Our Vision

“The GECDSB provides mathematics education that engages and empowers students through collaboration, communication, inquiry, critical thinking and problem-solving, to support each student’s learning and nurture a positive attitude towards mathematics.”

Whenever we strive to improve in any way, a vision of what that improvement might be is essential. We need to know what we are working towards and why that is important. We also need to know how we plan to reach that vision.

This vision has been developed specifically by and for the Greater Essex County District School Board through consultations with a wide variety of stakeholders including elementary and secondary teachers and administrators, program staff, Student Success, and Special Education. The intent of this vision, and the related strategies and approaches to mathematics teaching and learning, is to support schools and educators as they reflect on the needs of their students and how they will address them as part of their ongoing School Improvement Plans.

Within this vision there are various responsibilities we assume. As a school board, we believe our responsibilities are to create conditions for mathematics learning:

- where competent and knowledgeable educators integrate instruction and assessment;
- where educators and administrators are committed to ongoing learning about mathematics and mathematics instruction;
-where learning environments nurture positive attitudes towards mathematics; and
-where all students have opportunities and support to learn significant mathematics with depth and understanding.

It is the belief of the board that where this vision is actively pursued, and where these responsibilities are met, students

achievement in mathematics will increase.

This document will outline some of the strategies, approaches, theories, supports and resources that should be used to meet this vision and these responsibilities.

A Picture of Mathematical Literacy

What is ñMathematical Literacyò?

- Conceptual Understanding is the ability to understand mathematical concepts, operations, and relationships.
- Procedural Fluency is the skill in carrying out procedures flexibly, accurately, and efficiently, and knowing when the procedures should be applied.
- Adaptive Reasoning is the capacity

- Strategic Competence is the ability to formulate, represent and solve mathematical problems using an effective strategy.
- Productive Disposition is the inclination to see mathematics as useful and valuable.

In order to begin any conversation around improving mathematics we need to share a common understanding of mathematical literacy.

"Conceptual understanding is knowledge about the relationships or foundational ideas of a topic. Procedural understanding is knowledge of the rules and procedures used in carrying out mathematical processes and also the symbolism used to represent mathematics"

Elementary and Middle School Mathematics, van der Walle , Karp, Bay-Williams (2010)

An example of this is in the task 55 x 24. The *conceptual understanding* of this problem includes the idea that the problem could be represented as repeated addition, and that the problem could be represented in terms of the area of a quadrilateral, the number of seats in a theatre, and any other scenario they can conceive. The p*rocedural knowledge* could include the ability to carry out the standard algorithm (multiply 55 by 24). The ability to go beyond this algorithm or to create an algorithm (for example, 50 x 20, plus 5 x 20, plus 50 x 4, plus 5 x 4) requires *conceptual*

understanding of place value and multiplication.

The Ontario Curriculum refers to *adaptive reasoning* when ñteachers help students revisit conjectures that they have found to be true in one context to see if they are always true. For example, when teaching students in the junior grades about decimals, teachers may guide students to revisit the conjecture that multiplication always makes things biggerò

(The Ontario Curriculum Grades 1-8, Mathematics, 2005, p.14). It is tempting for teachers to define terms or provide explanations for formulas at the point where students are making conjectures. ñGallery walks and math congresses are opportunities to treat children as developing mathematicians, which emphasizes developing arguments and proofs to convince others.ò (Models of Intervention in Mathematics)

In approaching a problem, if you feel like you could apply a known or new strategy to solve the problem, try different approaches when the one you selected does not work, and/or create a model to represent your mathematics, this is evidence of *strategic competence.*

Mathematically literate people believe they can be successful and are persistent in their approach to problem solving. It is vital that teachers, students, and parents all strive to develop a *productive disposition* towards mathematics.

The following image is adapted from

Eight Considerations When Planning for Mathematical Instruction

1. Program Scope and Planning

Educators consider curriculum expectations, strands, mathematical processes, and big ideas when planning and using curriculum-appropriate resources.

'By organizing content around big ideas, teachers can teach more efficiently, but most importantly, students can make connections between seemingly disparate topics that help them learn new mathematical ideas.' Marian Small from Making Math Meaningful to Canadian Students, K-8 2013

"Life-long learners of mathematics build new knowledge and skills in prior knowledge using the mathematical processes" From MathGains

For more information about the math processes please go to the following website and select ôIntroduction and Overviewõ

http://edugains.ca/newsite/math2/mathematicalprocessesvideo.html

2. Teaching and Learning

Educators focus instruction on providing students opportunities to engage in minds-on tasks, mathematical inquiry, and

consolidation of their developing understanding of the big ideas.

teaching strategy naturally lends itself to differentiated instruction and differentiated assessment and when all students have an entry point the outcome is increased student success. Teachers careful selection of content rich tasks, Minds On activities that active prior knowledge and make students current thinking visible, and the effective use of consolidation, will deepen students understanding of the curriculum and ensure that all students regardless of their ability, move forward.

3. Learning Environment

Educators use appropriate physical classroom arrangements and group students to promote collaboration, communication and a positive, safe learning environment.

4. Student Tasks

Educators provide an appropriate balance of mathematical tasks including the practice of skills, application of procedures, integration of math processes, and rich problem solving. Even if students have not mastered basic skills, they have opportunities to engage in rich tasks that give them a context for these skills.

The tasks that students are asked to do help them to become mathematically literate as outlined in section 2. Tasks should address curriculum and IEP expectations and take into account the readiness, interests and learning styles of the students in the class. Tasks should be derived from multiple sources and resources, and should allow students ample opportunities to collaborate to develop new math knowledge, and communicate their understandings and wonderings about mathematics.

knowledge. Educators also use a skill-based or conceptual approach when appropriate.

Educators recognize that for students to be mathematically literate, and for them to fully understand the mathematical concepts, they have both conceptual understanding and procedural knowledge, they have the capacity for logical thought, reflection, explanation, and justification (adaptive reasoning), they have the ability to formulate, represent and solve mathematical problems using an effective strategy (strategic competence) and a positive disposition towards mathematics and mathematics learning.

6. Manipulatives and Technology

Educators provide students opportunities to use manipulatives and make use of technology to represent mathematical concepts and procedures, solve problems, and communicate their mathematical thinking and understanding.

Educators understand that manipulatives can support students in developing deeper conceptual understandings but that they must also be able to communicate and understand the math they represent. They also recognize that technology has limited capacity to support actual problem solving, but great scope to support students in communicating their thinking and understanding of mathematics to an audience beyond their classroom. The use of technology can also help students to reflect upon their understandings, learn from the understanding of others (adaptive

reasoning), and consider different approaches to solving mathematical problems (strategic competence).

7. Students' Mathematical Communication

Educators provide opportunities for students to use communication as both a way to learn mathematics and a way to articulate ideas. Oral, written and physical communication make mathematical thinking observable.

Mathematical communication is an essential process for learning mathematics because through communication, students reflect upon, clarify and expand their ideas and understanding of the mathematical relationships and mathematical arguments.

(Ontario Ministry of Education, 2005)

The Ontario Curriculum (Ontario Ministry of Education, 2005) also emphasizes the significance of communication in mathematics, describing it as a priority of both the elementary school and the secondary school programs. Students communicate to:

- build understanding and consolidate learning;
- ask questions, make conjectures, share ideas, suggest strategies, and explain their reasoning; and
- learning to distinguish between effective and less effective strategies.

Queen's Printer for Ontario, 2005.

Canadian Mathematical Society

http://cms.math.ca/

8. Assessment

Educators assess for different purposes

that feedback prior to assessment of learning; and

teaching and learning.

Paying Attention to Mathematics

http://www.edu.gov.on.ca/eng/teachers/studentsuccess/FoundationPrincipals.pdf

Growing Success; Assessment, Evaluation, and Reporting in Ontario Schools (2010)

http://www.edu.gov.on.ca/eng/policyfunding/growsuccess.pdf

ñA student who fully understands what 3 x 5 means not only realizes that it equals 15, but, at some point, understands all of the following as well:

Å It represent Ų

reasonableness of their answers and efficiency of their methodology. Students who have opportunities to play with invented procedures and consider alternative procedures shared by peers, learning concepts through problem solving will develop the competency to use procedures and algorithms strategically or with procedural fluency, and to judge their own methods against those used traditionally used in mathematics.

Review the previous section on ñMathematical Literacyò to learn more about the relationship between conceptual understanding, procedural knowledge, adaptive reasoning, strategic competence and productive disposition.

What is Math Talk?

A Math-Talk Learning Community is a community where individuals assist one anotherôs learning of mathematics by engaging in meaningful mathematical discourse. (Hufferd-Ackles, Fuson and Sherin 2004 p. 82)

Despite the importance of high quality math talk, left on their own students are not likely to engage in such talk. Teachers play a pivotal role in facilitating these opportunities.

Dr. Catherine D. Bruce, an assistant professor at Trent University in Peterborough, Ontario, and the author of the LNS Monograph Student Interaction in the Math Classroom, identifies five challenges that teachers face when trying

to engage students in high quality interactions during math. These are:

- complexities of teaching mathematics in ways they did not experience as students;

- discomfort with their own mathematics knowledge;

- lack of sustained professional development opportunities;

- greater requirement for facilitation skills and attention to classroom dynamics; and

- lack of time, especially in face of curricular demands.

She outlines five strategies for teachers to encourage high-quality interactions, along with evidence for why each is important and how it works:

- The use of rich math tasks;

- Justification of solutions;

- Students questioning one another;

- Use of wait time; and

- Use of guidelines for math-talk.

Whole class discussions can be facilitated using techniques such as Gallery Walk, Math Congress and Bansho. Although there are many similarities and differences in these strategies (which are listed in the ñCommunication in the Math Classroom Monographò), the main purpose for all three is to develop studentôs communication abilities in math.

Increasing math talk provides students with the opportunity to explain, defend,

and justify their mathematical thinking

uncomfortable with math, articulating that sentiment with, ñIm not good at mathò

that you value learning math. Of course if your own experience with learning math was difficult and these comments make you inwardly groan, don't try to fake an attitude of enthusiasm. Skip the commercial, try engaging students in a discussion of math skills that are essential for daily life and let it convey the message

within which math exists in all areas. A comprehensive approach to mathematics would be one where math is evident across the curriculum, time is dedicated for math problem-solving and inquiry, and students are supported in becoming mathematically literate.

The three-part math lesson is one effective component of a comprehensive mathematics program and emphasizes studentôs overall conceptual understanding through problem solving, math talk, questioning, and differentiated instruction. The three-part lesson is an inquiry based model where ñstudents are recognized as the ones who are actively creating their own knowledgeò (Marian Small).

The following videos are taken from resources provided by the Literacy and Numeracy Secretariat to support instruction in mathematics and outline the key concepts and theories underpinning the three-part lesson approach, as well as breaking each part down to show what the possibilities are.

BEFORE

During/action	
STUDENT	TEACHER
- Flexible grouping; pairs, small groups, or independent - Work to make sense of the problem in their own way to deepen and clarify their thinking - Communicate their thinking to one another and teacher through math talk -	

After/consolidation	
STUDENT	TEACHER
- Make connections between mathematical ideas and strategies - Apply descriptive feedback based on learning goals and success criteria - Complete a final practice assessment or reflection to demonstrate consolidated learning	Strategically facilitate whole-class and small-group discussions and sharing by: - Asking questions to clarify misunderstandings - Encourage students to explain and understand a variety of solution

students. It is not the textbook itself that is a potential problem, more how it is used and what role it plays in the teaching and learning of mathematics.

The following video from math teacher Dan Meyer outlines some of the ways we need to think more cr

other learning opportunities or assessments do the students need?

Once an educator has considered these questions, and acted upon their responses, the textbook will likely have a less prominent role in their math classroom,

sustainable growth. By regularly discussing the schoolôs shared focus administrators can encourage optimism in the face of everyday problems.

Through the GECDSB School Improvement Planning process, and the nature of ñSchool-Based Learningò, our educators have autonomy and ownership over how and what they learn. The improvement goals that drive this shift need to be identified by all stakeholders. Administrators coordinate professional learning opportunities that value teachers knowledge and experiences and are based on student learning

are more comfortable in that language.

Communication is rarely a discrete, individual act but rather occurs within the context of ongoing exchanges (Adler & Rod- man, 1994). Currently, a number of communication opportunities are available to teachers, ranging from blogs, school-to-home communication books, to face to face parent conferences. Every communication exchange, regardless of format, should reflect a thoughtful, planned approach and should be viewed as an opportunity for teachers to promote parent partnerships and, ultimately, to support student learning. Teachers are encouraged to use a variety of strategies, keeping in mind that the more proactive you are the better. The more you explain to parents up front, the less defensive work youôll have to do. As educators, if we want parents to be on our team, we must initiate, define, and practice what we want that relationship to look like.

Recent research suggests that creating a partnership climate in schools can improve math proficiency for students (Sheldon, Epstein & Galindo, 2010). Schools and teachers can go beyond communication activities to engage parents as partners in supporting student math learning. Some challenges to family involvement in math learning include:

1) Math is used differently at home but teachers havenôt been guided to take studentsô social contexts into account when planning math instruction; and

2) Most teachers have little education about how to involve parents in supporting

children to extend their math skills.

Adler, R. B., & Rodman, G. (1994). Understanding human communication. Orlando, FL: Harcourt Brace College Publishers.

More resources

http://www.edu.gov.on.ca/eng/studentsuc