Differentiated Instruction Teaching/Learning Examples

GRADE 10 MATHEMATICS, APPLIED (MFM2P): INTRODUCTION TO SOLVING LINEAR SYSTEMS

One 70–75 minute period

1. Pairs Comparison (Identifying Similarities and Differences, Setting Objectives and Providing Feedback)*
2. Choice Board**
3. Group Discussion
4. Exit Cards (Setting Objectives and Providing Feedback)*
5. Tiered Assignments**

*Marzano's Categories of Instructional Strategies (See Resources, below)
**Differentiated Instruction Structure

DIFFERENTIATED INSTRUCTION DETAILS

Knowledge of Students

Differentiation based on student:
☑ Readiness ☑ Interests ☑ Preferences:
☐ Styles ☐ Intelligences ☑ Method and tools for solving ☐ Other (e.g., environment, gender, culture)

Need to Know

- Student interests
- Each student's level of readiness to create and solve a real-life linear system that results in a point of intersection

How to Find Out

- Use interest surveys and/or knowledge of students from informal conversations, or formal math talk during prior lessons, to guide development of Choice Board activities
- Prior to the Tiered Assignments, observe students to determine their readiness to create and solve a real-life linear system that results in a point of intersection. Use the Linear Systems Assessment Checklist (Appendix B) as a pre-assessment.

Differentiated Instruction Response

☑ Learning materials (content) ☑ Ways of learning (process) ☐ Ways of demonstrating learning (product) ☐ Learning environment

CURRICULUM CONNECTIONS

Overall Expectation: Modeling Linear Relations

- Solve systems of two linear equations and related problems that arise from realistic situations

Specific Expectations:

- Determine graphically the point of intersection of two linear relations
- Solve problems that arise from realistic situations described in words or represented by given linear systems of two equations involving two variables, by choosing an appropriate algebraic or graphical method

Learning Goals:

- Given graphs of various relations, graphically determine the point of intersection
- Solve problems that arise from a realistic situation represented by two linear relations with fractional solutions or solutions with large numbers

ASSESSMENT AND EVALUATION

Assessment/Success Criteria

Thinking
- Reflecting≠: Assesses the effectiveness of a problem solving strategy used and proposes alternative strategies
- Reflecting≠: Judges the reasonableness of his or her results

Communication
- Communicating≠: Explains and justifies solutions orally, visually and/or in writing

Application
- Connecting≠: Makes connections between the point of intersection and a real world context
- Connecting≠: Creates a model (e.g., algebraic, graphical, numerical) for a linear relation

≠ Mathematical Process

Assessment Tools:

- Checklist
- Anecdotal Comments

PRIOR LEARNING

Prior to this lesson, students will have:
- Experience identifying and interpreting a point of intersection graphically
- An understanding of how to represent linear relations graphically and algebraically
- Experience using a variety of strategies and tools for solving rate of change problems (e.g., reading information from a graph, creating a graph, substituting values into an equation, using manipulatives to investigate patterns, and using charts or tables)

MATERIALS AND RESOURCES

Materials:

For Minds On Comparison task: provide linking cubes, Garbage Bag Cut-Outs (Appendix A2), colour tiles, pattern blocks, algebra tiles
Graph paper, chart paper
Graphing calculator, scientific calculators

Appendix A1: Comparing Wasty Wally to Enviro Joe—one per pair
Appendix A2: Garbage Bag Cut-Outs for Comparing Wasty Wally to Enviro Joe—one per pair
Appendix B: Linear Systems Assessment Checklist—one for teacher reference
Appendix C1: Choice Board (Column 1, Fractional Solutions)—one per student
Appendix C2: Choice Board (Column 2, Very Large Solutions)—one per student
Appendix D: Linear Systems Exit Card—one per student
Appendix E: Tier 1 Assignment—as needed
Appendix F: Tier 2 Assignment—as needed
Appendix G: Tier 3 Assignment—as needed

Internet Resource:

Ministry of Education (2008). *The Ontario Curriculum Grades 9–12, Environmental Education Scope and Sequence of Expectations*. www.edu.gov.on.ca/eng/curriculum/secondary/environ9to12curr.pdf

Resource:

Ministry of Education (2005). *The Ontario Curriculum, Grades 9 and 10: Mathematics*.

ISBN 978-1-4249-8987-4

Teaching/Learning Sequence: Grade 10 Mathematics, Applied (MFM2P)—Introduction to Solving Linear Systems

MINDS ON
- Establishing a positive learning environment
- Connecting to prior learning and/or experiences
- Setting the context for learning

CONNECTIONS
L: Literacy
ML: Mathematical Literacy
AfL, AoL: Assessment for/of Learning
EE: Environmental Education

Pairs → Comparison: Wasty Wally and Enviro Joe
Students:
- Work in pairs to complete Comparing Wasty Wally to Enviro Joe (Appendix A); see the Materials and Resources section on the reverse of this folder
- Solve Part C in as many ways as possible and record one solution on chart paper

Circulate while students work in pairs to observe whether they can reflect on the effectiveness of their problem solving strategies and propose alternate solutions. See Linear Systems Assessment Checklist (Appendix B).

AfL: Mathematical Processes—Reflecting and Connecting/ Comparison/Checklist

Whole Class → Discussion (Similarities and Differences)
Post chart paper in categories according to how the students solved the problem (e.g., using manipulatives, using a table/patterning/guess and check, using a graph).

Discuss similarities and differences in the solutions, as well as the applicability of each type of solution to other problems.

ACTION
- Introducing new learning or extending/reinforcing prior learning
- Providing opportunities for practice and application of learning (guided → independent)

Individuals → Choice Board
Students work independently to solve two problems, one from each column of a Choice Board (Appendices C1 and C2), to discover the ineffectiveness of solving a system of linear relations by graphing when the solution is fractional (Appendix C1, Column 1) or very large (Appendix C2, Column 2).

ML: Reflecting

Problems for the Choice Board should be matched to the specific interests of students in the class.
Ensure that any problems added to Column 1 have fractional solutions and problems added to Column 2 have solutions with large numbers that are not easy to graph.

Note: If some students in the class solve the problem using another more accurate method (instead of graphically), encourage them to connect their solution to a graphical representation of the problem and instead answer the question, "When would a graphical solution be better than their solution?"

CONSOLIDATION AND CONNECTION
- Helping students demonstrate what they have learned
- Providing opportunities for consolidation and reflection

Group → Choice Board Solution Discussion
When students have completed their question from Column 1, have them form a group with the other students in the class who solved the same problem and compare their solutions. Prompts for student discussion include the questions:
- Are our answers *exactly* the same?
- Does our answer seem reasonable?
- Do we think this problem can be solved in a different way?
- What challenges did we have when solving this problem?

Note: Students should conclude that solving by graphing is not accurate or efficient for solving the problems given and they should be asking for/looking for "a better way." This leads into a subsequent lesson on solving systems algebraically.
Repeat the above for the Column 2 problem.

ML: Communicating, Representing

Listen to student responses to determine whether students can judge the reasonableness of their results; ask them what results would not have made sense and why. See the Linear Systems Assessment Checklist (Appendix B).

AfL: Mathematical Processes—Reflecting and Communicating/ Choice Board Solution Discussion/ Checklist

Individuals → Exit Cards
Students complete a Linear Systems Exit Card (Appendix D) based on their group discussion.
Information from the Exit Cards and from observation of student work in the above activities will be used to inform the Tiering for student practice.

AfL: Exit Cards/ Checklist

Individuals → Tiered Assignments
Practice questions are tiered and provided in Appendices E, F and G. The tiers provide varying amounts of guidance and different points of entry. The questions differentiate the way students learn (process) and are based on student readiness. The problems posed by students from this practice can be used as examples in lessons taught throughout the unit.

Collect the Tiered Assignments and assess student work to ensure students are reading and interpreting the point of intersection correctly. Provide students with feedback through written comments or student-teacher conferences.

AfL: Tiered Assignments/ Anecdotal Comments

Extension
Whole Class → Discussion
Facilitate a discussion on lifestyle choices and their impact on the environment.

EE: Grade 9 Geography, Applied—Relate current lifestyle choices of Canadians to the prospects for sustaining Canada's economic and environmental well-being