Submission of Articles

The *Ontario Mathematics Gazette* (*OMG*) is looking for news items, articles, and good ideas that are useful to mathematics teachers and mathematics teacher education. We are seeking submissions, preferably from mathematics teachers K–12 and other mathematics education professionals, that describe innovative and creative approaches to mathematics teaching.

Please keep in mind the following criteria when making submissions to the *OMG*:

- The ideas/activities must be of interest to the readership.
- The ideas/activities must be fresh and innovative.
- The mathematics content must be appropriate for the readership.
- The mathematics content must be accurate.
- The article must be well written and easily understood.
- The article and its ideas must be free of sexual, ethnic, racial, or other bias.
- The article must not have been previously published, nor should it be out for review by other publications.
- The article must be original.

Articles must be word-processed in MS Word, double-spaced with wide margins, not exceeding 10 numbered pages of text, and prepared according to the *Publication Manual of the American Psychological Association, Fifth Edition*. Figures and diagrams should be drawn by computer, if possible, or drawn in black ink in camera-ready form. Embedded images must also be submitted separately in jpeg or tif format. Proof of the photographer's permission is required, and for **photos of students** under the age of 18, the written permission of a **parent or guardian is required**.

You must submit **one complete copy** of your article, embedded with any tables, figures, and captioned photographs or graphics, to the Editor, Stewart Craven, along with **separate files for each of the text, graphics, and/or photographs**. Please e-mail all files to Stewart Craven at **numeratecitizen@mac.com**.

Your name should not appear anywhere in your article, including websites, so that your article can be sent out for blind review. Your name, full mailing address, and e-mail address must be included on a separate sheet. Upon review, you will be notified as to whether your article has been accepted for publication (as is, or pending minor or major revisions) or rejected.

The Editor reserves the right to edit manuscripts prior to publication. Once an article is published, it becomes the property of OAME.

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The views expressed or implied in this publication, unless otherwise noted, should not be interpreted as official positions of OAME.

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Submission of Advertisements

Advertisements for publication in the *Ontario Mathematics Gazette* should be sent to **Robert Sherk** at the above address. Courier is recommended to avoid possible delays. Deadlines for advertisements are January 23 for the March issue, April 1 for the June issue, July 1 for the September issue, and October 1 for the December issue.

Full page advertisements are to be on 8.5" by 11" paper with a minimum of 0.5" margins and single sided. Each advertisement should be camera-ready and colour advertisements should have no bleeds.

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▲ Editor's Message

STEWART CRAVEN, EDITOR
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Welcome back! It's the beginning of a new school year, and we are anticipating that our students will be ready and eager to learn mathematics. We have had the time to reflect on our successes and our difficulties, and we have prepared ourselves to take on this year's challenges. For some, this meant taking time off to rest and pursue personal interests, and for others, it meant taking part in Additional Qualifications courses, university mathematics courses, or summertime professional development opportunities. September is the time of year when our energy is at a maximum and we are full of hope that our successes will far exceed our difficulties. I wish you the very best for the upcoming school year!

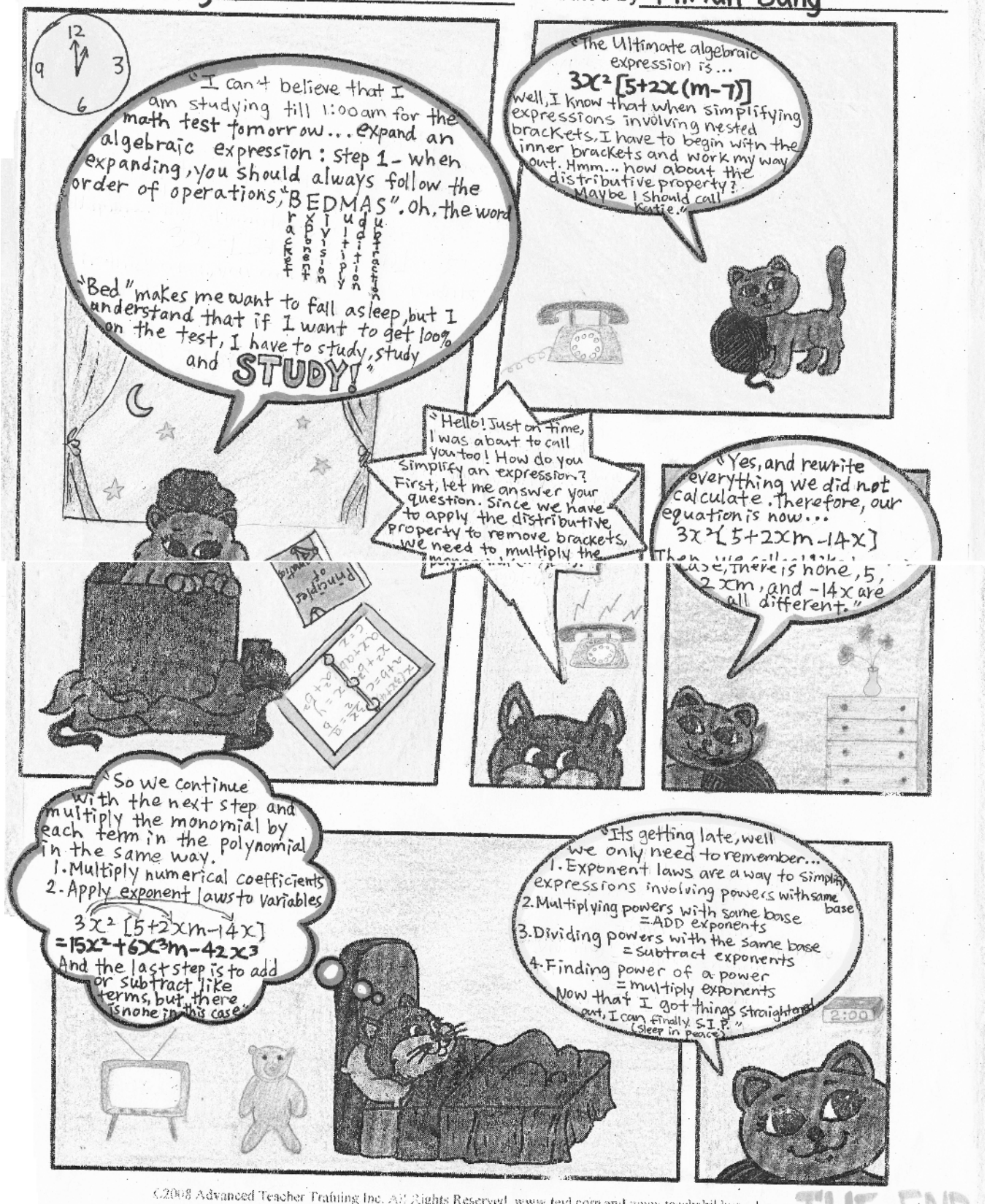
It is my hope that the *Ontario Mathematics Gazette* will provide you with useful information, as well as some thought-provoking ideas. Some of our columns (Web 2.0, Data Rocks, and Technology Corner) ensure that you are kept informed about the significant technological/communicative trends in mathematics education. Other columns (Hey, It's Elementary! and NCTM Report) provide information about current research in mathematics education and useful resources for the classroom. Inquiry in the mathematics classroom is paramount, and the column entitled What's the Problem? provides great ideas for problem solving. The articles and features delve more deeply into these and other issues. I would like to challenge you to consider writing an article for the *Gazette*. We are always in need of fresh points of view!

I hope to devote the March 2010 issue to The Mathematics of Games. However, this can happen only with the submission of a sufficient number of articles. The articles need not be long—I am looking for variety, reflecting the spectrum of possibilities from early elementary through secondary mathematics education.

Finally, I would once again like to thank the students who submitted cartoons for the cartoon contest. The second one that I am publishing is by Mirian Dang from Pierre Elliott Trudeau High School in Markham. Congratulations Mirian! ▲

Title The Nightmare

Created by Mirian Dang



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THE END

▲ President's Message

BEVERLY FARAHANI, PRESIDENT
E-MAIL: farahanib@limestone.on.ca



Beverly Farahani is Head of Mathematics at Kingston Collegiate and Vocational Institute. She is also a T³ Instructor and was on the Minister's Task Force.

I hope that everyone enjoyed their summer. I used my time to physically and mentally rejuvenate, get caught up on some reading, and do some professional development. I also found a factoid that might create some interest in my math classes. I discovered that the biggest prime number in a song is 8675309. Some of you may remember it as the song "Jenny" by Tommy Tutone. The person who had that phone number at the time got many calls from people who wanted to speak with Jenny! That person couldn't get rid of the number fast enough, but this year, a DJ from New Jersey paid US $186 853 (not a prime number) to own that same telephone number! After you share this information with your class, don't be surprised if a colleague asks if this is true.

Some of you will have had the opportunity to attend Math CAMPPP (**www.oame.on.ca/main/files/wshops/MathGainsCAMPPP2009**) or some other form of PD this summer. The ideas that you were exposed to and the people you met will likely impact what you do in your classroom this school year and may change how you approach some topics.

While participating in summer PD, I often reflect on how students might feel in my class. Being introduced to something for the first time or looking at an idea or concept that has proven difficult in the past can sometimes be overwhelming. Even though the presenter is eager, the participants may approach the activity with some trepidation. As the session progresses, the participants begin to feel more comfortable. This is often mirrored in the classroom. During your lesson, your excitement and enthusiasm may be infectious, yet your students may feel overwhelmed or out of their comfort zone. Over time, your students, too, will begin to have more confidence in their abilities and will move forward on their journey through mathematics.

As I write this, it is very early on in my summer vacation, and I have embarked on two new summer readings: *Descartes' Bones* and *Einstein: His Life and Universe*. These books were recommended to me by two different colleagues—one who teaches math and another who teaches philosophy. (I'll leave it the reader to decide who suggested which book.)

I hope that you find yourself strengthened by your summer activities and that you have found new energy to inspire our future leaders. ▲

▲ Call for *Gazette* Editor

The *Ontario Mathematics Gazette* is taking applications for a two-year term as editor commencing with the September 2010 issue.

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For more details, please contact:
Executive Directors:
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519-471-6324
EDs@oame.on.ca



▲ What's the Problem? Fun with Football

SHAWN GODIN
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Shawn is the head of Mathematics, Business and Technology at Cairine Wilson S.S. in Orleans, ON. The web page for this column is ***whats-the-problem.wikispaces.com****.*

Welcome back to a new school year, problem solvers! Last issue, I left you with the following problem:

The standings in the first round of the FIFA World Cup (Group B) are shown in the table below. Knowing that each team played each of the others exactly once, use the given information to determine the score of each match.

	Wins	Losses	Ties	Goals For	Goals Against
England	2	0	1	5	2
Sweden	1	0	2	3	2
Paraguay	1	2	0	2	2
Trinidad and Tobago	0	2	1	0	4

This problem appeared as problem 2728 in *The Journal of Recreational Mathematics,* Volume 34, No. 2. It is one of many problems posed by the journal that are accessible to students. The journal is published by Baywood Publishing Company, and you can find out more from Baywood's website at **baywood.com/journals/**.

This problem is great because the numbers are small enough that even very young students can tackle the problem using trial and error. I would also suggest using manipulatives to aid in the solution. If you have access to coloured chips, cubes, or pattern blocks, you could assign a colour or shape to each team. Set up tables, as below. (Pdf versions for student use are available on my wiki: **whats-the-problem.wikispaces.com**.)

England	Sweden	Paraguay	Trinidad and Tobago
EEE	S	P	

Trinidad and Tobago	England	Sweden	Paraguay
	E	SS P	

England	Paraguay	Trinidad and Tobago	Sweden
E			

The previous table can be used for all possible games. (You can check that each team played each other team exactly once.) With your markers for each team, use 5 for England, 3 for Sweden, 2 for Paraguay, and none for Trinidad and Tobago. The markers represent the goals that each team scored. Then place the markers in the boxes for that team. In the table above, I have used letters for my markers.

The table below is for the results. Since we are using "Goals For" as our reference, that column will be fixed and correct at all times. For "Goals Against," we will use the other team's goals as our markers. So, for Trinidad and Tobago, Paraguay scored once against them, England scored once against them, and Sweden didn't score, so there would be two (2) markers in the "Goals Against" column.

Similarly for the Wins, Losses, and Ties, each team gets one marker per game, and it goes in the appropriate column. Thus, for the England versus Sweden game, England's Marker goes in the Wins column and Sweden's goes in the Losses column. The results for the above games are shown below.

	Wins	Losses	Ties	Goals For	Goals Against
England	EEE			EEEEE	E
Sweden	S	S	S	SSS	SSSS
Paraguay	P	PP		PP	PPP
Trinidad and Tobago		TT	T		TT

We can now compare this to what we want to get, and make adjustments. (A spreadsheet version and instructions for its creation are available on my wiki at **whats-the-problem.wikispaces.com**.)

Now, lets look at the information logically. Notice that Paraguay has 2 "Goals Against," but lost 2 games. Each of these games must have been 1–0. Also, they have 1 win and 2 "Goals For." Trinidad and Tobago has no wins, so Paraguay must have defeated that team, and Trinidad and Tobago scored no goals, so we have the following results:

England defeated Paraguay 1–0; Sweden defeated Paraguay 1–0, and Paraguay defeated Trinidad and Tobago 2–0.

Notice that Sweden has two ties. Also, it scored a total of 2 goals, so we must have the following results: Sweden and England tie 2–2 and Sweden and Trinidad and Tobago tie 0–0. Once we have figured this out, the last game is self-determined: England defeated Trinidad and Tobago 2–0.

A very nice problem that can be solved in many different ways! I would be interested in any alternative solutions, so feel free to e-mail me, or post to my wiki.

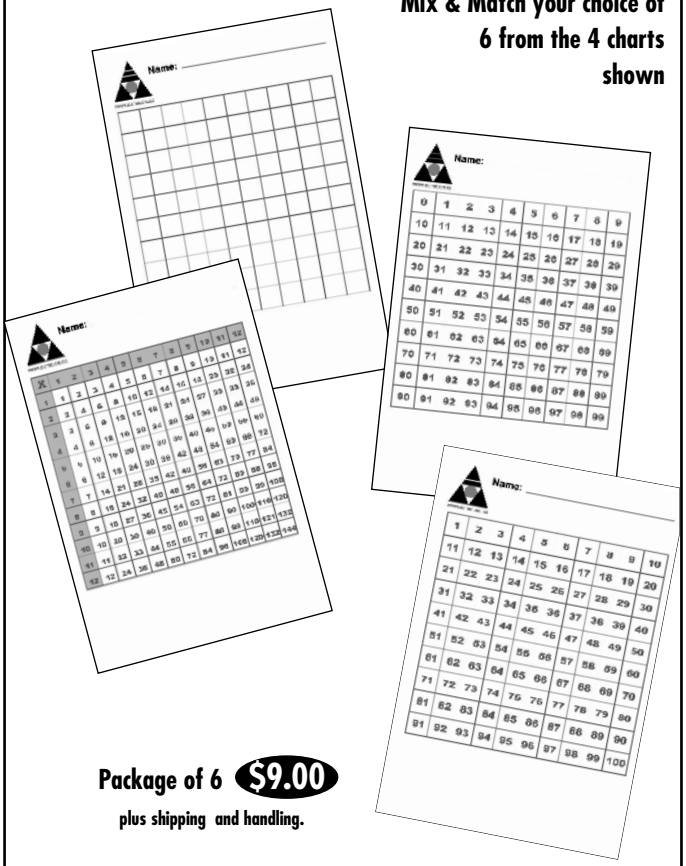
And now for some homework!

We have two coffee mugs with capacities of 3 and 5 cups, a water supply, and one packet of instant coffee, which, when dissolved in one cup of water, constitutes coffee of concentration 100%. Find all possible integral values of ***n*** *for which it is possible to make coffee of concentration* ***n%****.*

Until next time, happy problem solving! ▲

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▲ Data Rocks – Engaging Students in the Study of Their Peers, Using Data Analysis: *The Health Behaviour of School Children* Microdata File

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Yves Saint-Pierre has worked at Statistics Canada in many capacities since 1990: questionnaire design, data editing and imputation, analysis, and publication. He has been sharing his knowledge with schools since 2002.

Statistics Canada recently added to its website another source of microdata that students may use, either for culminating projects in MDM4U or for other analysis projects at earlier levels.

This microdata file was created from the 1997–1998 Health Behaviour in School-Aged Children survey in Canada and contains data from over 11 000 Canadian children from Grades 6 to 10. This survey was also conducted in more than 30 other countries; international aggregate data results for 1990 to 2002 can be found in E-STAT.

The microdata file includes 89 variables on the following broad topics:

(A few examples follow the broad topics.)

Personal Feelings

- How healthy do you think you are?
- Is there anything about your body you would like to change?
- How do you feel about your life?

Home Life

- I have a happy home life. (agree, disagree)
- My parents understand me. (agree, disagree)

Friends

- How easy is it for you to make new friends?
- How many close friends do you have?
- How easy is it for you to talk to friends of the opposite sex?

Risk Behaviours

- Number of times you were drunk
- Age you started smoking

School

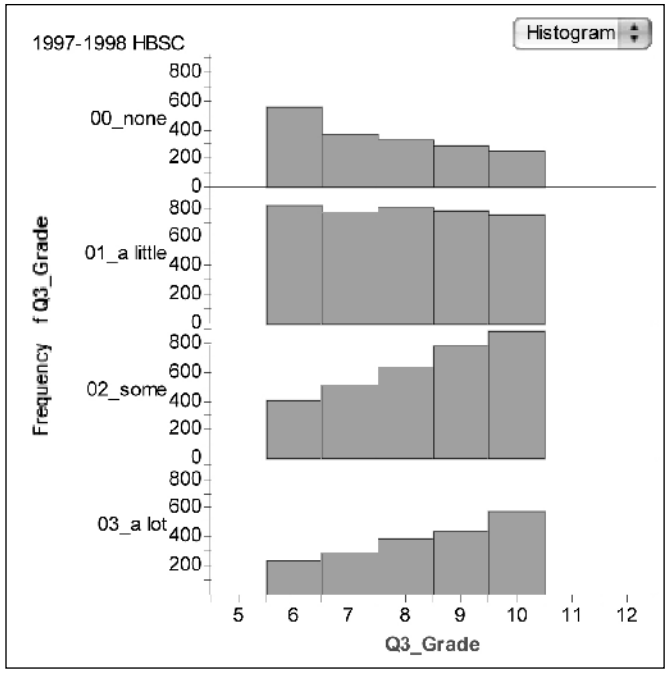
- I think school is boring.
- Teachers treat me fairly.
- Teachers are interested in me as a person.

Injuries and Injury Prevention

- How often do you wear a bicycle helmet?
- How often do you wear a seat belt?

The student activity asks students to look at the data set to find questions that interest them and to make hypotheses about what the data will show. Since most of the attributes in this data set are categorical, this is an opportunity for students to develop tools that help show a correlation between non-numeric variables.

One researcher found that as students progressed through the grades (Q3), the number of students who felt "a lot" or "some" pressure due to school work (Question 64) increased, whereas the number of students who felt "none" decreased. (See graph below.)



Frequency of students reporting various levels of pressure due to school work, by grade

What other variables might be related to feelings of pressure due to school? Such variables might include Degree of Parental Support (Question 62a: My parents help me with problems at school...) or Frequency of Social Outings (Question 69: Number of evenings spent out with friends...).

To find the microdata, go to the learning resources website **www.statcan.gc.ca/learningresources** and click on Resources by school subject > Math > Grades 9 to 12 > Data tab, and then look for Health Behaviour of School Children among the links of other microdata files. The direct link resulting from the above click sequence is **www.statcan.gc.ca/kits-trousses/microdata-microdonnees/edu06g3_0001-eng.htm**. Here, you'll find student activity and analysis ideas to accompany the data files. The data files are available in CSV, Excel, and Fathom.

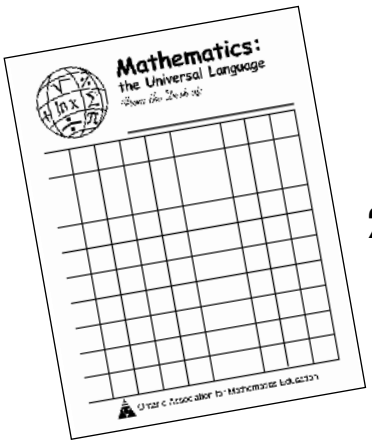
To find the aggregate data, go to **www.statcan.gc.ca /learningresources** and click on E-STAT (in the yellow box) > Accept and enter > About E-STAT > *Health Behaviour in School Children*: student friendly interface, or go directly to **www.statcan.gc.ca/estat/ guide/hbsc-csjs/hb-cs-eng.htm**.

Links to More Microdata

On the same page as the data for the *Health Behaviour in School Children*, there are other microdata files from Canada, as well as data links from international sources (including one microdata source: PISA, the Programme for International Student Assessment).

I am always curious to see how teachers use microdata. Please do not hesitate to write to me about this at **mdm4u@statcan.gc.ca**. ▲

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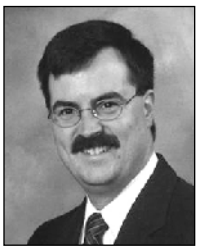
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▲ Web 2.0 – Reading and Writing, Part 1

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Ross Isenegger is the Numeracy Coordinator with the Near North DSB. For the past few years, he has been working on the Ministry of Education's CLIPS project. His blog can be found at ***mathfest.blogspot.com****.*

Welcome back! How did you spend your summer vacation? Did you check out some great websites? Did you keep up with a lot of feeds using Google Reader?

For those who missed the Introduction to Web 2.0 that was published in the June *Gazette*, we introduced an Internet application called Google Reader. We created a Google account, logged into the Reader application, and set up some feeds for you to check on throughout the summer. To access that column, log in to the Members Only section of the OAME website, click on the *Gazette* Archive link, and download a copy of the June *Gazette*. You can also find a step-by-step guide to get you started, and more, on the wiki pages devoted to this column at **mathfest.wikispaces.com/Web2.0+For+Math+Educators**.

In our first column, we introduced you to the Google Reader application and suggested some starting points. This month, we'll delve into one specific type of website—the blog—and show you how to search for blogs of interest and how to subscribe to them. At the end of the column, we'll present some suggestions regarding how you might use blogging in your classroom, and we'll provide some starting steps for creating a blog of your own.

What is a blog? The word "blog" is a contraction of "web log," and like many Internet terms, it has entered the vernacular. As its full name suggests, it is a log, or journal, kept by a single person or by a group of like-minded individuals. The entries, called *posts*, are dated and can be made daily, weekly, or at random intervals; the frequency depends solely on the author. It is considered bad form to edit the contents of a post after it has been published; new content belongs in a new post or in a section appended to the original post with any updates. Some bloggers are very prolific; others have moments of inspiration at irregular intervals. The topic of a blog can be as specific as teaching a specific course in high school or as general as whatever is on the author's mind at the time. According to Technorati.com's *State of the Blogosphere/2008* report (see **technorati.com/blogging/state-of-the-blogosphere/**), approximately 900 000 blog posts are made each day! Some of these may be germane to your teaching, while others may be related to an area of personal interest or may be part of an ongoing, intriguing series of posts that you would like to follow.

How do you find blogs and blog posts of interest? The easiest way is to use the Search feature in your RSS Reader. Assuming that you are using Google Reader (**reader.google.com**) and have logged in using the steps outlined in our last column, click on "Add a Subscription" to search for feeds. For example, if you enter the search term "Ontario Math Educators Technology," you will get a list of the main OAME and OSAPAC feeds (which are news feeds) and the mathfest blog. Clicking on one of these feeds allows you to preview the posts. Clicking the "Subscribe" button will add it to your Reader. It is a good idea to use the Feed Settings to add the new feed to a folder to improve organization.

The "Add a Subscription" button is also used to subscribe to feeds for which you know the address. If you go to a blog (or many other kinds of web pages), you will find orange RSS links, or links labelled "Subscribe." Right-clicking on these, you can Copy Link Location (or Copy Shortcut), and paste the location into the "Add a Subscription" search term text box. (A good place to try this out is **www.cbc.ca/rss**.) Of course, Firefox users are alerted to the presence of feeds on a page with an orange icon right in the address bar and can configure that button to add feeds to Google Reader automatically, saving a lot of hassle. Once you find some blogs that you like, you can find others that are referred to in posts,

that are listed in a "Blog Roll," or that belong to commentators. While the "Add a Subscription" button subscribes you to a feed, what if you just want to read posts of interest related to a topic from a variety of blogs? The folks at Google have a tool for that as well. Go to **blogsearch.google.com** and enter a search term at the top (using "Ontario Math Educators Technology" again will provide an instructive contrast). Instead of listing blogs of interest, it lists blog *posts* of interest. In fact, the blogs found in the earlier search are nowhere to be found here (well, not nowhere, but pages down the search results somewhere). On the left, there is a link to subscribe to this RSS feed, and at the bottom, to add the feed to your Google Reader. In this way, you can create a custom feed that searches the blogosphere for posts that are pertinent to your specific interests. One of the authors subscribes to feeds for "Geometer's Sketchpad" and "Ross Isenegger" this way; can you guess which one? The RSS page of the Web 2.0 for Math Educators wiki (**mathfest.wikispaces.com/Web+2.0+RSS**) has a couple of instructive movies that introduce Google Reader and go over the process of navigating and adding feeds to it.

Once you have subscribed to feeds that appeal to your professional and personal interests, your thoughts may turn to how to use blogs as an instructional tool in the classroom. Stephen Downes, a widely read edublogger from the National Research Council in New Brunswick (**www.downes.ca/**), gives the following excellent overview, which can be found at **halfanhour.blogspot.com/2009/04/blogs-in-education.html**.

How To Use Blogging In Learning

Begin simply. Most uses of blogs in the classroom began with the instructor using blogs to post class information such as lists of readings and assignment deadlines. This fosters in the teacher a familiarity with the technology and with students a habit of regularly checking the online resource.

Lead by example. Before requiring students to blog, instructors should lead by example, creating their own blogs and adding links to interesting resources and commentary on class topics. This not only produces a useful source of supplemental information for students, it creates a pattern and sets expectations for when students begin their own blogging.

Read. Students should begin their entry into blogging by reading other blogs. Teachers should use this practice not only to demonstrate how other people use blogs to support learning, but also to foster critical thinking and reading skills. Teaching how to respond to blog posts is as important as creating blog posts.

Create a context. Like the author facing a blank sheet of paper, a blogger will be perplexed unless given something specific to write about. Have students blog about a current issue, about a specific [piece] of writing, or some question that comes up in the course.

Encourage interaction. Blogging should not be a solo activity. Encourage bloggers to read each other's works and to comment on them. Encouraging students to set up an RSS reader with each other's blogs will make reading and commenting a lot easier. Teachers, also, should subscribe to student blogs and offer comments, again setting an example of the expected practice.

Respect ownership. A student blog becomes important because it is a manifestation of his or her own work. However, to have this value, a student's ownership of a blog must be genuine. While reasonable limits or codes of practice need to be respected, student bloggers should have the widest latitude possible for personal expression and opinion.

Address issues immediately. The most significant danger to students online is posed by other students. In particular, bullying (or ragging) is a significant problem. It is important to spot instances of bullying as soon as they occur and to take steps to prevent further incidents. Teachers should educate themselves, as online bullying can be invisible and hard to address.

Once you are ready to start producing posts, rather than simply reading them, you will need to create a blog. There are lots of good blog-hosting sites, including Blogger, where you can create a blog for free. The process is painless. In fact, the hardest part is deciding on a name for your blog! For a classroom blog, consider a name like "PFCSS-Mr.Clarke." Consult the "Help" for the site or software that you choose to use. Blogger even has its own YouTube Help channel (**www.youtube.com/user/BloggerHelp**), with videos like "How to Create a Blog with Blogger." Creating a blog post is as simple as visiting your site, logging in, and clicking "New Post." Good posts have lots of links to related material.

Google Reader thus becomes your personal online magazine, and the bloggers to whom you subscribe, its regular columnists. Google blogsearches are like teletype machines, bringing in stories from around the world. Once you start posting to your own blog, you can become the purveyor of fact and opinion to literally tens of readers! Let us join those readers; post a link to your blog at the bottom section of **mathfest.wikispaces.com /Web+2.0+Blogs**. Similarly, if you find a blog that you think would be of general interest, please add it to the list as well.

In our opinion, the professional learning that will result from the discipline of reading and writing blogs cannot be overstated.

Links and References

Google Blog Search tool **blogsearch.google.com**

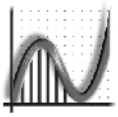
How to Use Blogging In Learning: Posted Monday, April 13, 2009 by Stephen Downes. Retrieved July 5, 2009 from **halfanhour.blogspot.com/2009/04/blogs-in-education.html**

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▲ Technology Corner – SMART Math Classrooms

MARY BOURASSA
E-MAIL: mary.bourassa@ocdsb.ca



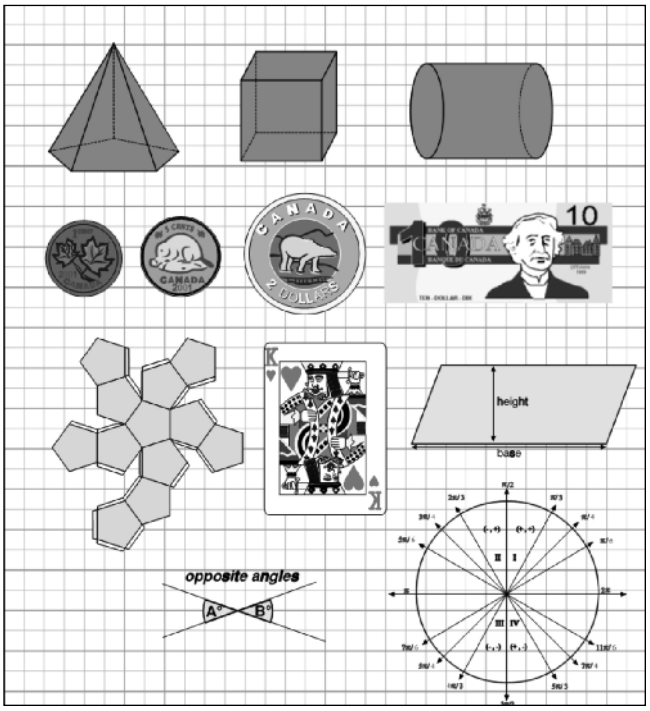
Currently on maternity leave #4, Mary has been teaching mathematics and computer science for the past 15 years. She is a strong advocate for the appropriate use of technology in the classroom. Mary has presented workshops to teachers around the world, has been involved in authoring high school mathematics textbooks, and is a past Vice-President of OAME and Past-President of COMA. Winner of NCTM's Future Leader Award, member of a Kenneth D. Fryer Award-winning mathematics department, and 2009 recipient of the Award for Exceptional and Creative Teaching in Secondary Mathematics, Mary continually strives to discover new and better ways of helping students learn and love mathematics.

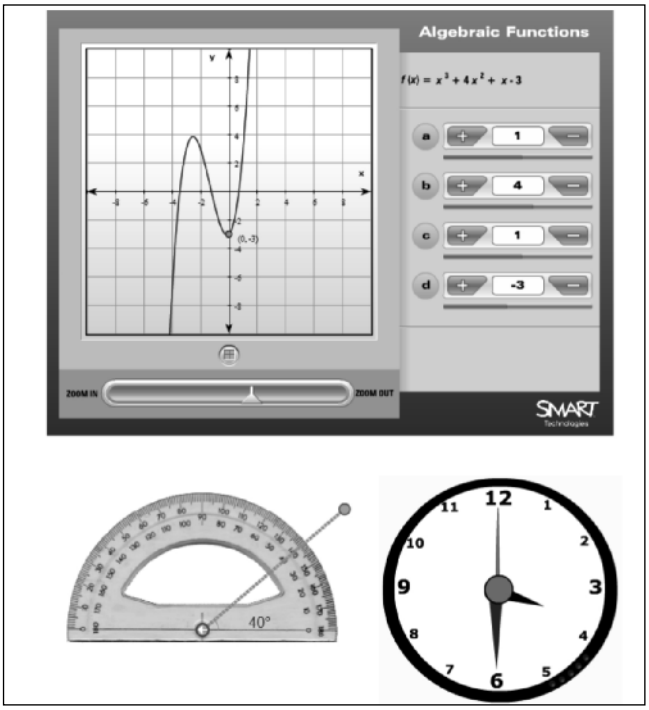
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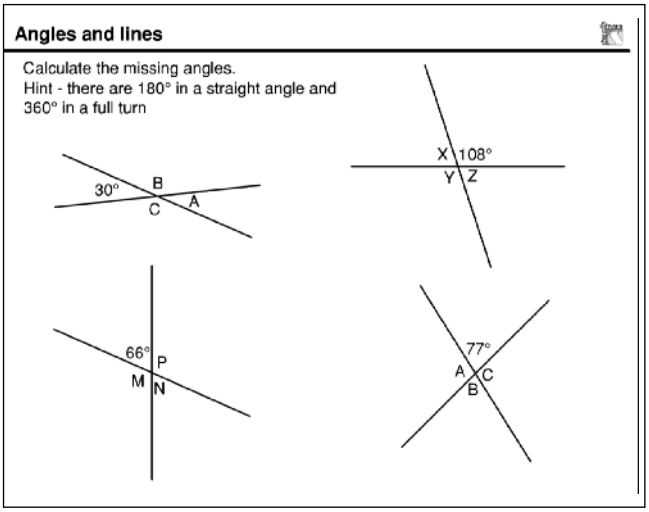
Interactive whiteboards are like "virtual chalkboards" upon which you can display notes, images, and videos and can write and circle, zoom in on, or highlight objects. You can hide your lesson with a shade and reveal it as you go, you can add pull-tabs to reveal answers when appropriate, or you can write over answers in white pen and then erase to reveal them. Everything written on the SMART Board™ is captured as an image and can be saved, uploaded, or printed. This is very useful for the student who misses a class or whose IEP requires teacher-provided notes. You can also record and save audio, thus allowing you to create an entire lesson before your class even begins! Students and teachers love SMART Boards. Students like going to the board to write on it (using a pen colour of their choice), and they

like seeing the animation, never quite knowing what's coming next.

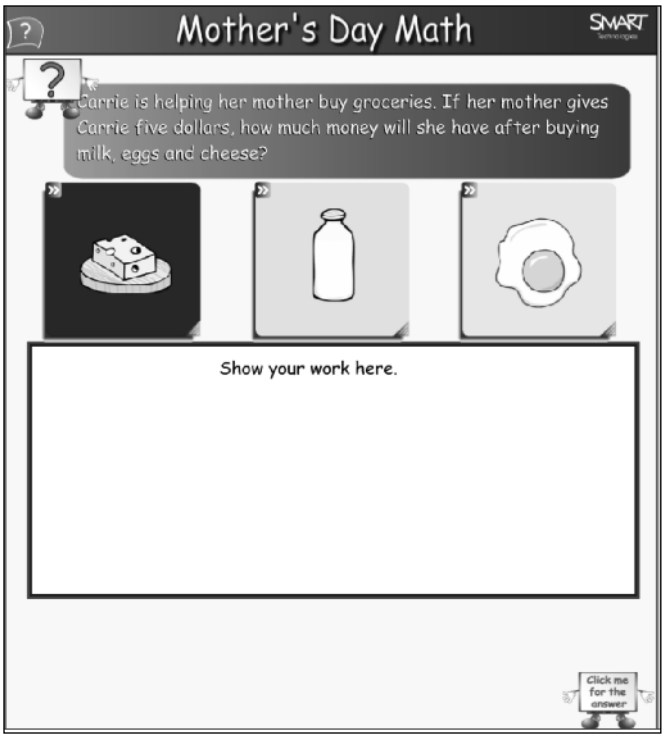
SMART Notebook 10™ is software that comes with a SMART Board. It comes with the Lesson Activity Toolkit, which contains things such as playing cards and dominoes, as well as animated dice and many tools to make the Notebook pages interactive. In the mathematics section of Essentials for Educators, there are pictures and backgrounds that include algebra tile templates, angles, grids, shapes, coins and bills, circle fractions, nets, thermometers, unit circles, and much more. You can also add interactive objects to your Notebook page to explore—among other things—functions, time, temperature, fractions, and angle measures. These fun and engaging interactive objects allow you (or your students) to change parameters, make choices, or simply move objects. There are also ready-made worksheets, such as the one shown on calculating angles.



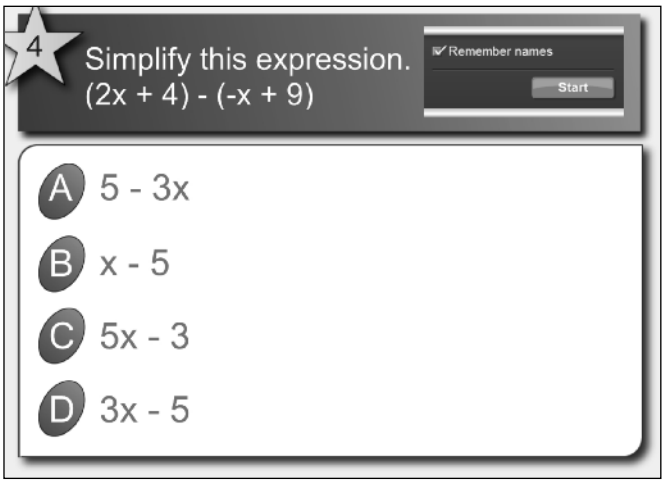




On its website, SMART offers over 300 math-specific lesson activities that help teach topics on everything from integers to the 24-hour clock. All of these activities can be modified to suit your needs. You are able to search by subject and grade, so finding what you need is simple. In the example shown, students can touch each item to find out its price and then calculate the sum in the box provided. (Please note that this is only one page of this activity.)



SMART Response™ question sets are also available for downloading from the website. Each of these sets features ten questions on a particular topic, allowing teachers to quickly assess whether students understand the concepts.



SMART's commitment to educators is obvious. The company listens to feedback in order to improve its products and has employed educators to ensure that it produces useful and meaningful tools and content. SMART's generous support of OAME's Annual Conference has not only helped more teachers see the power of the interactive whiteboard, but has also provided two teachers with SMART Boards of their own!

SMART has created other cool technology like the SMART Table™ and the Senteo™ system, but the most exciting news about SMART technologies and mathematics is the upcoming release of the SMART Math Notebook™ (this fall). This remarkable piece of software will incorporate an equation editor, a custom graph builder, a mathematical symbol recognition feature, and more. Unlike the SMART Notebook, this software will be for sale. From the preview I have seen, it will be well worth the investment.

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▲ Hey, It's Elementary! Working with Mathematically Gifted Students

LYNDA COLGAN
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Lynda is celebrating her 32nd year as an educator. She has taught at all levels—elementary, secondary, and post-secondary—and has mentored fellow teachers and more recently, teacher candidates and graduate students. Her first teaching award, The Marshall McLuhan Distinguished Teacher Award, was given in recognition of her "Learning Partner Initiative," in which elementary children attended professional development sessions with their classroom teacher to learn about innovative uses of technology in mathematics.

Our primary goal must be mathematical power for all students. We speak often about providing rich opportunities for disadvantaged students. But among the students we have in our mathematics programs are some that have either high abilities or high interest, or both. Our programs must include opportunities for these students as well. These students are likely to become significant users of mathematics as our future scientists, mathematicians, statisticians, engineers, technologists, and researchers. They deserve programmatic attention just as students with other kinds of special needs do.

Glenda Lappan, former president, NCTM

According to the oft-told tale, wee Carl Friedrich Gauss, a precocious 7-year-old student, was trying his teacher's patience in class during one of his first days in school. Relegated to a corner, he was instructed to sit quietly and remain there until he had summed the numbers from 1 to 100. Within seconds, he boldly marched to the front of the class and announced the answer: 5050. His teachers were gobsmacked, demanding to know how he had accurately computed the total almost instantaneously. Gauss explained that he had "simply spotted" 50 particular pairs of numbers between 1 and 100, each summing to 101 (i.e., 1 and 100, 2 and 99, 3 and 98 and so on) and thus, the task was reduced to a simple, one-step multiplication exercise.



Johann Carl Friedrich Gauss (1777–1855), painted by Christian Albrecht Jensen

Characteristics of a Gifted Child (Parker, 2007)

- Learns quickly and easily
- Readily comprehends things
- Often reads above grade(s) level
- Good memory and retains what is heard or read
- Bores with routine tasks, doesn't usually benefit from any drill and repetition
- Vocabulary and linguistic ability is often quite advanced
- Natural curiosity (makes inquiries)
- Can be very assertive and hang tight to personal beliefs
- Depending on the level of interest, can have a long attention span
- Good sense of wit, imagination, and creativity
- Prefers complex ideas and activities of an investigative nature
- Can conceptualize and generalize thoughts and ideas with ease
- Reaches levels of abstract thought at an earlier age and is interested in cause–effect relationships earlier than peers
- Often exhibits a wide range of interests
- Can be very task committed, goal oriented, and self-directed when the activity is within their area of interest
- Can become totally absorbed in certain areas, focusing all attention intensely on those areas
- Needs to be engaged and will become frustrated with inactivity or boring and/or repetitive tasks
- Can be a perfectionist
- Can be quite sensitive

Characteristics of the Mathematically Gifted Child
(Krutetskii, 1976)

- An ability to generalize mathematical material (an ability to discover the general in what is externally different or isolated)
- A flexibility of mental processes (an ability to switch rapidly from one operation to another, from one train of thought to another)
- A striving to find the easiest, clearest, and most economical ways to solve problems
- An ability chiefly to remember generalized relations, reasoning schemas, and methods of solving type-problems
- Curtailment of the reasoning processes, a shortening of its individual links
- Formation of elementary forms of a particular "mathematical" perception of the environment—as if many facts and phenomena were refracted through [the] prism of mathematical relationships

Of late, I have been unable to shake the mental image of Gauss, the prodigious young boy: curious and confident; creative and keenly observant; generative and intellectually playful; complex and constructive. As my mind's eye pictures the young Gauss standing before his teacher, eagerly explaining his unique approach and enthusiastically sharing the combinations he saw among the counting numbers that defined the problem, I can imagine his animated account of the elegant solution that lay behind the ingenuous "5050" scrawled across a page in childish print.

As an elementary school classroom teacher, one is privileged to assume a role in the mathematical learning journey of many children. There is no denying the joy one experiences when the student who is struggling finally "gets" place value or the meaning of the denominator; when the student with the negative disposition breaks into a wide grin in response to his original tessellation artwork; or, when the student who lacks confidence volunteers to display his or her solution on the Elmo™ projector for the whole class to see. And nothing compares to nurturing, challenging, and keeping up with the gifted[1] or talented mathematics student (typically defined as falling within the top 5% to 10% in the school).

As Mathematics Coordinator for the Board of Education for the City of Scarborough between 1992 and 1998, I had the honour of supporting, meeting, and working with the many gifted and talented mathematics students who participated in our locally developed and administered Mathematics Leagues (Grades 7/8, Junior [Grades 9 & 10], and Senior [Grades 11, 12, & 13]); University of Waterloo Mathematics Contests and Challenges; school-based mathematics clubs and competitions; and provincial Mathematics Olympics teams.

One of the annual "perks" of the job was hosting a Math Awards Night each May, an extraordinary evening of celebration conducted at the Education Centre. Over the course of the evening, hundreds of individual students and dozens of teams were recognized and celebrated by proud peers, teachers, and parents for their outstanding mathematics achievements at the national, provincial, city, and school levels. On such occasions, I presented trophies and certificates to a host of remarkable young people, many of whom went on to greatness—competing in international competitions and winning gold medals individually (like Scarborough's own David Pritchard, pictured below) and collaboratively, as members of a national team.



2000 Canadian Team for the International Olympiad in Informatics (Denis Dmitriev [Centennial Senior S.S., Coquitlam, BC], David Arthur [Upper Canada College, Toronto, ON], David Pritchard [Woburn C.I., Scarborough, ON], and Jonathan Gilbert [Vincent Massey C.I., Winnipeg, MB]).

[1] In Canada, each province varies in definition. The Ministry of Education for the province of Ontario has adopted a definition of "giftedness" which is as follows: "An unusually advanced degree of general intellectual ability that requires differentiated learning experiences of a depth and breadth beyond those normally provided in the regular school program to satisfy the level of educational potential indicated." In order to be considered as exceptional according to Bill 82, a student must be identified by an Identification, Placement, and Review Committee (IPRC) of the school board. The board is then required to provide a placement appropriate to the student's needs. This is true for all exceptionalities, including "gifted." Typically, gifted children are identified by a test in Grades 5/6 and are not retested. Only 2% of pupils are labelled "gifted."

For gifted and talented students, their participation in competitions should be for the purpose of providing an optimal learning experience; therefore, the identification process should be seen as a means to an end, rather than an end in itself. Riley & Karnes, 2006, p. 158.

On those occasions, I was in awe of—and humbled by—the achievements of these many students, particularly their capacity for abstract thought, and like Gauss before them, their intellectual courage and their ability to produce new combinations and patterns of ideas.

Be an opener of doors for such as come after thee. (Ralph Waldo Emerson)

At the time, I was—and remain to this day—sincerely appreciative of the countless hours invested by these students' mentors: Peter Crippin, Larry Rice, Diane Lang, Peter Harrison, Merilyn Fox, Krishna Rajballie, and others too numerous to list. Mathematicians, as well as mathematics teachers, these incomparable coaches scoured resources from around the world to get the inspiration to create new and intriguing mathematics challenges for the brilliant students about whom they cared so much. Wanting to nurture the students' passion for mathematics, while meeting their unique needs for enrichment and challenge, these coaches designed tasks that were based, not on the standard curriculum, but on ancient mathematical writings and texts, as well as on up-to-the-minute discoveries and innovative ancillary problems emerging from recently published breakthroughs. These educational masterminds opened doors for students' "visits" to the worlds, quandaries, and discoveries of Archimedes and Pythagoras, Fibonacci and Cantor, Dodgson and Fermi, Penrose and Coxeter, Pick and von Koch. Juxtaposing the giants of ancient times with those of the present day, and throwing in healthy doses of humour via the mathematical musical musings of Tom Lehrer or the mathemagical comics of Bill Amend, these exceptional, front-line teacher-mathematicians worked tirelessly to share, cultivate, and build upon their students' interests, curiosity, and depth of understanding. They embodied the Vygotskian (1978) principle of the significant role played by adults in the actualization of talent.

Retrospective studies have shown that many eminent achievers showed curiosity and interest in their chosen fields at a very early age, a finding that suggests that the gifts and talents of children need to be nurtured from the start: a call to action for elementary mathematics teachers, albeit no easy feat.

He who would search for pearls must dive below.
John Dryden

As teachers, we must recognize that the classroom experience can be difficult for the gifted and talented child who may be perceived by his or her peers as a non-conformist. Bright, achieving students may be left out of those childishly mean inner circles for being "different."



FoxTrot 20090208 FoxTrot © 2009 Bill Amend. Reprinted by permission of Universal Press Syndicate. All rights reserved.

However, like other children, gifted children deserve a happy childhood full of vigour, joy, optimism, and growth. Gifted individuals of all ages thrive best in learning environments that are a good fit for the level and pace of their development, with the joys and strengths that come from mastering challenges as well as companions who share their interests, curiosity, depth of understanding, and sense of humour. (Neihart, Reis, Robinson, & Moon, 2002)

For what is the best choice for each individual is the highest it is possible for him to achieve.

Aristotle

Second, according to a recent study about nurturing gifted and talented children by Professor Valsa Koshy, Christine Mitchell, and Dr. Mary Williams of Brunel University, children who are under-challenged and regularly asked to repeat activities they have long-ago mastered, risk not only the stultifying effects of incessant boredom, but are likely to turn off their learning and not make appropriate progress. These researchers also suggest that gifted and talented students may also try their best to be "just like everyone else," meaning that we may lose them at a very early age as they morph into underachievers.

Do not confine your children to your own learning, for they were born in another time.

Chinese proverb

In England, Australia, New Zealand, and many school districts in the United States, the gifted and talented mathematics student has become an educational priority, engendering significant investments in professional and resource development. The time is ripe for Ontario mathematics educators in all capacities to reflect on how best to implement effective teaching and learning strategies for gifted and talented students.

Many studies, including those of Viktor Freiman from the Université de Moncton, New Brunswick, have suggested that the discovery and nurturing of theoretical thinking is not possible if children are working with routine arithmetical tasks, merely applying algorithms provided by the teacher, who tells his or her students what to do and how to do it. To this end, Freiman, like Krutetskii and others before him, suggests that the mathematics curriculum be built around "challenging situations" that provide many "growing-up opportunities" for mathematical talent by

providing the student with an opportunity to face an obstacle of a pure mathematical nature, the so-called epistemological obstacle. In order to overcome it, the student will have to reorganise her mathematical knowledge, create new links, new structures following laws of logical inference.

These researchers claim that situations satisfying these conditions allow the teacher to identify and nurture mathematical giftedness among his or her students. It is the teacher's responsibility to present a problem that goes above or beyond the average level of difficulty, thus, encouraging the child to surpass what is normally expected of children that age, thus demonstrating the child's precocity, which is a sign of mathematical giftedness. It is within the purview of the teacher to create a friendly environment in which a child can compete with himself or herself, sharing his or her discoveries with other children, and learning from others, thereby giving mathematically gifted children who are not high achievers opportunities to participate actively in class and to succeed.

Freiman (using Krutetskii's taxonomy) argues that the "challenging situation" cannot be created as an isolated learning task. The appropriate implementation of a "challenging situation model" can be realized only within a system of teaching based on a challenging curriculum as a whole. This would create a learning environment in which every child would be able to demonstrate his or her highest level of ability. This model, contends Freiman, means that teachers are not only able to get gifted children involved in genuine mathematical activity, but also that opportunities can be created for all children to increase their intellectual potential.

Finally, says Freiman, the "challenging situation model" has another opening for gifted children: They can always go further, go beyond situations, ask new questions, initiate their own investigations, and be more creative in their mathematical work. This spontaneous mathematical reaction feeds back into the learning environment in a positive way and further enhances the potential of all children.

In 2010, the world will be watching some of the best athletes from around the globe as they compete in the Vancouver Olympics. We will marvel at their athletic prowess and practised skill. We will be exhilarated by their risk taking and courage. We will share in their victories and defeats. We will be grateful to their knowledgeable and expert coaches and the parents who encouraged them, provided opportunities for them, and made sacrifices for them. On such occasions, there is a

collective appreciation for these superstars, whose physical, emotional, and intellectual gifts have been perfected through hard work, appropriate teaching, and focused practice. Never does it occur to the Olympic spectator that these athletes should not have taken the long road of specialization and competition, or that the intense training camps and preparatory contests were exclusionary or elitist.

Perhaps the 2010 Olympics will be the motivation to move the mathematics education horizon. There is no doubt that there is a need for a focus on numeracy, high-quality remedial and/or intervention programs, and specially educated teachers for disadvantaged students of all types. But there is also a need to better identify and support the gifted and talented mathematics students in our elementary classes by providing them with specialist teachers who share, not just a passion for mathematics but, like the Olympic coaches, their expert knowledge, experience, strategies, and resources.

> ***The root of excellence****—from the Greek—is not, properly, to surpass others—or to be greater than them, but rather, to rise up naturally, to raise—as a crop is raised. The oldest root in the word—from the Greek—is that for HILL. Imagine that hill. It was not placed on the landscape to make the prairie feel flat. It was not raised to make the sky tremble. Its job is to be a hill. We do not know why, but we know a hill-less world would be unbearable.*
>
> Jorie Graham,
> Pulitzer Prize for Poetry, 1996
> *The Dream of the Unified Field*

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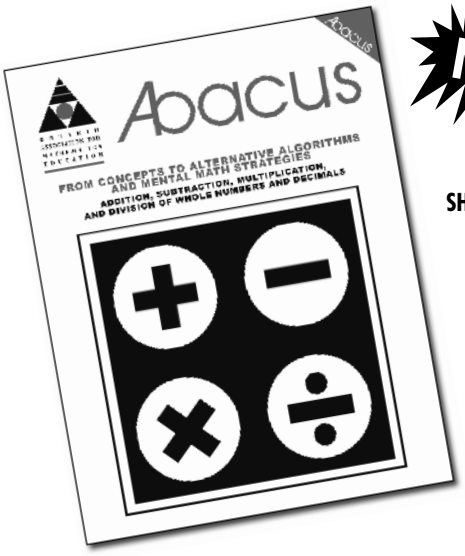
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▲ OAME/NCTM Report September 2009

LAURIE MOHER
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PLaurie is an Instructional Coach Facilitator for Literacy and Numeracy (JK–8) with the Kawartha Pine Ridge DSB. She has served on the Board of Directors of OAME for 12 years.

Earlier this year, NCTM announced its next president: J. Michael Shaughnessy. Currently, Mr. Shaughnessy is a professor at Portland State University. He previously taught at Oregon State University and had visiting professorships in Spain, Australia, and New Zealand. J. Michael Shaughnessy began working alongside current NCTM president, Henry (Hank) Kepner, in April 2009 and will continue to do so until April 2010. In April 2010, Mr. Shaughnessy will take over as NCTM president and will serve in that capacity until 2012.

Current NCTM president, Hank Kepner, has encouraged teachers and principals to work collaboratively to improve student learning. In his recent "President's Messages," Mr. Kepner highlighted a number of ways that this could be accomplished, including:

- principals and teachers working together to establish a protocol for analyzing student work
- principals providing opportunities for teachers to examine curriculum and look for connections among state standards, assessment frameworks, and local curriculum guides
- principals and teachers working together to identify the "focal points" or "Big Ideas" and their progression over time and across grade levels

As I read these messages, I was struck by how President Kepner's suggestions for professional development align so well with what many teacher leaders are currently doing in Ontario and how these ideas allow for rich dialogue between teachers and principals, which, in turn, leads to improved student learning.

All of Hank Kepner's "President's Messages" can be found on the NCTM website and are available to non-members as well as to members.

If you have not had an opportunity to visit the *Illuminations* site recently (**www.illuminations.nctm.org**), it is worth taking the time to do so. In addition to a new logo, there have been other improvements to this resource-rich site. The site now has revised versions of Concentration and an improved Circle Tool. The revised Concentration applets focus on numbers, shapes, fractions, decimals, and percents. The Circle Tool allows students to explore the relationships among radius, diameter, area, and circumference. Free Ride is a new applet that allows students to complete a bicycle race by applying their knowledge of ratios. These applets, along with more than 100 other applets, can be found in the "Activities" section of the *Illuminations* site. In this section, there is also easy access to the e-Examples from the NCTM Standards.

The *Illuminations* site also has a "Lessons" section, which contains 540 lesson plans, including some new ones that have been recently added. This section can be searched by grade band and/or strand (content standards), as well as by other, more specific, search criteria. The main page of this section also features two highlighted lessons.

Another useful section of this site is the "Standards" section. This section links to the Standards for K–12 (by strand). In addition, each grade band has links to the Standards specific to that grade band and to Electronic Examples. A third part of this grade band section is entitled "Video Reflection." It features a number of short video clips and guiding questions. This would be a wonderful resource to use with a group of teachers who are exploring an identified topic.

The final section on this site is entitled "Web Links." This links to 724 Internet resources, selected by an NCTM editorial board. To use this part of the site, click on the resource name or image to read a brief review by the editorial board, or click on "Direct to Web Resource" to go right to the website.

The Activities, Lessons, Standards, and Web Links can all be easily accessed by using the navigation bar at the top of the *Illuminations* home page. ▲

▲ Let's All Use Our Fingers

PAUL BETTS
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Paul Betts is an Associate Professor in the Faculty of Education at the University of Winnipeg. He teaches mathematics teaching methods to elementary pre-service teachers. One of his main research interests is the professional learning of mathematics teachers.

Our findings support the view that children who are able to use their fingers as representational and procedural tools perform better in mathematics.[1]

Children naturally use their fingers to make sense of quantities. I have watched my daughter match up four objects with four fingers on her right hand, count her matched fingers, and conclude that there were four objects.[2] I have also watched her use her fingers to calculate small sums, such as 4 + 3 and 8 + 5.[3] A child's fingers are important for their developing number sense. The question becomes: What should teachers do? In this short article, I will draw on cognitive and cultural/historical perspectives to suggest the importance of finger use by children, and to suggest possible teacher actions that foster and build on finger use by children. I also wish to emphasize the importance of not suppressing children's use of their fingers to make sense of quantity, even later in development.

I will first consider the importance of finger use from a cognitive perspective. Research by various psychologists[4] suggests that finger use is related to mathematical ability, and that suppressing finger use can be detrimental to children's mathematical development. We might be worried about children being dependent on their fingers to do simple math, or worried that finger use interferes with mental math and basic fact recall. Baroody[5] states that children achieve computational fluency by progressing through three phases: 1) Using concrete, verbal, or kinesthetic counting strategies to compute a quantity—this includes finger use. 2) Deducing an unknown through the use of known amounts; these known amounts are basic facts that gradually become automatic from the first phase. 3) Mastery. A child cannot reach phase three without successful experiences in phases one and two. Bruner's theory of learning[6] states that beginning with concrete, then pictorial, and finally symbolic representations of a concept optimizes learning. Fingers are ideal for concrete representations of small quantities. Generally, cognitive theorists and researchers suggest that finger use is fundamental for developing children's number sense, and that suppressing finger use could be detrimental to the natural developmental processes involved in understanding quantities.

Informal opportunities to foster number sense through finger use will always come up in the classroom, and are an integral part of Baroody's beginning phase of computational fluency. But we may want to ensure that children are provided with opportunities to formalize their number sense. One possibility would be to tap into what Egan[7] refers to as the power of children's imagination. Egan believes that the imagination of children can be successfully tapped to trigger learning in any discipline. Below, I suggest two examples of developing number sense through imagination and finger use.

Example one involves storytelling, puppetry, and other dramatic arts. Imagine a land where the creatures have four hands. In this land live three best friends—Digit, Tom Thumb, and Tuna Finger. Digit has four fingers and one thumb on each hand, so he can count to twenty with his fingers. Tom Thumb is all thumbs, so he can count only up to four. Tuna Finger has two fingers on

[1] *Penner-Wilger, M., LeFevre, J., Fast, L., Smith-Chant, B., Skwarchuk, S., Bisanz, J. & Kamawar, D. (2007, March). Putting your finger on it: How neuropsychological tests predict children's math ability. Poster presented at the Society for Research on Child Development Biannual Conference, Boston.*

[2] *When she was four years old.*

[3] *When she was six years old.*

[4] *See, for example, Penner-Wilger, et al. (endnote 1); Baroody (endnote 3); Gracia-Bafalluy & Noël (2008), Does finger training increase young children's numerical performance?,* Cortex*, 44(4), 368–375; Butterworth (1999),* What counts: How every brain is hardwired for math, *New York: The Free Press.*

[5] *Baroody, A. (2006). Why children have difficulties mastering the basic number combinations and how to help them.* Teaching Children Mathematics, *13(1), 22–31.*

[6] *Bruner, J. (1966).* Toward a Theory of Instruction. *Cambridge: Harvard University Press.*

[7] *Egan, K. (2005).* An Imaginative Approach to Teaching. *San Francisco, CA: Jossey-Bass.*

each hand, so she can count only as far as eight. Stories revolve around the adventures of Digit, Tom, and Tuna. Each day, an event happens involving math. Anytime Tom or Tuna need to calculate a larger quantity, they ask Digit. For example, one day, the story might be about a marble game, where Tom started with fifteen marbles and lost seven to Tuna, who started with nine marbles. Digit must determine how many marbles Tom and Tuna have at the end of the day. Children can draw pictures of the storyline, including a picture of Digit doing calculations with his fingers. Or, perhaps a real puppet could be used. Questions can target basic facts up to 9 + 9. Children can be encouraged to build multiple decompositions of a number, such as 16 = 9 + 7 (marble example above), 16 = 5 + 5 + 5 + 1 (using three of Digit's hands and one finger from his other hand), and 16 = 4 + 4 + 4 + 4 (using all four fingers from each of Digit's four hands). The goal is to provide a context from which children can work with concrete and pictorial representations of number, which is consistent with Bruner's theory of learning. These opportunities may also trigger movement through Baroody's phases.

Example 2 involves imagining the use of fingers to calculate. Consider this progression for developing basic addition facts up to 5 + 5: On day one, children calculate sums such as 5 + 4, using their fingers. On day two, questions are in related pairs, such as 4 + 2 and 4 + 3. Students use their fingers for the first question in a pair, and use their fingers behind their backs, imagining the use of their fingers, to calculate the answer to the second question. (Using a related pair of questions helps to insure success). The next day, the procedure from day two is repeated, but question pairs are not related. On day four, children try to answer all questions with their hands behind their back, but can look if they are having difficulty. On day five, children try to calculate by imagining their fingers in their head, but if they struggle, they can use their hands behind their back or look at their hands. Do about three pairs of questions per day, which should take less than ten minutes, changing the questions each day. Repeat this five-day cycle. In two to three weeks, most students will likely be able to recall quickly, accurately, and with understanding, all addition facts up to 5 + 5. (Not including 0 and addition order, that is 15 facts.) This establishes a collection of known facts that can be built on. In other words, there is a base of understanding that is required for children to move into Baroody's second phase. The key, according to Bruner's theory, is that children are always allowed to use their fingers—whether imagined or not—to be successful, and where basic fact recall emerges, essentially for free.

I will now consider the importance of finger use by children to make sense of numerical contexts from a historical/cultural perspective. Counting appears to be an almost universal activity of human cultures, from tribal to modern day.[8] Across various cultures and history, there are many different ways of counting, but all seem to be rooted in the use of fingers to keep track of quantity.[9] Many cultures use groups of ten, the number of fingers on both hands. Roman numerals are based on groups of five, the number of fingers on one hand. At least one tribal culture uses groups of eight, based on the number of gaps between fingers (four per hand). These examples are meant to suggest that counting is a fundamental cultural activity that emerges from daily activity and the use of fingers to represent quantity.

There are numerous examples of the use of counting systems from other cultures to develop number sense in children.[10] Asian number systems use number words that don't hide place value meaning. For example, 12 translates as one 10 and 2 in all Asian languages, rather than the place-value-obscuring "twelve" in English. The place value synchrony of Asian number words has been used in North American classrooms to help students unpack the relationship between number names, quantity, and place value. On the other hand, other non-base-ten number systems can be used to develop number sense by providing a motivated context for building up and decomposing quantities. These brief examples are described in greater detail elsewhere, and are meant to suggest the variety of possibilities available to teachers. In this article, my focus in on the use of fingers to represent counting and calculating quantities, an example of which I develop below.

The Tamanacas, a tribe found in South America, use hands and feet to keep track of quantities, based on groups of five and groups of twenty.[11] One to five is

[8] *Ascher, M. (2004).* Mathematics Elsewhere: An Exploration of Ideas across Cultures*. Princeton, NJ: Princeton University Press.*

[9] *Allen, D. (2000). The Origins of Mathematics. Retrieved June 16, 2006 from* ***www.math.tamu.edu/~dallen/masters/origins/origins.pdf****.*

[10] *Zaslavsky, Claudia (2001). Developing number sense: What can other cultures tell us?* Teaching Children Mathematics. *7(6) February, 312–319.*

[11] *See Allen, D. (2000).*

counted by fingers on one hand, six to ten is counted by saying the number of fingers on the other hand (e.g., 7 = raise one hand and say/raise "two" on the other hand). Eleven to nineteen requires the use of one foot or both feet (e.g., 18 = raise both hands, put out one foot, and say "three" on the other foot). Twenty, forty, and sixty are one, two, and three Tamanacas, respectively. For example, 57 is two Tamanacas, both hands, one foot, and "two" on the other foot.

We can build effective math lessons based on Tamanaca counting. Several kinesthetic activities could be used to develop and problem solve progressively larger numbers. These activities would create opportunities for children to build numbers in ways that differ from our standard base ten notation, and thereby develop a richer sense of number. For example, children can experience through actions with their fingers, hands, feet, and other students that 44 = 20 + 20 + 4 (Tamanaca + Tamanaca + 4 fingers). This construction, and others like it, would lead to understandings necessary for improved (mental) calculation, and probably a more flexible understanding of place value. At the very least, it creates opportunities for reasoning quantities from known amounts, a move from Baroody's phase one to phase two, and, as per Bruner, hinges on the use of fingers to shift from informal/concrete to formal/symbolic understandings of quantity.

The focus I have made on finger counting should not be taken as a rejection of other contexts for exploring quantity with children. I strongly believe that children should generalize across multiple linkages, from the physical to the imaged to the symbolic, which can be accomplished using fingers, counters, blocks (e.g., Dienes blocks, Cuisenaire rods), number lines, and hundred boards. As Wright, Martland, and Stafford[12] note, "one expects ultimately that children will no longer rely on using finger patterns. Nevertheless, finger patterns play an important role in early numerical strategies, and their use and development is to be encouraged."

On the other hand, we should not conclude that finger counting is a primitive context for making sense of quantity and something from which children need to be weaned. Based on a cognitive and historical/cultural perspective, finger counting is fundamental to developing number sense.[13] To suppress its use, in the name of encouraging more sophisticated methods, is to rob children of a foundational tool (both cognitively and historically/culturally) for doing mathematics. It is my belief that fingers will not turn into a crutch impeding students' developing number sense. Fingers are a tool that are always available, and thus, can always support the development of sophisticated methods for dealing with quantities.[14] As a simple example, my daughter now uses her fingers to keep track of quantities while doing mental multiplication and while skip counting.[15] Further, to insist that children—at any age—not be allowed to use their fingers to make sense of numerical contexts could do more harm than good because it may reduce opportunities for children to be successful while their number sense develops. ▲

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[12] Wright, Robert J., Martland, Jim, & Stafford, Ann K. (2000). Early numeracy: Assessment for teaching and intervention. *London: Paul Chapman.*

[13] Some readers may object to this claim, arguing that fingers could become a crutch, similar to the claim that too much calculator use may impede mental math skills. I disagree, and maintain the stronger claim that finger use ***will not*** *impede the development of number sense for five reasons: First, as argued in this paper, cognitive and historical/cultural perspectives support finger use by children. Second, fingers help children to be successful with calculation, so suppressing their use may contribute to math anxiety. Third, fingers are always available, so why not be able to use them to support calculations? Fourth, we assume that calculation without fingers is more sophisticated than with fingers, but this assumption is a* value judgment *and is not grounded in theories of thinking or learning. A child who uses his or her fingers to make sense of a quantitative context may be using highly sophisticated thinking. Finally, I have not found any empirical research evidence to support the claim that finger use does become a crutch in the same way that calculator overuse impedes mental math skill.*

[14] For example, Brooks described how fingers and an abacus can be used to perform more advanced calculations, such as those done by a tax accountant. See Andre Brooks, "Fingers Make a Comeback in Math," New York Times*, January 8, 1978.*

[15] For example, 21 x 3 is calculated mentally as follows: 20, 40, 60, 61, 62, 63. The skip counts by 20 are tracked using fingers.

▲ Call for Manuscripts

The *Ontario Mathematics Gazette* is inviting manuscripts for all grade levels.

Instructions for submission of manuscripts are found on page 1 of any *OMG*.

Contact the Editor for further details.

▲ 2009 OAME Awards

The **Award for Outstanding Contribution to OAME/AOEM and Mathematics Education in Ontario** recognizes an individual who has made a significant contribution to OAME, but who is not necessarily an educator or a member of OAME. This year's recipient is **Joel Yan**, who recently retired as an outreach officer for Statistics Canada.



At the awards banquet, almost everyone put up their hand when asked whether they had used Statistics Canada materials, compared to maybe half a dozen who put up their hand to indicate that they had used materials from any other governmental agency. The engagement of Statistics Canada with Ontario mathematics education is largely the result of Joel's efforts. Joel has presented and organized numerous workshops at OAME provincial and chapter conferences, as well as in schools, boards, and faculties of education across Ontario. Joel has prepared and/or disseminated learning resources related to data for teachers at all grade levels, both on the official Statistics Canada website (**www.statcan.gc.ca/kits-trousses/courses-cours/edu05_0019-eng.htm**) and on a site he initiated and maintains especially for mathematics teachers (**www.teacherweb.com/ON/ Statistics/Math/**). These resources have been posted in response to requests by OAME and OMCA members and have been validated by thousands of downloads. Joel also moderated (in both official languages) a StatCan listserv for mathematics teachers and set up an e-mail address (**mdm4u@statcan.ca**) to help MDM4U students across the province. Joel has been an advocate for the use of provincially licensed software such as Fathom, and has developed a wide set of data sets and lessons to support its use. Some of these resources are featured on the resource-sharing site at Key Curriculum Press (**www.keypress.com/x2812.xml**) and on the following OSAPAC website: **www.osapac.org/dbOESS/ResourceBrowse.asp?ViewGrade=All&Subject=Mathematics&Selector=key&GridChoice=All%20Subjects&SrchKey=yan&OrderBy=Downloads**. Joel was instrumental in licensing the Canadian Community Health Survey microdata and *Beyond 20/20* for use in Ontario schools, subsequently providing tutorials on their use. He also wrote a regular column (Data Rocks) for the *Ontario Mathematics Gazette* and advised provincial curriculum review committees, supporting their work with resources like *Function Modelling Using Secondary Data from E-STAT.* (See **www.statcan.gc.ca/edu/edu 05_0018c-eng.htm**.) Joel has energetically and freely shared his enthusiasm, knowledge, and resources with the mathematics community in Ontario.

The **Kenneth D. Fryer Award** recognizes a secondary



school mathematics department that fosters collegiality, teamwork, and excellent classroom teaching; contributes to the overall development of students; and demonstrates leadership in the mathematics community. Congratulations to the **Mathematics Department of Mother Teresa High School in the Ottawa Catholic District School Board**. The members of this department have demonstrated the ability to work together as a team and have undertaken a number of initiatives that positively impact the classroom. Furthermore, they do this with enthusiasm as they collaborate and support one another on their professional journey as lifelong learners. Additionally, they mentor young teachers in other departments and share their successes with other mathematics educators at various conferences. Members of this department have undertaken the development of lessons for TIPS4RM and have embraced the use of TIPS material in their classrooms. They have also embarked on an initiative involving student ownership of TI-Nspire handheld calculators. Included in this is the sharing of expertise in ways to use this technology more effectively within the Ottawa TI user group. Members of the department have also led presentations on "Project-Based Learning" and "Using Technology Effectively in the Teaching of Mathematics." As well, the department is presently

involved in a Ministry of Education assessment project that requires a significant commitment on the part of its members. Although the sharing of expertise and resources is important and prominent in the department, it is the sharing with one another that has created the greatest success in the school. Each and every member of the department is welcome to ask for help or materials, share a wonderful story, or discuss a challenging situation. These teachers work as a team in the truest sense of the word. For example, the teacher on prep usually spends this time in another classroom, helping the regular teacher troubleshoot technology. The principal appointed to Mother Teresa in September 2008 said this about the department: "I am honoured to have the opportunity to work with professionals who exemplify collegiality, teamwork, excellent classroom teaching, and leadership that they share with everyone throughout our school, community, school board, and province."

The Award for Exceptional and Creative Teaching in Elementary Mathematics is presented annually to recognize an exceptional and creative elementary teacher who demonstrates excellence in mathematics education by contributing to the overall development of students. This year, the award was presented to two worthy recipients, **Laurie Moher** and **Jennifer Brown**.

Laurie Moher is presently an instructional coach facilitator for the Kawartha Pine Ridge District School Board. Laurie has been serving on the Board of Directors for OAME since 1997 and is presently the NCTM representative, which keeps her on the forefront of mathematics thinking—something she willingly and enthusiastically brings back to educators and students in the board. Laurie began teaching in 1987, and throughout her career, she has held a variety of positions of leadership and responsibility, including that of literacy and numeracy coach. Laurie has planned and presented mathematics workshops locally and provincially and has prepared and shared strategies to use the Ministry math exemplars and the Ontario Unit Planner. Presently, her responsibility includes creating and delivering math workshops to support the knowledge development of all instructional coaches in her superintendency. These coaches then share this knowledge and their new-found expertise as they help teachers in classrooms grapple with instructional and assessment strategies in numeracy.



Laurie strives to improve her own mathematics understanding and provides opportunities for growth for educators around her. For example, Laurie co-led a system-wide PD series on the mathematical processes, which involved a range of educators who participated in a variety of activities designed to help them engage in rich dialogue around moving mathematics instruction from content knowledge to process-based, "math talk" communities. The result was improved classroom instruction and student learning. Laurie has had a tremendous impact on student achievement and on the teaching of mathematics.

Jennifer Brown's mission statement is, "A ship is safe in its harbour, but that's not what ships are for." Creativity requires a certain amount of risk taking—that is, challenging one's self to go outside one's comfort zone to create and implement new initiatives and set the course for others to follow. Jennifer, from the Simcoe County District School Board, has done this at the provincial, regional, and board levels. For example, she has given presentations on numeracy coaching at the Provincial GAINS Conference, at the Student Success Regional Conference, and as coordinator of numeracy K–12 for the Simcoe County District School Board. Her main focus in each case is on achievement for all students. Jennifer has been responsible for coordinating the implementation of the SMART Board™ initiative for the Simcoe County District School Board and has planned system-wide professional development that has been acknowledged by SMART Technologies as an exemplary model. Also a PRIME presenter, she has the extraordinary ability to present mathematical ideas and information in a way that empowers teachers to try new methods, thus passing her creativity on to other math educators. Jennifer also guides teachers and parents in their efforts to help students understand math in more authentic ways. In her various roles, Jennifer has always remembered her roots in the classroom and has found frequent opportunities to practise what she advocates by being in the classroom as much as possible, teaching with great passion and enthusiasm.



The **Award for Exceptional and Creative Teaching in Secondary Mathematics** recognizes an exceptional and creative secondary teacher who demonstrates

excellence in mathematics education by contributing to the overall development of students. **Mary Bourassa**, this year's recipient, teaches at Lisgar Collegiate Institute in the Ottawa-Carleton District School Board. Her experience includes teaching all grades of mathematics, computer programming, and computer networking. Mary has demonstrated her dedication to teaching and students during her entire teaching career. As an adaptable and willing learner herself, she has implemented strategies that enhance her teaching and lead to improved student success. This was exemplified when Mary took a leading role in the implementation of hand-held technology in the classroom. Mary has continued learning and sharing her expertise with this technology and has been a T^3 National Instructor since 2005. Mary's creativity is evident in her development of lessons and activities for students, particularly with respect to lessons involving hand-held technology. Her expertise and leadership is recognized in the Ottawa area, in Ontario, in the United States, and in Australia. One of Mary's struggling students said of Mary, "I was motivated to make her proud throughout the course. As a student, a teacher's enjoyment of their job is blatantly obvious to us. Mrs. Bourassa always seemed to truly enjoy her profession and put effort into every lesson she taught. Mrs. Bourassa was always in good humour and genuinely looked like she was having fun while teaching the class. She did not simply present the class with an idea, but let us explore it beforehand. Her teaching style catered to all types of learners."



Mary continually tries to find the best way for her students to learn mathematics and to enjoy not only the subject, but learning, too. She is very effective at finding the best tools for teaching the material and has her students investigate the math they are learning by gathering primary and secondary data. Furthermore, Mary contacts parents regularly to let them know how their son or daughter is doing. Mary's leadership in math education is apparent: She was on the Board of Directors for OAME from 2001–2007, was Program Co-chair for the OAME 2009 conference, is a regular columnist for the *Ontario Mathematics Gazette*, and continues to be a sought-after presenter at conferences throughout Ontario. The executive of COMA voted unanimously to nominate Mary for this award. She gives tirelessly of her time to students and teachers alike and is an exceptional secondary mathematics teacher.

The **Leadership in Mathematics Education Award** recognizes an educator who has demonstrated leadership by contributing in a significant way to the development of mathematics teachers and the enhancement of mathematics education in Ontario. Congratulations to **Kathy Kubota-Zarivnij**, a very deserving recipient. "Kathy is a gift to the students and teachers of this province" sums up the praise and accolades included in Kathy's nomination package. Kathy's involvement as an active member of OAME since 1993 is only the beginning of her mathematics leadership story. Under her leadership, mathematics educators in Ontario and across Canada have changed their view about what it means to have students do mathematics. Kathy challenges educators to focus on children's thinking and to knit their ideas together so that math class becomes a knowledge-building environment where everyone contributes. Kathy encourages change because she wants to make mathematics accessible to all people. Let's take a short glimpse into some of her activities for the past year: She taught Intermediate Mathematics Additional Qualifications courses; wrote mathematical leadership resource materials for the Catholic Principals' Association; led a working group at the Canadian Mathematics Education Study Group (CMESG) and produced a paper to report on the learnings; facilitated at the OAME Leadership Conference; and co-edited "*Abacus*." She has also provided numerous workshops and is working on her doctorate. All of this is in addition to her work in the Literacy and Numeracy Secretariat!



It requires a leader to guide constructive change. In his book *The Six Secrets of Change*, Mike Fullan describes what the best leaders do to help their organizations survive and thrive. Kathy brings these six secrets to life in the following ways:

1. *Love your employees:* It is because of the love Kathy has for educators and the students that they teach that she continues to present at annual, leadership, and chapter OAME conferences. At these sessions, she provides experiences that encourage teachers and leaders to take their learning back to their boards, chapters, and classrooms.

2. *Connect peers with purpose:* Kathy skillfully engages educators in purposeful interaction when they come together under her leadership during professional learning.
3. *Capacity building prevails:* In-service participants return to their classrooms and board offices with renewed energy and enthusiasm and with the vision of putting their collective learning into practice.
4. *Learning is the work:* Over the past number of years, we have seen Kathy focus her capacity-building efforts in the area of teaching through problem solving, Bansho, and complexity theory. Her focused and precise work has developed a new depth of understanding among the teachers and leaders in the province.
5. *Transparency rules:* Kathy provides educators with the evidence-informed theories and professional learning experiences needed to transform their teaching. By drawing on the knowledge developed by educators and their successful experiences with teaching through problem solving, educators are making shifts in their practice.
6. *Systems learn:* Kathy invests time and energy to develop future leaders so that the change will sustain itself. She enables, engages, and supports other leaders.

It is evident that the work that Kathy has accomplished over the years truly brings to life the Six Secrets of Change and makes her a very worthy recipient of this Leadership Award.

The **OAME Life Member Award** recognizes an educator who has demonstrated outstanding leadership in mathematics education in Ontario and who has contributed in a significant way to OAME. **Myrna Ingalls** is unquestionably ***the*** leader of mathematics education in our province. In addition to being an avid sailor in her spare time, she navigates the instructional waters and adjusts the sails in order to manage the winds and waves of mathematics educational reform. As education officer at the Ministry of Education for Mathematics, Grades 7–12, Myrna is always on the lookout for favourable winds when it comes to supporting positive changes in mathematics instruction and takes advantages of "lifts" when they present themselves. She engages more and more educators in a wide range of roles as the mathematics journey progresses, and she believes in sharing the helm with others. This is particularly evident in the most recent initiative of implementing math coaching in every board in the province. Myrna believes that in order to reach every student, we must reach every teacher, and that just as one instructional path does not address the needs of all students in a classroom, one type of professional learning opportunity does not prepare all educators to implement necessary changes. Under her visionary leadership, large and expanding networks of mathematics educators are brought together through a series of interconnected development projects led by various boards of education across the province. *TIPS* for Grades 7–9 Applied Mathematics, released in 2003, was the first comprehensive set of implementation supports for teachers, principals, and professional learning providers. Myrna sets parameters for projects that include the collaborative processes of planning, creating, questioning, applying research findings, and providing constructive feedback. Myrna sees her main contributions as conceptualizing and positioning the work; gathering strong teams; nurturing creativity and collaboration; making sure the work meets high standards for depth of treatment and high quality; and finding ways of engaging, at an appropriate level, all who express an interest in its involvement. As a result of this work, teachers and students have benefited from resources such as the *Leading Math Success Expert Panel Report, Grades 7–12; TIPS4RM: Targeted Implementation and Planning Supports for Revised Mathematics; CLIPS: Critical Learning Instructional Paths Supports; GAINS: Growing Accessible Interactive Networked Supports;* and *PLMLP: Professional Learning for Mathematics Leaders Project.* You might gather that Myrna loves acronyms. We fondly refer to her as our "main node," not just because it describes her role as central to the networks she builds, but also because *NODE* is an acronym for Networking, Outward looking, Dynamic, and Engaging.



Despite Myrna's devotion to her work, she finds time for balance in her life, especially when it comes to her family. Myrna carves out time to sail and travel with her husband, David, and to spend time with her daughter, Janet, son-in-law, Mark, and granddaughter, Kaitlyn—the princess in her life. Many educators have benefited from being mentored by Myrna. Ontario is fortunate to have this amazing, hard-working leader, who works to make gains in student success by helping educators make shifts in their practice. She is truly a deserving recipient of the OAME Life Membership Award. ▲

▲ Mathematical Inquiry in Ontario Classrooms

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Current views on mathematics education promote engaging students in mathematical inquiry through problem solving and investigation. These views are backed by research and have surfaced in mathematics curricula around the world, including the Ontario mathematics curriculum. Such curricula reflect the recognition that knowing mathematics means more than simply knowing procedures; it includes being able to reason and communicate mathematically and engage in solving mathematical problems (Ball 2003; Boaler, 2002; Hiebert, 1997; NCTM, 1989, 2000). In an inquiry-oriented approach, students might be introduced to a rich problem, set about working on the problem individually or in small groups, and have a variety of resources available, such as manipulatives or technology, to model or represent the problem and solution. To consolidate their understanding, students would then share their strategies and solutions in a mathematical discussion facilitated by the teacher. Not every lesson follows this pattern exactly, but the focus is on engaging students in mathematical activity, rather than having them passively take notes of examples.

The Ontario mathematics curriculum encourages mathematical inquiry as part of regular classroom practice. The curriculum states that problem solving "forms the basis of effective mathematics programs and should be the mainstay of mathematical instruction" (OME, 2005a, p. 11 & 2005b, p. 12). It also indicates that using a variety of tools, including concrete materials and technology, is an essential part of classroom practice, as it helps students learn concepts and develop flexible thinking. Communication is a key element of instructional and assessment practices, and classroom strategies that promote student-to-student dialogue about mathematical ideas are encouraged to enhance students' understandings of mathematics.

But what does this look like in practice? How do teachers move from a lesson design of the teacher taking up homework, then providing examples, followed by students working on practice questions, to an approach where students engage in problem solving, students share solutions, and teachers facilitate the consolidation of their understanding?

CIIM Case Studies

In order to discuss what engaging students in mathematical inquiry might look like, we will draw on the case study data gathered in the Curriculum Implementation in Intermediate Math (CIIM) research project. This project was a large-scale study over three years that was designed to provide information about how the Ontario mathematics curriculum for Grades 7–10 is understood, taught, and supported. Data were gathered through an analysis of the Ontario mathematics curriculum; interviews with leaders in mathematics education; an extensive questionnaire for teachers of intermediate math (n = 1096); interviews with mathematics teachers; and nine one-week case studies of environments in which teachers used inquiry-oriented practices.

Some of the preliminary data from focus group interviews and the teacher questionnaire have been shared through the CIIM Research Report[1] (Suurtamm & Graves, 2007) that was distributed to Ontario school boards in 2007. However, for this article, we will draw on the classroom case study data to describe what engaging students in mathematical inquiry looks like. For each of these, we observed and videotaped four to six mathematics lessons and interviewed the classroom teacher and school and department administrators. The case studies took place in a variety of teachers' classrooms in school boards throughout the province and included classes in Grade 7, Grade 8, Grade 9 Applied, Grade 9 Academic, and Grade 10 Academic.

Enacting Inquiry-Oriented Practice

The case studies provide us with evidence of inquiry-oriented practices, and in our analysis and descriptions, it was useful to direct our attention to specific classroom practices that are integrated components of inquiry-oriented teaching and learning. These include providing opportunities for problem solving, encouraging the use of mathematical thinking tools, and facilitating mathematical communication. We saw evidence of these practices in all case study classrooms, but in our discussion, there is space to provide only a few specific examples drawn from a few classes.

Opportunities for Problem Solving

Opportunities for problem solving were evidenced in all of the case studies. Teachers might begin a lesson with a

problem to introduce the topic, or might, at other times, interject small problems into the lesson for students to think about, discuss with a partner, and then share their ideas in a whole-class discussion. Our video data show teachers posing problems and students moving in and out of groups to investigate and discuss the problems. Students had access to a variety of manipulatives, and they used these to construct mathematical models, examine their properties, and conjecture connections to other representations such as pictorial, symbolic, and linguistic. Students shared their solutions with the class, and through discussions facilitated by the teacher, consolidated their understanding. In most case studies, the class moved very easily in and out of group problem-solving activities, suggesting that a culture of problem solving had been established.

For instance, Angela's Grade 8 classes often began with a problem. In one particular lesson that focused on problem solving and the development of algebraic thinking, the students were given the following problem called "The Tug of War."

> In the first tug of war, 4 frogs on one side had a tie with 5 fairy godmothers on the other side.
>
> In the second tug of war, 1 dragon had a tie with 2 fairy godmothers and 1 frog.
>
> The third tug of war was between 1 dragon and 3 fairy godmothers on one side and 4 frogs on the other side. Who would win the tug of war?

In pairs, students worked with markers and a large sheet of chart paper and had access to a variety of manipulatives. While students worked, Angela circulated and used a wide range of questioning techniques; she continuously challenged her students to consider *why* and *how* as well as *what* they were investigating, encouraging them to look for patterns, offer conjectures, and make connections with other mathematical ideas. To solve the problem, students used different representations and a range of mathematical ideas, such as proportional reasoning, substitution, using variables, and providing a numeric value to each of the characters.

This description provides an example of the types of activities that were observed in several Grade 8 classes. For instance, in another Grade 8 class, Megan, the teacher, presented the students with ten problems, and in their problem-solving groups, they worked together to choose at least one problem to solve. Each group then presented its solutions and provided reasons for choosing that problem. This activity provided space for an extended mathematical discussion. The students provided a rich variety of representations, including drawings, graphs, natural language descriptions, tables of values, diagrams, and charts. One group created an embodied representation and physically acted out a problem to determine how many handshakes would occur if everyone shook hands.

All teachers spoke about the importance of problem solving in the current math curriculum. In response to our question, "What is this particular math curriculum buying us in terms of children's learning?" Megan replied,

> *It's buying us problem solvers, children who are willing to take risks with their learning and try something different. It's developing team approach—working with others, co-operatively... It's giving us students who are able to understand the whole concept and not just go from point a to point b and have no comprehension of what happened between them. It's also buying us students who see that math is all around us.*
>
> (Megan, Grade 8 teacher, interview)

Mathematical Thinking Tools

We use the expression mathematical thinking tools for materials—such as manipulatives or technology—that students use in class to help them create, think about, and discuss mathematical ideas. In the case study classrooms, we observed students using a variety of mathematical manipulatives, such as linking cubes, algebra tiles, and two-colour counters.

In one case study, the entire secondary mathematics department included mathematics manipulatives in all of its math courses. We observed one teacher from the department, Terry, while she taught her Grade 10 Academic class. The students were working on quadratic relationships. The following is a description of a segment of her lesson:

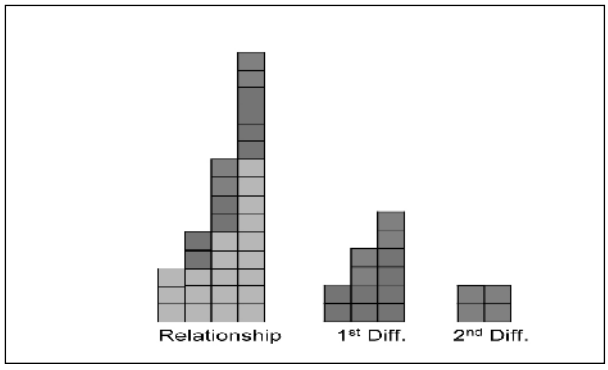
> Terry began the lesson by modelling a linear relationship with stacked linking cubes. She made a series of stacks of cubes and then drew the associated table of values. Through questioning, the class discussed first differences and the relationship of first differences to the slope of a linear relationship. Students were asked to work in groups to construct models of a linear function based on an assigned first difference. Terry circulated and assigned a first

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[1] *The CIIM Research Report is available at* ***www.edu.gov.on.ca/eng/studentsuccess/lms/files/CIIMResearchReport2007.pdf****.*

difference to each individual group, and the groups worked with cubes to construct the models. After several minutes, the groups shared their models and there was a whole-class discussion of the created models. As the models were presented, the teacher wrote the table of values on the board and the class determined the equation of each model. The class compared and contrasted the slopes of the models.

Terry then presented colour-coded linking cube models of quadratic relationships that she had prepared before class. The colour coding helped to show the first and second differences.



Terry then worked with the class to create a table of values for the model and determined first differences and second differences. She also used the models to show the curved relationship and connection to a table of values.

Groups were then asked to create a relationship with a given second difference (assigned by the teacher, e.g., -1, 1, and 3), using different coloured blocks to represent first and second differences. While the students worked, the teacher circulated and responded to student questions and provided prompts when necessary. Some groups started with a linear model and thought about how to adapt it for a quadratic model. Other groups began with a table of values, while others started by building with the cubes.

When all of the groups had brought their models to the front, Terry drew the students' attention to the front and began a whole-class discussion. She chose one of the student models to work with and constructed a table of values. Later, the class moved to using the graphing calculators to represent their quadratic model graphically. (Observation of Terry's Grade 10 Academic class)

We also saw extensive use of area models in case study classes to represent algebraic ideas and operations, such as multiplying and factoring polynomials through the use of algebra tiles. For instance, Vivian, a Grade 8 teacher, used algebra tiles to support students' understanding of collecting like terms. She felt it was important "to show them the area representation of algebra" and appreciated that this was something new for her students.

In the case studies, we also saw a range of technologies being used that included graphing calculators, interactive whiteboards, clickers, motion sensors, and computers, particularly in the Grade 9 and Grade 10 classrooms. In her Grade 9 Applied classes, Claire made extensive use of technology, including all of the above, as well as virtual algebra tiles and even the students' own iPods. In one lesson in Claire's classes, students used clickers to respond to two questions. The questions involved connecting graphs to scenarios. One scenario was about the motion of a Ferris wheel, while the other was about the motion of a swing. Students were asked to match graphs to the scenarios. Claire asked the students to answer the question themselves and key in their responses to the question on the clicker. A circle graph displaying the range of student responses was shown on the interactive whiteboard. Students then worked in pairs to discuss their responses to the question. Next, students were asked the same question again, and again they keyed in their responses. The responses were now much more closely aligned with one another, as well as with the correct response. A whole-class discussion of each question took place. In our interview, Claire discussed this activity as a mode of formative assessment, one she uses to check students' understanding. The activity also stressed the importance of student discussion and argumentation in solving problems.

Several case study teachers suggested that not only does technology help students represent mathematical ideas, but it also increases students' motivation. During our observations of Joe's Grade 8 classroom, we saw Joe draw on video clips to initiate many of the mathematical conversations in interesting ways. For example, to introduce the topic of probability and motivate a conversation on probability versus chance, he showed the students a video of Tiger Woods shooting his 9th hole-in-one.

Mathematical Communication

In all case study classrooms, students were observed discussing mathematical ideas with one another in both small-group and whole-class discussions. We also saw

teachers encouraging students to express their ideas using mathematical language and appropriate terminology. For example, in Maria's Grade 7 class, which had a range of English Language Learners (ELLs), Maria spent a great deal of time helping students express their mathematical thinking appropriately. The classroom had many posters and charts, as well as a word wall, so that students could refer to mathematical terminology, diagrams, and definitions. It was not unusual to see a student get up and go to the wall to look up a definition or term.

In two case studies, the teachers were explicitly modelling the creation of a math talk community—or math congress—based on Cathy Fosnot's work (Fosnot & Dolk, 2001). Jason was one of the teachers working on creating a math talk community in his Grade 9 Academic class. The lessons that we observed were focused on developing algebraic concepts, and the direction of the lesson followed the path of the students' thinking as they argued the difference between $x^2 + x^3$ and $(x^2)(x^3)$ and how each of the expressions can be simplified.

In all case studies, we saw students presenting solutions to their classmates, who observed, paraphrased, and asked questions. The dialogue in these classrooms was not just between students and teachers. Rather, students engaged in mathematical discussions with one another. For instance, Claire presented the students with a graph showing four lines that represented different runners. She then used a whole-class discussion to help students interpret each of the four lines on the graph. Students engaged in the discussion and made up stories about what might have happened to each of the runners. In many classrooms, the communicative interactions became the content of the math lesson. In Megan's classroom, following the student presentations of their strategies and solutions as part of a problem-solving activity, she voiced the following observations to the class:

> *As I was walking around, as your groups were finding your solutions, what was working well? I saw a lot of participation within each group; everyone was involved... I was seeing manipulatives being used to demonstrate and verify what you were working on. It took us a lot of time to get to those solutions and that's okay. What I'm seeing is some good demonstration of understanding.* (Observation of Megan's class)

Comments such as these show that the contributions of the students are valued; further, such comments reinforce those behaviours that are considered important for developing robust mathematical understanding. The teachers in the case studies were sensitive to the need for—and value of—students' expressing their mathematical thinking, and the discussion gave the teachers a window into their students' thinking.

Uncertainties, Dilemmas, and Support

While our case study data show teachers successfully engaging in inquiry-oriented practices, the practices that are being asked of teachers are often difficult to define, feel unfamiliar, and require a certain level of risk taking. Most of the teachers involved in the case studies displayed their willingness to take risks. In her interview, Terry spoke of how she tried new things in the classroom, even when she wasn't certain how they would work out. In fact, she invited us to observe her trying out a new idea during a lesson, and wanted us to see how it unfolded. She claims that "you have to be fearless, you have to try these things, and if it messes up, just keep trying." Vivian also spoke about learning to deal with her discomfort. While she now uses mathematics manipulatives in her classes, they were at one time unfamiliar to her, since they had not been part of her math experience in teacher education, and she had not observed math lessons taught with manipulatives.

We observed teachers in the case studies reflecting on their lessons and often questioning whether they had done the right thing at a particular moment. They discussed the degree to which they needed to adapt moment to moment as the lesson changed direction, based on what the students were doing and saying. Jason commented that lessons often took longer than expected, as the direction of the lessons often came from the students. Joe also expressed concern about how multiple demands on time might curtail the kind of extensive investigation from which students would benefit. Rather than allowing discussions to truly evolve, he would find himself providing hints.

The dilemmas that teachers faced when changing their practice did not always come from within the classroom. Teachers were not only influenced by their own beliefs, knowledge, and practices, but were also influenced by student responses, colleague and administrator impressions, and parent concerns. At times, colleagues or parents questioned what the teachers were doing, as it often appeared to differ from what others teaching the same course were doing. Teachers worried about whether students would be adequately prepared for moving on to

the next grade, where teacher expectations might be very different. Grade 9 teachers also worried about student performance on the large-scale assessment that is administered to Grade 9 students at the end of each term.

Faced with such uncertainties and dilemmas, one wonders why these teachers were committed to these classroom practices. All of the teachers believed that this way of teaching engaged students in mathematical thinking and developed a deeper understanding of mathematics. Claire indicated that her own children's negative experiences with mathematics learning motivated her to teach math differently, to make sure that mathematics was accessible and engaging to all students. Angela talked about the value of students understanding mathematics. Her own learning experiences and teacher training were characterized as traditional teacher-directed delivery of instruction, and while she had excellent marks in mathematics as a student in elementary and secondary school, this was followed by real confusion in university mathematics. She spoke about her desire for her classroom to exemplify a different vision of mathematics, one in which students are engaged in thinking and talking about mathematics so that they truly understand.

While the case study teachers' beliefs about the way they were teaching helped to support their practices, there were also other ways in which their practice was supported. The value of collegial support was very evident. In some cases, teachers found colleagues in their schools with whom they could work. For instance, Terry specifically talked about the role that collaboration with her department colleagues played in the development of her practice and the building of her confidence. In other cases, the case study teacher did not necessarily have colleagues in his or her school with whom to share ideas, but had made strong networks outside of the school through involvement in district or provincial initiatives, such as writing Targeted Implementation Program Supports (TIPS) materials or being involved in lesson studies or professional learning communities. These initiatives gave these teachers the opportunity to meet and dialogue with other teachers who had ideas similar to theirs and to try out and discuss new ideas in their classrooms.

Administrative support was seen as crucial to the confidence and comfort of the teacher in trying out new ideas. In one case, we saw an initiative led by the department head, who, in turn, was supported by the principal through release time so that the department head could work with new teachers. In one of the Grade 8 case studies, the principal recognized the importance of timetabling a school schedule that permits large blocks of time for math, as well as time for teachers to meet together for discussion and planning. In our interviews with administrators, we were also able to see how their involvement in mathematics initiatives enhanced their understanding of mathematics teachers' work.

Concluding Comments

The CIIM case studies provide detailed information of how inquiry practices are actually realized in the classroom. They offer examples of students engaging in problem solving, using a variety of tools and strategies, sharing solutions, taking part in mathematical discussions, and consolidating their understanding. The case studies also help us to understand the dilemmas that teachers face as they implement new practices. In addition, our data demonstrate the role that collegial collaboration plays in supporting new teacher practices and the importance of providing opportunities for teachers to share ideas, discuss teaching strategies, and work together in planning. We saw the crucial role that administrators and policy makers can play in helping to provide such opportunities. We also saw coherence and meaning in teachers' professional practice as they designed resources, classroom materials, and lessons that connected to the curriculum, to current ways of thinking about mathematics teaching and learning, and to their own personal teaching goals. These teachers believed in what they were doing and had their own evidence through the engagement and success of their students. Like many of the teachers we worked with, Vivian was encouraged by the successes of her students as they engaged in mathematical exploration and discussion. When asked what she wanted her students to accomplish in math, she replied:

> *I want them to love math. I want them to be interested in math... I want them to see math in different contexts. I want them to see it outside. I want them to think about it. I want them to bring it back into class. I want them to feel confident that they can do it... those are my overall goals, and I want them to be successful and have tools to independently speak for themselves, find ways to figure things out, to problem solve,… even beyond math.* (Vivian, interview)

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▲ Ontario Math Olympics 2009

Sandra Jean Price and Jacqueline Hill



What do a crime scene investigation, a mathematical music performance, math posters, math chants, and a series of other competitive tasks have in common? These are all events that occurred during the 2009 Ontario Mathematics Olympics held at Trent University in Peterborough on Friday, May 29 and Saturday, May 30.

Out of the approximately 14 000 Grade 7 and Grade 8 math students in the province, the top 120 students—the "best of the best"—competed at Trent University for the honour of belonging to the top team in the 2009 Ontario Mathematics Olympics. Each team was sponsored by a local chapter of the Ontario Association for Mathematics Education (OAME), the provincial association that initiated the event 14 years ago to promote gender equity, the use of technology, teamwork, and genuine problem solving in math. For the second year in a row, the event was hosted by the Pine Ridge Mathematics Association (PRMA).

Upon arrival on Friday night, each team presented a chant that linked the team to its chapter and explained the chapter's geographical boundaries. These chants, along with team posters, were assessed, and teams were awarded points toward their competition total. Teams also gave a "math performance" in which students interviewed a math concept or created a math poem, skit, or song. This part of the contest was sponsored by the Math Performance Festival. Following the math performances, teams participated in a "Crime Scene Investigation." Using math skills, observation, inference, and reasoning, students had to work through several challenges to figure out who committed a burglary. Despite the slightly chilly conditions, the students were amazingly successful in working together to solve the crime. After dinner, everyone had an opportunity to hear some of the songs entered in the math performance section of the contest.



Working on the team relay...

On Saturday, the students were tested in four separate events: the individual event, the technology event, the relay, and the team event. While students exercised their minds, their chaperones and coaches spent a day exploring the nearby Petroglyphs.

The awards ceremony and a celebration video reflecting highlights of the two-day event concluded the Ontario Math Olympics 2009. In third place was the SWOAME (South Western Ontario Association for Mathematics Education) team of Jerry Feng, Jenny Zhang, Chen Chang, and Jason Zhang. Second place was awarded to the COMA (Carleton-Ottawa Mathematics Association) team, comprising Stephen Xu, Nancy Guo, Daniel Yand, and Anne Wu. The trophy for first place was awarded to Wan Qi Luo, Andrew Tran, David Wang, and Claudinne Naidas of TEAMS (Toronto Educators Association for Mathematics). The winning team will proudly display the trophy until next year's event.



Working to solve the burglary...CSI

The Math Performance Awards were also presented. In third place were Katie Cass, Kevin Chien, Yousef Elmor, and Rachel Morai from ISOMA (Independent Schools of Ontario Mathematics Association). In second place were Luke Lawford, Evy Kassirer, Sarah Mitchell, and Heather Michael Zhu from COMA (Carleton-Ottawa Mathematics Association). The CHAMP (Credit Humber Association for Mathematics Promotion) team of Onelia Charles, Hubert Argasinski, Jonathan Panuelos, and Liana David won first place in the math performance component.

Special awards were given out to teams and individual students to recognize other achievements. The "Team Spirit Award" was given to Isaac Kong, Larysa Santavy, Lauren Ferguson, and Dan Hicks from



WOMA (Western Ontario Mathematics Association). Winners of the "Best Chant Award," as determined by the participants, were Sung An, Jessica Baik, Christina Chan, and Freda Liu from SAME. Several students were recognized for earning a perfect score in the Individual Event. Sabrina Ge (ISOMA), George Cheng (ISOMA), Claudinne Naidas (TEAMS), and Albert Dieu (TEAMS) each received a TI graphing calculator.

The Pine Ridge Mathematics Association would like to thank the sponsors of OMO 2009: The University of Ontario Institute of Technology, The Imperial Oil Foundation, Lazer Graphics, Bound2Learn, McGraw-Hill Ryerson, Nelson, The Ontario Waterpower Association, The Math Performance Festival, Pearson, PepsiCo, the Rotary Club of Peterborough, Spectrum Educational Supplies, Staples, Sun Life Financial, The Teaching Table, Trent University, and Texas Instruments. We would also like to thank all of the tireless volunteers who helped organize this exceptional event in celebration of mathematics education. ▲

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▲ SNAP Math Fairs

TANYA THOMPSON
E-MAIL: TThompson@thinkfun.com



As Director of Education for ThinkFun, Inc., Tanya Thompson develops programs to teach problem solving using games and puzzles. Tanya, who taught mathematics in Simcoe County for 12 years, has spoken at conferences around the world on the subject of SNAP Math Fairs. A puzzle enthusiast, she is part of a group of international puzzlers (IPP) who meet all over the world. One of Tanya's biggest thrills was to become a friend of Martin Gardner, whom she visits each year. Tanya received the McMaster University Alumni Arch Award in 2006 for excellence in her profession.

What is a SNAP Math Fair?

A SNAP Math Fair is a magical event where students, faculty, and families gather together to celebrate mathematics. Through creative, interactive projects, students bring to life interesting mathematical puzzles and problems.

As a teacher, I have found that math fairs provide many benefits. They give students an opportunity to develop their problem-solving skills in a fun, non-competitive environment and help to dispel the fear of math. Furthermore, SNAP Math Fairs help students build their self-confidence, while giving them an opportunity to do mathematics for a real purpose and for a real audience.

In a SNAP Math Fair, a class is divided into small groups, and each group is given a mathematical puzzle or problem to solve. The group prepares a project to illustrate the problem, and during the main event, members of the group act as facilitators to help fair visitors solve the problem.

What does SNAP stand for?

SNAP is an acronym that identifies the essential features of the math fair:

- **Student-centred:** The students "own" the problem. They solve the problem, design and create the display, and present the problem to passers-by. They also help the passers-by solve the problem. The students are actively involved in the presentation.

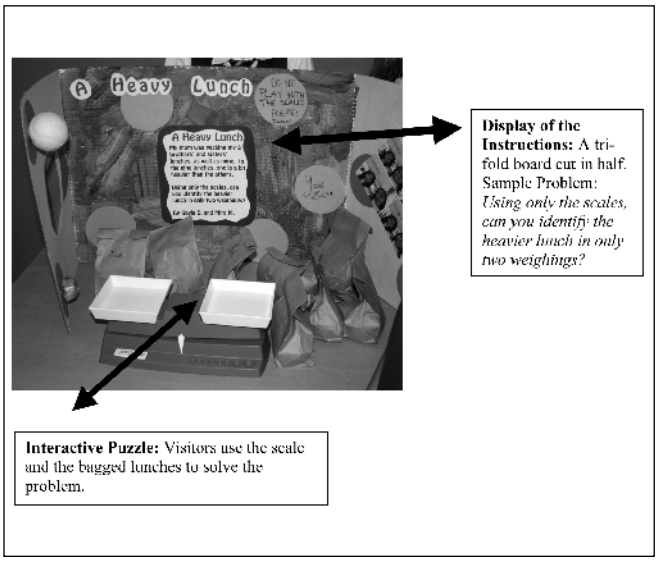
This is not a poster session!

- **Non-competitive:** There is no judging involved (apart from whatever grading scheme the teachers use), and there is no first prize for best presentation. This encourages equal participation by all students.
- **All-inclusive:** All students take part! This is not meant only for the elite; rather, every student, weak and strong, is involved in the fair.
- **Problem-based:** Any problem that can be solved using a manipulative is a suitable problem for a SNAP Math Fair.

What are the major components of the SNAP Math Fair projects?

A SNAP Math Fair project has three main components.

1. **Display of the instructions:** It is important that students do not display the solution(s). The students are the experts and must therefore know the solution. Displays are creative, colourful, and engaging!
2. **Interactive problem solving:** This is the part that brings the problem to life. Visitors play with the model to help solve the problem.
3. **Oral presentation:** In a clear, audible voice, students demonstrate their expertise. Without giving away the entire solution, they guide visitors of varying abilities, using appropriate hints. The project should have multiple levels, if possible, so that visitors of varying abilities can experience success.



Themes for a SNAP Math Fair

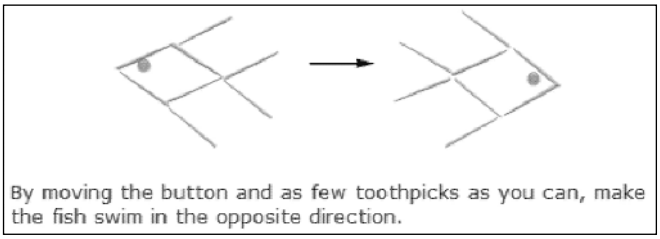
SNAP Math Fairs often have a theme. A theme helps the students focus and take ownership of the problem, and it helps to unify the fair. Students must cast their puzzles in such a way that it relates to the theme. This involves rewriting the problems, thus focusing on both math and literacy.

Tip: Many schools with little or no budget have used an "Environment" theme, making projects from items from the recycling box.

Theme Examples:

- Educational Theme (e.g., Space, Pioneers, Earth Day)
- Historical Event or Period (e.g., Medieval Times, The Olympics)
- Popular Film (e.g., The Lion King, Harry Potter, The Wizard of Oz)
- Seasonal Theme (e.g., Winter Wonderland, At the Beach)

Problem:



Wizard of Oz Theme (literature and school play)



At the Beach Theme



Where can I find resources for the problems/puzzles?

The following resources can assist teachers in gathering appropriate math fair problems to assign to students. One of the best resources is *The Math Fair Booklet* by Ted Lewis. This booklet can be found at **www.mathfair.com** and is available in English, French, and Spanish.

Other useful print resources include:

- *The Big Book of Brain Games* by Ivan Moscovich
- *1000 Play Thinks* by Ivan Moscovich
- *The Giant Book of Math* Fun by Raymond Blum
- *Mathematical Fun Fair* by Brian Bolt
- *Problem Solving Through Puzzles* (Key Curriculum Press)
- *The Mathematical Puzzles of Sam Loyd* (Martin Gardner Books)

As well, I have published a collection of over 100 hands-on puzzles, intended specifically for SNAP Math Fairs (Hands-On Puzzles). These can be found at **www.puzzles.com** in the Puzzles in Education section (classified as Grades 1 to 8).

Other useful websites include:

- **www.figurethis.org**
- **www.galileo.org/math/puzzles**
- **nrich.maths.org/public/index.php**
- **thinks.com/puzzles/**
- **www.mathpuzzle.com**
- **www.gamepuzzles.com**

How do I organize a SNAP Math Fair?

Follow these five easy steps to run a SNAP Math Fair at your school:

1. Distribute the puzzles.
2. Have students solve the puzzles.
3. Have students prepare the displays, using the theme.
4. Have students rehearse.
5. Run the Math Fair event!

1. Distributing the Puzzles

There are many ways to distribute the puzzles to your students. Primary classes tend to solve the problems as a class and then decide later which group will build which problem. Intermediate classes work more independently. Here are some ideas:

- Put all problems in a jar and have students 'draw' a problem; exchanges may be made.
- Assign problems to specific students.
- Have the entire class work on a collection of puzzles together. Afterward, divide the students into groups, and have each group choose which problem to build for the fair. This is a common approach in the younger grades.
- Have groups work on most of the puzzles; assign problems to groups afterward.
- Have groups rotate around problem-solving centres, and have them choose their problems later.
- Make problem sets for all of the problems (approximately 6 sets for a class of 34). Put the problem sets around the room. Have each group tear off a problem, and after the group has solved a puzzle that the group members like, the group claims it as its own and tears it out of the other problem sets. Be sure to keep a master list as the problems are chosen.

2. Solving the Puzzles

This is the real reason for the math fair! Students develop problem-solving skills by solving challenging problems. A good puzzle takes time to solve—certainly more than a few minutes, and sometimes more than one day—so sufficient time must be allotted for this part of the math fair.

In the process of solving the puzzle, students should think of good hints that will not give away their solution. Older students should be encouraged to prepare varying levels of hints so that the problem or puzzle will appeal to both younger and older visitors.

3. Preparing the Displays

The projects have three components: a display for the instructions, the manipulative that is played with to solve the problem, and an oral presentation. The project must help present the puzzle (not the answer) to the math fair visitors, and should tempt the visitors to try to solve the puzzle.

Preparing the Instructions

The following is a list of suggested materials on which the instructions can be displayed:

- A tri-fold board (The tri-fold board can be commercial, or it can be home-made, from materials such as cardboard boxes or file folders.)
- Art paper or bristol board that lies flat on the desk or table
- Pizza boxes or file folders
- A free-standing, three-dimensional model that displays the instructions (e.g., a cardboard spaceship for a project about outer space)

Tri-Fold Board



File Folder



Pizza Box



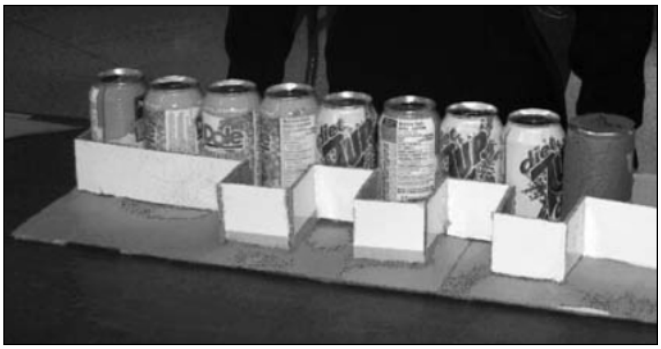
3D Free-Standing Structure



Manipulatives

- Manipulatives can be built out of whatever resources are available (e.g., paper, wood, cardboard, bristol board, Plexiglas™).
- Recycled materials work well, especially with an environmental theme.
- One school—where lack of funds and resources was an issue—built the manipulatives out of items already in the classroom.
- With life-sized projects, math fair visitors themselves can be used as manipulative pieces!

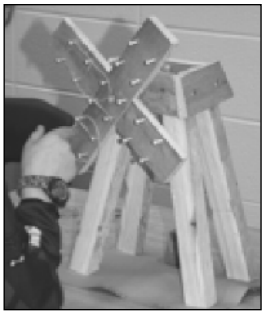
Recycled Materials



Unifix Cubes



Wood



4. Rehearsing

An in-house rehearsal will reveal any glitches in the students' presentations, flimsy parts of the displays will be discovered, and the students will have the chance to show that they really are the experts regarding their problems.

- Each group can present to the rest of the class.
- Different classes can present to other classes, or different grades can present to other grades.
- The whole fair can be set up as a true dress rehearsal, in which one-half of each group presents the math fair to the other half. After about an hour, the students switch roles.

5. Running the Math Fair Event

Presenting to the Public

The math fair should be set up in an appropriate place; for example, in the school gymnasium, at a shopping mall, at a local museum, or even in the classroom. The students preside over their booths, and the public is invited to try the puzzles.

Typically, a math fair lasts from one to two hours, but some may last considerably longer. Time should be allowed for students to have breaks and food. Some teachers have organized math fairs with rotations. Each project is presided over by at least two students, so that one student can visit other projects while the remaining students preside over their own. After a certain amount of time, the students exchange duties.

Whom to Invite

Invite:

- other students, classes, or grades within the school
- parents or guardians of the students
- other schools (Schools can pair up, having each school visit the other's math fair, or the school running the fair can invite another school that has never attended a math fair.)
- a class in another country (The students could pair up through the Internet with a 'pen pal' group that is solving the same problem. Web cameras could then be set up to share the final results.)

If running a SNAP Math Fair at the college or university level, post-secondary students could present the math fair to elementary or high school students. There are two options here: the math fair can be taken to the school, or the school can be invited to bring its students to the university. This has proven to be immensely popular, and the school can use the university event as a model for its own math fair at a later date.

How much time will a SNAP Math Fair take?

This is really up to you and how elaborate your fair and the projects will be. In many cases, a two- to four-week preparation is sufficient, so the timeline can be fairly short and concentrated.

Should I or shouldn't I?

The idea that mathematics is mostly about arithmetic is like thinking that literature is mostly about being able to spell. I believe that as mathematics educators, it is our

responsibility to inspire our students in mathematics. I have found that SNAP Math Fairs do this.

In Ontario, we are required to teach the Mathematical Process Standards. SNAP Math Fairs teach each of these standards.

- Problem Solving
- Reasoning and Proving
- Reflecting
- Selecting Tools and Computational Strategies
- Connecting
- Representing
- Communicating

SNAP Math Fairs began in Alberta, Canada, just over ten years ago and are now spreading across the world. The idea was first presented in Ontario at OAME in 2005. Since then, annual presentations have been given at OAME, and an entire conference dedicated solely to SNAP Math Fairs is held each year at the Fields Institute, University of Toronto. SNAP Math Fairs are also happening in Eastern Canada, the United States, Sweden, Australia, and Germany. Please join us!

For more information about SNAP Math Fairs, please visit **www.mathfair.com**, or contact Tanya Thompson at **tcthompson@hotmail.com** or **tthompson@thinkfun.com** if you are interested in SNAP Math Fairs or would like to attend the SNAP Math Fair Conference at the Fields Institute in 2010. ▲

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▲ Directors' Dialogue

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Ann Michele Stenning is a mathematics teacher at South Secondary School with the Thames Valley District School Board. Having finished her Masters of Education degree in Curriculum Studies, she is currently assisting other parent volunteers with the development of weekly literacy activities, which she and other moms provide to at-risk students.

OAME BOARD OF DIRECTORS MEETING
June 12–13, 2009

Friday, June 12, 2009 Chapter Representatives Meeting

Greg Clarke welcomed the many new chapter representatives, as well as the returning ones. Sue Hessey reported on the new OAME products that the chapter reps might want to purchase: Frisbees; *Abacus*, Volume 46; Post-It Notes (for elementary or secondary teachers); T-shirts; memo pads; and decals. Sue then outlined the responsibilities of chapter representatives and reminded them that electronic newsletters are sent out four times a year, between issues of the *Gazette*, and that a sign-up list for OAME's promotion kit for the Fall mini-conferences was in circulation. Greg Clarke presented ideas on how to use OAME's website, and ideas for the October PD session were discussed. Chapter representatives were then given the opportunity to ask questions about OAME and their roles as representatives. Lastly, chapter representatives were asked to provide the 40th Anniversary Organizing Committee with a brief history of their respective OAME chapters.

Board of Directors Meeting

Beverly Farahani, OAME's new president, welcomed everyone and introduced the new board members. Sue Hessey reviewed some housekeeping items and Beverly Farahani asked members to pair up and interview each other. While being interviewed, members described professional development topics with which they were familiar and provided some interesting information about themselves. Bill Otto, Dave Hessey, and Fred Ferneyhough facilitated an interactive session to identify what OAME does well. Specifically, members requested that OAME be an efficient and effective organization that provides strong leadership from the executive, that OAME be an organization that provides feedback to its members on Ministry initiatives, and that OAME continue to provide input to the Ministry on current projects. Board members were proud of the annual conferences, the *Gazette*, the *Abacus*, and the OAME website, and they wanted OAME to continue to support the Ontario Math Olympics, to continue acting as a connection between elementary and secondary teachers, and to continue being run for teachers, by teachers. OAME's roles were discussed, and modifications to these roles were noted.

Saturday June 13, 2009 Board of Directors Meeting

Sue Melville reported on the Equity Breakfast held at last year's OAME annual conference. Kelly-Lee Assinewe was the speaker, and the panel discussion that followed was well received. Laurie Moher, NCTM representative, reminded members of the free resources available on NCTM's website, including **www.illuminations.nctm.org**, a website that offers 540 lesson plans; video clips with guiding questions; and 724 web links. The minutes of February's board meeting were passed and can be found on the OAME website. Dave Hessey presented the financial picture and balance sheet as at April 30, 2009, and Anna Jupp reported on the Leadership Conference. Glynnis Fleming reported that the theme for OAME 2010 is "On the Brink." The 2010 conference will be chaired by Ed Haines, Elizabeth Pattison, and Liisa Suurtamm. Online speaker proposals will be posted soon.

Sharon Buschbeck reported on the Ontario Math Olympics (OMO) 2009. Students took part in a CSI activity and "Math Performances," as well as the four main OMO events. The top three teams were from TEAMS, COMA, and SWOAME. A video has been posted to the OAME website.

Beverly Farahani reported on the Leadership Conference 2010, which will focus on Instructional Decision Making. Marian Small will be the K–8 presenter as well as Thursday's keynote speaker. Jacqueline Hill will be the presenter for Grades 7–9, and Shirley Dalrymple will be the presenter for Grades 9–12. Ron Lancaster will be Friday's keynote speaker. ▲

2009-2010 OAME BOARD

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