

Math in *Motion*

A K–12 newsletter that fosters numeracy and mathematics awareness and shares research, resources and actions

Promising Practices in Mathematics Secondary School Case Studies

In the **February issue of Math in Motion**, we reported on 11 elementary schools which over five years significantly improved their EQAO results. These schools built a climate of engagement and inclusion, nurtured shared learning and leadership, developed capacity and content knowledge of staff and found ways to make mathematics relevant and exciting for students. Their math improvement journey, captured in a series of video vignettes, is now available on [LearnTeachLead](#).

A recent case study in the secondary panel investigated the factors that contribute to consistent and improved outcomes for students in Applied math courses. Staff and students shared their success stories with researchers last spring. Five English language secondary schools were selected for site visits based on Grade 9 and 10 pass rates and improved performance on the Grade 9 Assessment for Mathematics. Drawing from school visits, interviews, classroom observations and focus groups, the researcher identified the precise strategies and activities that these schools put in place. In brief, the highlights were:

1. Starting with curriculum ...

- Plan, sequence and connect mathematics key concepts
- Spiral concepts throughout semester/year to review and/or reinforce prior learning
- Use discretion in the selection of instructional support material

2. Focusing on the instructional core ...

- Hold high expectations that students can succeed
- Teach for deep understanding, building conceptual and procedural knowledge of mathematics

- Explicitly use learning goals and success criteria
- Provide frequent formative assessment and feedback to students
- Use a variety of instructional strategies and supports to engage students
- Encourage students to use multiple strategies for problem solving
- Provide access to tutoring and additional support

3. Taking an all-school approach ...

- Share responsibility for improvement
- Use data to help place incoming students and track their progress over time
- Monitor students' success across their program.

Coming soon ... video vignettes of Promising Practices – Secondary.

How were schools selected?

Grade 9 Math Pass Rates

- highest rate of improvement in % of students who achieved at or above Level 3 on Grade 9 Academic and Applied mathematics between 2009–10 and 2013–14

Achievements in EQAO Math

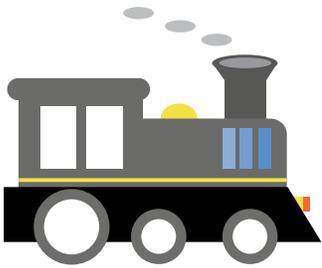
- highest rate of improvement in % of students who achieved at or above Level 3 on EQAO Assessment of Mathematics between 2009–10 and 2013–14

Further Considerations

- 32 short-listed schools (based on above) were reviewed with respect to:
 - participation in other ministry initiatives
 - Grade 10 Applied and Academic mathematics results for the last three years
 - changes in course selection between Grade 9 Applied vs Grade 9 Academic
 - contextual factors such as enrolment, % of students who live in lower-income households, etc.
 - School/Board director willing to participate

5 schools met the criteria





The little initiative that could ... Small and Northern Boards

Launched in 2009–10 with 17 district school boards, mostly in northern Ontario, the Small and Northern Boards (SNB) initiative has evolved over five years to become one of the ministry’s key initiatives for supporting districts facing challenges in mathematics. Today, SNB provides funding to 37 small districts, in all parts of the province, to build a culture of ongoing professional learning in math. This additional funding enables boards to hire a full-time numeracy facilitator to work with classroom teachers to improve their understanding of mathematics, anticipate student learning needs and improve instructional strategies.

As well as providing job-embedded professional learning to classroom teachers, numeracy facilitators participate in professional learning sessions to increase their own pedagogical content knowledge in mathematics. Early on in SNB, these sessions were offered centrally, in Toronto, but as the initiative grew, it became difficult to provide meaningful professional learning to everyone in one location. Today, four annual sessions are provided in Thunder Bay, Sudbury, Belleville and London, and each is focused on regional learning needs.

Numeracy facilitators play a “knowledge brokerage role,” building and bringing local expertise from one school to the next, and so SNB is not just about building a facilitator’s individual expertise but rather about collective capacity building. To this end, regional learning sessions are organized by “learning groups,” consisting of a numeracy facilitator joined by a Grade 6 teacher, a principal from at least one school in the board, a board math champion and a ministry student achievement officer.

But is it working?

In 2011–12, schools participating in SNB improved their Grade 3 and 6 EQAO math results. However, in 2012–13, participating schools experienced a drop in results, reflecting an overall provincial

decline. In 2014–15, to understand better, and improve, the impact of numeracy facilitators on student mathematics learning, the ministry partnered with researchers from OISE’s Robertson Program for Inquiry-based Teaching in Science and Mathematics. The focus of this work was spatial reasoning, an area of mathematics that is critical to mathematical thinking and achievement more generally.

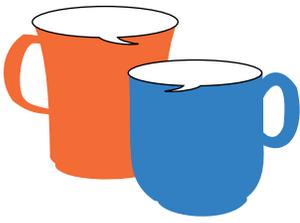
Pre- and post-tests of SNB students’ spatial reasoning skills show significant improvement. Between the beginning and the end of the 2014–15 school year, students increased their scores on all three versions of mental rotation tasks, were significantly more likely to answer the EQAO multiple choice question correctly and were significantly more likely to meet or achieve the provincial standard (level 3 or higher) on each of the EQAO open-ended questions on the post-test compared to the pretest. Educators, not surprisingly, reported greater comfort in leading the learning in spatial reasoning.



Pre- and post-test results suggest that the evolving SNB model – classroom embedded coaching + regional co-learning teams + focusing on a strand or big idea in mathematics – is beginning to yield results.



As for this little initiative that has grown in scope and sophistication, the next focus is measurement through the lens of spatial reasoning. Pre- and post-assessments will continue to be used to monitor impact.



Let's get the conversation started ...

As educators we are frequently asked, “What is a balanced approach to mathematics” and just as frequently we struggle with an answer. “Balanced” implies equilibrium, quite literally a mid-point between two poles, neither fully one nor the other, and when thinking about teaching mathematics, there are many more than two aspects to consider. Each of these aspects must be fully and completely embraced if students are to develop math proficiency.

So, perhaps, the question should be “What is an effective approach to mathematics?”

In the Achieving Excellence Fall 2015 Resources package, you'll find a **poster** which begins to describe what effective learning and teaching in mathematics looks like. It's important to emphasize that the poster is designed to promote conversation among educators about the effective learning and teaching of mathematics.

The culinary metaphor suggests that, in much the same way that a master chef skillfully selects the right ingredients, in the right proportions, at the right

time, for the right diner, so, too, do educators draw on their professional judgment to construct learning experiences that provoke understanding, strengthen skills, develop strategies and promote creativity – all in a way that fosters a growth mindset in students.

To do this, educators identify the math content a student is ready to learn; they choose from a wide range of assessment and instructional strategies; and they create an environment that is safe and engaging, valuing the voice of the learner. Educators make these professional decisions all the time, tweaking the recipe so that it perfectly responds to the palate of these students at this time.

So What Do You Think?

This poster will undoubtedly convey ideas that you like and others that you don't. We want to hear from you. How would you describe the effective teaching and learning of mathematics? What ideas would you emphasize? Email your comments to studentachievementdivision@ontario.ca. We look forward to hearing from you.

DRAFT

A CONVERSATION STARTER

Effective Mathematics Learning and Teaching

What transforms healthy ingredients into a culinary masterpiece? The knowledge, skills and intentionality of a master chef. It's the same in a math class. Educators use informed professional judgement to make plans that advance the mathematics learning of their students.

Educators

x

Mathematics Content

...based on the Ontario Curriculum

+

Assessment for and as Learning

...to help students monitor and advance their learning

+

Responsive Instruction

+

Learning Environment

...to engage every student

=

Productive Disposition

Conceptual Understanding Procedural Fluency Strategic Competence Adaptive Reasoning

Examples:

- How can I understand what a student knows, knows and is able to do?
- How can I teach students to become effective assessors of their own learning? In what, do they can make informed decisions about next steps?
- How will I monitor and I gather, store and use descriptive feedback?

Examples:

- How will I co-construct learning goals and success criteria?
- How evidence-informed strategies, rich tasks and models will best develop understanding?
- How will I differentiate for students' varying abilities and prior learning?
- How will students collaborate and apply learning for deep understanding?
- How will students practice their skills for fluency?

Examples:

- How will I give students voice and choice in their learning and build on a desire to make sense of their world?
- How will I encourage risk-taking, a growth mindset and student efficacy?
- How will I organize space for different purposes?
- How can I engage students in all-around, collaborative and communication?
- How can I promote student well-being?

Examples:

- Assess and evaluate as co-learners
- Opportunities for equitable participation
- Access to manipulatives/learning tools
- Shared student thinking and learning
- Regular attention on learning opportunities
- Space for all interactive and independent learning
- Time for self-reflection and respectful learning
- Explicit statement on cultural knowledge

Foundational Documents: Mathematics Curriculum • Growing Success • Learning for All • Paying Attention to Mathematics Series • Other Ministry Resources

This is a DRAFT document. For an electronic copy go to: www.digitalschools.ca/math/motion.pdf To provide input and feedback on this document email: studentachievementdivision@ontario.ca

Keeping the Spotlight on Spatial Reasoning

Spatial Reasoning in Number Sense and Numeration

Look for the *Spatial Reasoning in Number Sense and Numeration* video in the Achieving Excellence Fall 2015 Resources package.

Seven aspects of spatial reasoning, referenced in *Paying Attention to Spatial Reasoning*, are explored:

- Visualizing
- Proportional reasoning
- Scaling up or down
- Composing and decomposing
- Non-verbal reasoning
- Manipulating objects
- Comparing objects

Overview of the video ...

Primary, junior and intermediate educators engage in collaborative inquiry to explore the use of manipulatives and **mathies** digital tools to support student learning in number sense and numeration. Primary educators explore addition and subtraction

of two-digit numbers using whole number rods. An intermediate educator explores addition and subtraction of fractions using fraction strips. As educators solve problems using these tools, and then observe their students doing the same, they come to realize the potential of concrete and digital tools in developing spatial reasoning, specifically through the seven aspects presented in this resource.

A description is provided for each focus aspect of spatial reasoning. Educator co-planning, co-teaching, and co-debriefing, as well as student, educator, psychologist, and researcher interviews support viewers in making sense of each of the seven aspects in primary and intermediate. Related junior resources are also available, and include activities involving mathies learning tools and games. Specific examples of how to promote spatial reasoning are highlighted within this resource, making connections to the recommendations included in the *Paying Attention to Spatial Reasoning*.



Mathies.ca, hosted by the Ontario Association for Mathematics Education (OAME), is designed for Ontario K–12 students and parents. This website includes games, learning tools, activities, and additional supports for students to explore, build and enhance their mathematical thinking.

Are you looking for newsletter ideas?

The ministry has created a repository of practical tips, activities and resources to help inform parents about how they can support their children in the learning of mathematics. School leaders may include these ideas in their communications (e.g. newsletters, websites) with parents/guardians.

In order to build the repository, contributions of resources and ideas are welcomed. Submit these to theodora.vales@ontario.ca. All contributions

will be acknowledged through mention of the school board name.

[Click here for Ideas for School Newsletters](#)

We want to hear from you!

Please share with us tips, tools and strategies for integrating mathematics learning and teaching across the curriculum! We'll be exploring ways to mobilize them across the province.

For more information about this newsletter or to make a comment, contact Shawna.Eby@ontario.ca.