

An Annotated Learning Journey within a Grade 9 Applied Mathematics Classroom

Setting the Context: Grade 9 MFM1P

Ontario Catholic School Graduate Expectations: 2b, 2c, 3e, 4c

Gospel Values/Virtues: Excellence, Hope, Community, Love

Learning Skills and Work Habits: Responsibility, Initiative, Self-Regulation, Organization, Independent Work

Curricular Learning Goals: Strand - Number Sense and Algebra

I can solve problems involving proportional reasoning in various contexts using a variety of strategies.

I can solve problems requiring the expressions of percents, fractions, and decimals in their equivalent forms.

The educator wonders...

"How might this experience strengthen each child's own self-efficacy toward mathematical thinking and establish a strong Catholic learning community?"

How might an assessment of learning task be designed to reach each student's needs as well as allowing students to demonstrate connections between proportional reasoning and authentic contexts?

How might this task be designed to be engaging for every student?

How might students be involved in the assessment process to increase engagement and responsibility?"

Planning with the end in mind:

Designing a learning journey that will allow students to:

- explore big ideas in mathematics,
- practice skills over time with possibilities for feedback in order to improve,
- engage in relevant learning to make connections to everyday life,
- demonstrate learning at an endpoint

...requires a plan that recognizes and respects the needs of each student. Offering choice to students as a way to demonstrate their learning empowers each student to choose a task they feel will validate their thinking.

Revealing the educator's intentional decisions to allow for student-centred collaborative inquiry:

- "Providing choice for students is an intentional decision I make to engage students in relevant learning.
- Describing what success looks like together is an essential component in our learning community.
- Respecting the needs, interests and differences of each student is valued in my classroom.
- If I feel I need help from colleagues, I will ask for help.
- There should be no mystery in the classroom. I want to know how students are progressing over time. Observation, listening and conferencing will help me get to know my students.
- We are co-learners. We will help each other. We will celebrate learning."

Revealing the educator's thinking:

"As an educator of mathematics it is essential to make mathematics relevant for every student, particularly at the Applied level. Providing students with concrete examples to illustrate that proportional reasoning is a skill inherent in everyday life was the first step in the introduction of this learning experience. It would have been easy to use a test as an assessment of learning, but I felt it was important to use a series of tasks that reflected the widespread applications of proportional reasoning. Accommodations specified in Individual Education Plans, such as, chunking and extra-time can easily be respected."

Assessment for, as and of Learning:

It is a misconception held by some educators that providing choice within an assessment of learning means that multiple rubrics need to be generated. This learning experience shows that the same rubric can be used for four different tasks with the same learning goals and anchored on the same big ideas of proportional reasoning. The specific topic may be different but the concepts can be witnessed within the student thinking. The more important assessment principle is that students come to hold a vision of quality that is held by the educator. Describing success needs to be transparent so no student is guessing; no student is held at a disadvantage.

The Learning Experience:

An assessment of learning task involving choice:

Students had the choice of four different tasks:

- 1) The first task involved students creating a scale diagram of the tiled floor in the classroom. This involved selecting an appropriate scale factor as well as using unit rate and percents in order to calculate the total cost.
- 2) The second task involved students bringing in a photograph of a hockey rink. Students researched the actual dimensions in order to calculate the scale factor. They had to determine how much paint would be required to paint the blue lines as well as the cost including tax. Other choices were offered, such as, a soccer field, a football field or a tennis court.
- 3) The third task involved creating a scale diagram of the windows in the Learning Commons and subsequently determining the cost of replacing the glass.
- 4) The fourth task involved using proportional reasoning to create a piece of art work. Students worked through the process of gridding and painting with the Art Teacher. Calculations were completed to demonstrate scale factor and the impact of discounts and taxes.

These tasks should take three to five 75-minute blocks.

Students were given multiple opportunities to explore and practice the learning goals prior to the introduction of the rich assessment task. Students were given choice of manipulatives to explore concepts.

Student choice is a vital element to promote engagement.

Activation:

In preparation for the rich assessment task (i.e. assessment of learning) students worked on a series of problems involving the calculation of scale factor, percentage discounts and sales tax.

They were also shown a video entitled Nature by Numbers: Fibonacci Sequence and The Golden Ratio http://www.youtube.com/watch?v=aB_KstBiou4 This video explained the presence of the Golden Ratio everywhere, particularly in art and nature.

Once students had been exposed to a variety of applications, they were given the list of suggested tasks and a blank rubric that would be co-constructed as a class.

Co-constructing the Rubric: Once students had selected their task and had started working on it, the rubric was co-constructed. As a class, students described what each of the components should look like in order to achieve levels 2, 3 and 4. There were four different components of the project that were included in the rubric. Criteria included scale factor, unit rate, percent and proportions. Students were given time to think about what evidence of learning would look like under each criterion.

What is the impact of co-constructing the rubric?

The success criteria that educators envision are not always what students understand. The process of co-constructing criteria helps ensure students understood what is expected of them and subsequently to focus them in their task completion.

For educators, the process highlights misconceptions or gaps in understanding that can be addressed before the final task completion. This supports differentiation and personalization for each student.

Working on it:

Task 1: Some students chose to retiling the classroom. This project involved drawing a scale diagram of the classroom floor that showed the number of tiles that would be required. Calculations determining costs also had to be evident.

Task 2: Many students chose to bring a photograph of a sporting venue like a hockey rink or a soccer field. They had to calculate the scale factor between the photograph and the actual venue. Using that scale factor, they had to perform calculations required to determine the cost of painting the lines that appear. These calculations also included a discount in price and sales tax.

Task 3: This option was not chosen by a student.

Task 4: Several students chose to complete the "Art" project. This project had students selecting a photograph that they would like to enlarge and paint on a canvas. Students worked with the Art teacher. In order to allow for collaboration much of the work was completed during the lunch break. The Art teacher used direct instruction to show students how to complete gridding. They learned how to complete the gridding process which was used to enlarge objects proportionally. They also had to track quantities of paint and materials used in order to perform calculations to demonstrate understanding of scale factor and tax.

A Glimpse of Student Thinking:

To honour the thinking of each student, it is imperative that they be given multiple opportunities to demonstrate their learning in a variety of ways in order to show growth over time. Observations, conversations and written products, aligned to learning goals and success criteria, are gathered and documented by educators and students.

Conferencing with Students

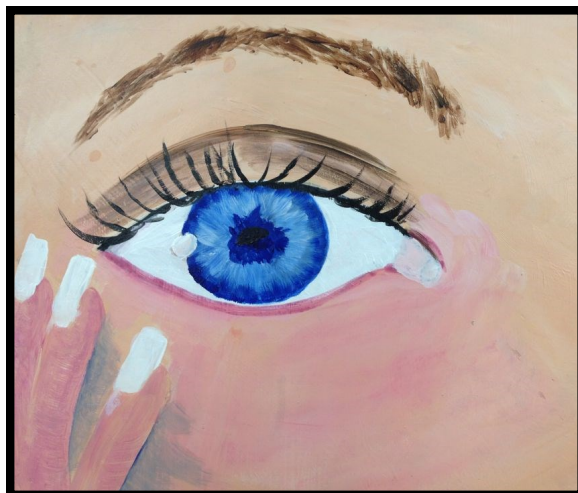
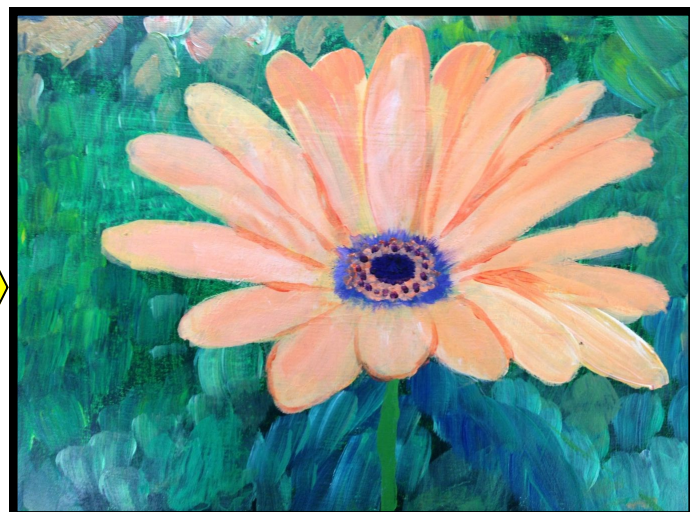
"While working on their task, conferences were set up where they showed me their photograph, if applicable or their work in progress. This was important since it provided students with a scaffold approach to breakdown the steps of the task. It also provided students with an opportunity to ask any questions before the measurement and calculation component started.

As students worked on the non-art projects, I was observing and listening to their conversations. It was interesting when students who had similar photographs got different scale factors. At first they argued and said the other was incorrect, but then they looked at the math and realized they were both right. Since the photographs were not exactly the same, their answers should be different. These debates provided for rich learning opportunities.

Another pivotal moment occurred when a group of boys had to convert feet into meters in order to have matching units. Although this concept was not a direct course expectation, they realized they could use an internet search to find the conversion factor and then a proportion to calculate the answer.

Based on the criteria established together in class, students were given opportunities to give each other peer feedback. The conferencing plus the feedback allowed students to work to their potential on this assessment of learning task. I overheard students saying they were proud to hand in this work."

Student work:
Proportional Reasoning
found in the creative art
process representing
nature.



Consolidation:

This series of tasks highlighted many different opportunities for learning for both educators and students. Offering students choice based on personal interest, for example, including hockey, football, art or design photos increased their level of engagement. The students who completed the "Art" task demonstrated a significantly high level of engagement. They were surprised that this task would be offered as a choice in the mathematics class. They were even more surprised to actually explore all the necessary mathematical concepts needed to complete the task.

Time was given for students to share their work with other students. Discussion about common big ideas helped to consolidate learning goals. All the tasks helped illustrate that proportional reasoning is everywhere and very relevant to their own interests.

For educators, these learning experiences reinforced the concept that the co-construction of success criteria within rubrics is essential to ensure the transparency of learning. This learning journey helped affirm the power of cross-curricular collaboration between educators. The art choice would not have occurred if the Art educator had not been willing to facilitate its completion.

In the best possible scenario, an assessment of learning, which traditionally is seen as an endpoint, may become a sacred moment. When students are given choice in the manner in which they demonstrate their learning and then this learning is shared with others, curiosity, mystery and awe can be the by-products of the learning.

Celebration of the efforts of others builds a climate of respect where students realize the gifts of each student and perhaps realize a longing for their own potential. In this case, students were so impressed with the artwork of their peers they were interested in the process and, if given a second choice, expressed an interest to redo the task!

During consolidation the educator engaged students in mathematical discourse about proportional reasoning regardless of the task each student chose. A variety of student work provided insights into the big ideas.

Reflection:

Everyone benefits when the process is transparent by establishing the learning goals, the success criteria and building the rubric together. Making the criteria 'come alive' to everyone occurs by using exemplars and allowing students to practice pinpointing the strengths, areas of improvement and next steps in student work.

A culture of 'supporting each other towards a final learning destination' was created in this course. From teacher-student conferencing to peer and self assessment before submission of the final product, student work could be refined and improved in order to put forth the best possible demonstration of learning.

Deep observation and listening to students is so important. As a student *receiving* the feedback, it will help identify any errors that may be present. As a student *providing* the feedback, it will confirm understanding of the concept. As an educator, observation of the peer feedback given will help identify any misconceptions that students may have. Opportunities to confer with students periodically throughout the process will help to close gaps.

For students to 'demonstrate a confident and positive sense of self and respect for the dignity and welfare of others' (CGE 4a), the role of peer and self-assessment can be an important process to foster feelings of efficacy.

Learning how to give specific, descriptive feedback in a respectful and empathetic manner needs to be modelled and practised.

The timing of feedback needs to be planned. Although opportunities for feedback should be on-going, giving students an opportunity to respond to feedback prior to an assessment of learning deadline is critical to ensure a student's best possible demonstration of learning.

Next Steps:

Metacognition should always be at the heart of learning. The learning does not stop at the end of an assessment of learning. Although time always seems to be scarce, a moment to reflect back on the learning goals - both curricular, learning skills and work habits, as well as the impact on the learning environment - is well worth the time.

Student Voice: Asking students for their feedback is an important component of the educator's reflection as well, especially when a new strategy has been attempted. What did they like? What would they change? What would they add?

Student Voice: a tool to build relationships. "Schools that have struggled with student engagement and achievement are finding that utilizing student voice as a whole school approach can shift the culture from a deficit focus to a growth mindset. In the schools that are exploring student inquiry as a way to enhance voice and engagement, educators are finding that their students are more focused and that student learning is exceeding their expectations." *Natural Curiosity*, 2011

An Annotated Learning Journey within a Secondary Classroom

Contextual Information

Grade 9 Applied Mathematics, MFM1P: Strand—Number Sense and Algebra

Anchoring on the Big Ideas of Proportional Reasoning:

1. Knowing the measurements of one shape can sometimes provide information about measurements of another shape.
2. Numbers are compared in many ways. Sometimes they are compared to each other; other times, they are compared to benchmark numbers.

Overall Expectations:

Solve problems involving proportional reasoning.

Specific Expectations

- Solve problems involving ratios, rates, and directly proportional relationships in various contexts (e.g., currency conversions, scale drawings, measurement), using a variety of methods (e.g., using algebraic reasoning, equivalent ratios, a constant of proportionality; using dynamic geometry software to construct and measure scale drawings);
- Solve problems requiring the expression of percents, fractions, and decimals in their equivalent forms (e.g., calculating simple interest and sales tax; analyzing data).

Connecting the Mathematical Processes to Curricular Goals:

Reasoning and Proving: develop and apply reasoning skills to make mathematical conjectures, assess conjectures, and justify conclusions, and plan and construct organized mathematical arguments;

Reflecting: demonstrate that they are reflecting on and monitoring their thinking to help clarify their understanding as they complete an investigation or solve a problem;

Connecting: make connections among mathematical concepts and procedures, and relate mathematical ideas to situations or phenomena drawn from other contexts;

Representing: create a variety of representations of mathematical ideas, make connections and compare them, and select and apply the appropriate representations to solve problems;

Communicating: communicate mathematical thinking orally, visually, and in writing, using mathematical vocabulary and a variety of appropriate representations, and observing mathematical conventions.

Developing Ontario Catholic School Graduate Expectations:

An Effective Communicator who:

CGE2b: Reads, understands and uses written materials effectively.

CGE2c: Presents information and ideas clearly and honestly and with sensitivity to others.

A Reflective and Creative Thinker who:

CGE3e: Adopts a holistic approach to life by integrating learning from various subject areas and experience.

A Self-Directed, Responsible, Life Long Learner who:

CGE4c: Takes initiative and demonstrates Christian leadership.

Cross-Curricular Links: Visual Arts

Creating and Presenting: Overall Expectation A3

Produce artworks, using a variety of media/materials and traditional and/or emerging technologies, tools, and techniques, and demonstrate an understanding of a variety of ways of presenting their works and the works of others.

The Power and Gift of Collaboration

The power of collective capacity is that it enables ordinary people to accomplish extraordinary things, for two reasons. One is that knowledge about effective practice becomes more widely available and accessible on a daily basis. The second reason is more powerful still — working together generates commitment.

All Systems Go: The Change Imperative for Whole System Reform. Fullan, 2010

*How might educators leverage the power of collaboration to design a faith-based professional learning community?

Key Ideas: The power of 'Co'

- **Collaboration** supports professional dialogue and mitigates feelings of isolation and being overwhelmed by the complexity of education,
- **Co-planning** supports the deconstruction of curriculum to align the big ideas and cluster the expectations,
- **Co-planning** supports the mindfulness of intentionally considering both instructional and assessment strategies in order to envision what students need to know, do and communicate, while strategically incorporating student voice and choice for their own learning,
- **Co-designing** rich, authentic learning experiences allows educators to engage and invite all students to learning opportunities,
- **Co-teaching** allows educators to work as learning partners in order to listen and deeply observe students at work in order to learn from their interactions and use this feedback to make responsive instructional decisions,
- **Co-assessing** or moderating student work helps educators calibrate their thinking about how evidence of learning aligns with success criteria. The process allows educators to bring problems of practice to the table, valuing the collective experience and knowledge of the group to find solutions to challenges,
- Developing **common** assessments as diagnostic tools or for assessment of learning allows educators to reveal the thinking of their students within a community of learners,
- **Co-generational** learning highlights the significance of students as **co-learners** and establishes relational trust with educators in this technological era,
- **Co-regulating** the understanding of knowledge and skills through the **co-construction** of criteria and the ongoing negotiation of meaning to check for misconceptions creates a transparency in the learning process that allows each student to achieve.

*EOCCC. (2013). **Seeing Through the Eyes the Jesus: Growing Success for Students in Catholic Schools, Grades 1 to 12**, pg. 36-37.

Making the Learning Transparent

*Success for All is Constructed by Describing Success:

“Students and educators work collaboratively to answer the questions, “What does success look like?” and “What evidence will we gather to show that we have learned?” This involves:

- Learning taking place in a risk-free learning environment where attempts, misconceptions, or errors are seen as opportunities for growth rather than mistakes,
- Providing students with opportunities to show what they already know by activating prior knowledge,
- Sharing and clarifying learning goals with students in order to engage students in the vision of the learning.
Note: Learning goals do not always have to be shared at the beginning of a cycle of learning! When students are engaged in inquiry learning, learning goals may be co-constructed during the consolidation phase of a learning period (i.e. What have we discovered through our inquiry?),
- Engaging students in describing success by comparing and contrasting samples of varying degrees of quality,
- Co-constructing success criteria in the consolidation phase of the process of comparing and contrasting samples,
 - **The Process of Co-constructing Criteria:
 - Brainstorm with students the criteria for success or exemplary work;
 - Sort and classify the criteria;
 - Rework the criteria by creating a T-chart that is used as an anchor chart/reference guide/checklist;
 - Revisit and refine as needed.
 - The co-constructed criteria become the foundation for ongoing feedback as well as peer and self-assessment. The final rubric is dependent on the criteria co-constructed by the teacher and the students.
- Allowing students to suggest how they may best demonstrate their learning based on the learning goals and success criteria and then working with them to design rich learning experiences,
- Intentionally choosing instructional strategies that match the needs of the whole group as well as targeted groups of students and individual needs. (e.g. modelled-shared-guided-independent practice, inquiry learning, explicit teaching, small group instruction)
- Using guiding questions to promote students’ understanding, reveal thinking, encourage reflection based on the success criteria,
- Collaboratively creating learning walls and respectfully using samples to show progression of improvement based on success criteria,
- Explicitly modelling how to give feedback using the co-constructed criteria,
- Providing feedback that is timely, specific and includes what was done well and what needs improvement with specific suggestions for improvement. Feedback is focused on the greatest need, is manageable and personalized for each student,
- Celebrating each small success and using feedback to encourage another small step forward.”

*EOCCC. (2013). *Seeing Through the Eyes the Jesus: Growing Success for Students in Catholic Schools, Grades 1 to 12*, pg. 50-52

**C. Cameron, and A. Davies. (1996). *Setting and Using Criteria* K. Gregory, Connections Publishing. pg.7, 8, 11, 13.

Differentiating Instruction

*Differentiated Instruction Defined:

“Differentiated instruction is effective instruction that is responsive to students’ readiness, interests and learning preferences.”

“The process of differentiating instruction for students depends on the ongoing use of assessment to gather information about where students are in their learning and about their readiness, interests and learning preferences. Teachers use this information to vary the learning environment, instruction, and assessment and evaluation.”

“Differentiated instruction is not individualized instruction. It is responding to varying student needs by providing a balance of modeled, shared, guided and independent instructional strategies.

Effective:

Use *Think Literacy (7-12)* or the *Guides to Effective Instruction (K-6)* to explicitly teach strategies that will make your subject content accessible to a wide range of learners. Explicit strategy instruction is the first step in the ‘gradual release of responsibility’ model referred to in *Education for All*.

Relevant:

Connect ideas to student interests and to their lives beyond the classroom.

Responsive:

Use simple graphic organizers such as Venn diagrams or Know/Want to Know/Learned (KWL) charts to have students record what they know about a concept before you teach it so that you know what to emphasize and which students might need support.

Engaging:

Vary instructional strategies to meet learning preferences. For example, if you are presenting information and having students take notes, add a video clip or ask students to take notes in two columns, using words in one column and visual representations in the other. In other instances, ask students to discuss what they’ve read or learned with a partner.”

*OTF/ETFO/OECTA. (2009). *Reach Every Student through Differentiated Instruction*,

**An Example of a Differentiated Instruction Structure:

Choice Boards are a common differentiation structure used to provide students with a choice of tasks. Students select one or more tasks to complete:

- May be used to help students learn (i.e. instruction and assessment) or as a way for students to demonstrate their learning (i.e. evaluation);
- All choices address the same learning goal. Choices may be based on interest (e.g. a task related to sports, music, art...) or learning preferences (e.g. learning styles or multiple intelligences)
- Clear assessment criteria are developed and shared with students prior to beginning the activity so that each ‘choice’ is assessed or evaluated in the same way.

** Ontario Ministry of Education. (2010). *DI – Educator’s Package: Scrapbook*, p. 17.