.1). Each group member receives one clue.

Review the guidelines for Solving Group Math Problems, as appropriate.

A for L

Mathematical Processes/Observation/Mental Note: Circulate observing group work, and listening to students, noting the variety of approaches used. Share these during **Consolidate Debrief**.

Grouping Considerations
See Day 1.

Consolidate Debrief

Whole Class → Discussion

Students post their solutions. As a class, sort the solutions by ways the problem was solved. This provides an opportunity for students to see the work of other groups and to note the similarities and differences in their strategies. Students ask each other questions about their strategies.

Discuss and summarize the properties of graphs showing a proportional relationship.

Since the same problem is given to all students in the class, you could begin by having students with the same clue discuss it to gain a better understanding prior to moving to their working groups.

Application
Concept
Practice

Home Activity or Further Classroom Consolidation

Complete the Worksheet.

Provide the Worksheet, Tea Time from TIPS4RM Grade 8 Unit 8 Day 5, p. 17.

8.2.1: Group Problem Day 2


Juice for All

You are helping to organize an Earth Day event for your class and their families. You think that 150 people will take part.

How many cans of mix do you need to buy?


Juice for All

Each person at the Earth Day event will drink 1200 mL of juice throughout the event.

How many cans of mix do you need to buy?


Juice for All

Each can of mix holds 50 scoops. You need 3 scoops of mix to make 2 cups of juice.

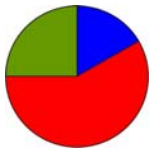
How many cans of mix do you need to buy?


Juice for All

One cup of juice is about 300 mL.

How many cans of mix do you need to buy?

Unit 8: Day 3: Group Problems – Proportions (Adjusted Day 6)



Math Learning Goals

- Develop teamwork skills through cooperative learning.
- Apply a variety of problem-solving strategies.
- Solve problems involving proportions and ratios.

Materials

- manipulatives
- class anchor chart – Good Group Work
- BLM 8.3.1–8.3.6

Minds On…

Whole Class → Four Corners

Choose four indicators that students need to improve on. Post one indicator from the Group Work Anchor charts, in a corner of the room.

Students go to the corner that has the criteria they want to work on.

Students in each corner share strategies that they will use to improve their group work skill.

Groups of Four → Frayer Model

Groups of four complete a Frayer Model for Proportional Relationships.

Think Literacy Cross Curricular Approaches, Mathematics, pp. 106, 41

Action!

DI

Small Groups → Problem Solving

Review the Guidelines for Solving Group Math Problems (BLM 8.1.2).

Differentiate content (problem) based on readiness: Place students into the same groups of 4 as in Day 2. Make adjustments to any groups with members not at the same readiness level, not functioning well, or if students are absent.

Groups work on different problems based on the group's readiness level. Each student in the group receives one clue for a problem, also based on readiness level (BLM 8.3.1 –8.3.6) that they share with the group members and use in determining the answer to the problem.

Grouping Considerations
See Day 1.

AoL

Curriculum Expectations (Proportional Reasoning)/Observation/Mental Note:
Circulate observing group work, and listening to students. Provide support and extension using prompting questions, as required.

Consolidate Debrief

Whole Class → Discussion

Groups share their methods for solving their problem.

Ask probing questions of groups where you observed aspects of proportional reasoning needing clarification or consolidation.

Students discuss how confident they are in their answer and what they could do to increase their confidence.

Application
Differentiated

Home Activity or Further Classroom Consolidation

Complete the assigned questions.

Assign appropriate questions on rate, ratio, and proportion by readiness.

8.3.1: Problem: Group 1

Wii™ versus Playstation® 15% of M.J. Hobbs seventh graders own a Wii™ gaming system. How many seventh graders are at M.J. Hobbs?	***Wii™ versus Playstation®*** 25% of M.J. Hobbs seventh graders own a Playstation® gaming system. How many seventh graders are at M.J. Hobbs?
Wii™ versus Playstation® 68 M.J. Hobbs seventh graders don't own either a Wii™ nor a Playstation® gaming system. How many seventh graders are at M.J. Hobbs?	***Wii™ versus Playstation®*** No one owns both a Wii™ and a Playstation® gaming system. How many seventh graders own a Wii™ and how many own a Playstation®?

8.3.2: Problem: Group 2

Which Cookie is Healthier?

John buys four packages of cookies: oatmeal, shortbread, vanilla, and raisin. The serving size of the oatmeal cookies is 100 g and each cookie has 24.3 g of fat.

Which cookie is healthier based on the amount of fat?

Which Cookie is Healthier?

The serving size of the raisin cookies is 25 g and each cookie has 5.9 g of fat.

Which cookie is healthier based on the amount of fat?

Which Cookie is Healthier?

The serving size of the vanilla cookies is 24 g and each cookie has 5.7 g of fat.

Which cookie is healthier based on the amount of fat?

Which Cookie is Healthier?

The serving size of the shortbread cookies is 75 g and each cookie has 19.8g of fat.

Which cookie is healthier based on the amount of fat?

8.3.3: Problem: Group 3

Tree Planting Phillip, Josie, Carrie, and Xu wanted to do something for the environment this summer so they decided to plant trees. Xu can plant 7 trees for every 3 that Josie plants. How many trees can each of the teens plant in 1 minute?	**Tree Planting** Josie has been planting trees with her parents the last several years so she has become fairly efficient at it and is able to plant 18 trees in 3 minutes.
Tree Planting Phillip is able to plant half the number of trees that Josie can plant in double the amount of time and Carrie can plant 4 trees for every 2 trees that Phillip plants.	**Tree Planting** The teens each get paid $40 when they have planted 20 trees. How long will it take each of the teens to make $80?

8.3.4: Problem: Group 4

Between Here and There

Kali is going to visit her friend Carey who lives in Ottawa. Kali realized that on the map Ottawa is 9.1 cm away from her home.

How many times does Kali have to stop for gas on her trip?

Between Here and There

Kali's fuel consumption is 5.3L/100km.

How many times does Kali have to stop for gas on her trip?

Between Here and There

The scale of the map was 1:10 000 000.

How many times does Kali have to stop for gas on her trip?

Between Here and There

Kali's car tank holds 40 L of gas.

How many times does Kali have to stop for gas on her trip?

8.3.5: Problem: Group 5

Winter Play Day There are 500 students at Pine Ridge Elementary School. How many students went snowboarding?	**Winter Play Day** 75% of the students at Pine Ridge Elementary signed up for Winter Play Day. How many students participated in each event on Winter Play Day?
Winter Play Day $\frac{3}{5}$ of the students who signed up for Winter Play Day actually showed up to participate.	**Winter Play Day** 60% of the students who participated in Winter Play Day went snowboarding; 8% went skiing and the rest of the students went skating.

8.3.6: Problem: Group 6

Patio Stones

Kailee and Owen have decided to use patio stones to create a design in their front walkway. They measure the area of the walkway and determine that it is 36 units.

What patio stones do Kailee and Owen have to buy? What might their patio look like?

Patio Stones

When Kailee and Owen go to the store to buy the stones they discover that there are four shapes to choose from. There are yellow hexagons, blue rhombuses, green triangles, and red trapezoids. The green triangle is a sixth of the area of the yellow hexagon, half of the area of the blue rhombus and a third of the area of the red trapezoid.

What patio stones do Kailee and Owen have to buy? What might their patio look like?

Patio Stones

Owen decides that he wants yellow patio stones to cover $\frac{1}{3}$ of the total area of the design. He also wants the ratio of the area covered by the blue stones to the ratio of the area covered by the yellow stones to be 1:2.

What patio stones do Kailee and Owen have to buy? What might their patio look like?

Patio Stones

Kailee wants to have a colourful patio so she decides that she would like to have some stones of each colour. She decides that the ratio of the area covered by the green stones to that covered by the red stones should be 1:1.

What patio stones do Kailee and Owen have to buy? What might their patio look like?