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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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



Recently, I had the opportunity to present a workshop entitled "In the Face of Technology, Do We Need to Be Numerate?" It was my intention to initiate conversation by suggesting that children from a very young age are immersed in a world where they observe virtually all mathematics being performed with the assistance of technology. They see cashiers using cash registers when purchases are made. They see their parents preparing tax forms with the aid of calculators. They see older siblings using programs like Excel to prepare graphs. Perhaps, subconsciously, many young people are beginning to believe that old-fashioned pencil-and-paper mathematics is an anachronism and hence, that learning mathematics in the traditional sense has little intrinsic value. So my controversial assertion—not proven by any stretch of the imagination—was that many young children are not motivated to learn mathematics because they do not see the value in being numerate!

I then posed the question, "Does it really matter if large segments of the citizenry are not numerate?" In order to tease out a response from my audience, I provided three actual scenarios—one taken from a newspaper column, a second heard on the radio, and a third received by way of e-mail. The following is the text of an e-mail that was sent in bulk to random recipients and likely forwarded to many more:

> *Please find below my suggestion for fixing Canada's economy. Instead of giving billions of dollars to banks and car companies that will squander the money on lavish parties and unearned bonuses, use the following plan:*
>
> *There are about 20 million people over 50 in the workforce. Pay them $1 million apiece severance for early retirement, with the following stipulations:*
>
> - *They MUST retire. Twenty million job openings. Unemployment fixed.*
> - *They MUST buy a new Canadian car. Twenty million cars ordered. Auto industry fixed.*
> - *They MUST either buy a house or pay off their mortgage. Housing crisis fixed.*

- *They MUST send their kids to school/college/university. Crime rate fixed.*
- *[They MUST] buy $50 of alcohol/ tobacco/petrol a week. There's your money back in duty/tax, etc.*

It can't get any easier than that!

The initial response from many people was, "Wow, that's brilliant!" However, I did some fact checking and discovered the following:

Assuming there really *were* 20 million people over 50 in Canada's workforce (out of a population of approximately 33.7 million), the total price tag of the above scheme would be:

- 20 million X $1 million = 2.0 X $10^{13}. However, the estimated world GDP is $6.9 X 10^{13}, so the cost of such a program would equal almost one-third of the world's GDP!

Canada's *actual* workforce population over the age of 55 is just over **2 million** (not 20 million, as stated in the e-mail). But even this would result in a cost of 2.0 X $10^{12}, an amount well over Canada's current GDP of approximately $1.3 X 10^{12}.

Hence, checking orders of magnitude and "crunching the numbers" can help to inform—and in some cases change—our opinions about such ideas.

As it turned out, discussion during the workshop was lively. We tried to define what it means to be a "numerate citizen" and agreed that we must work harder in our classrooms to ensure that our students see the value in becoming numerate citizens.

I would like to briefly address two more topics:

- You will notice that one of the articles published this month is my own. This is not my preference, but we are lacking submissions that relate directly to mathematics education. Please consider writing an article or even a short feature piece. June will be my last issue as editor, and in either the March or June issue, I would like to do a focus on "games"—either the mathematics of games or the use of games to learn mathematics.
- I would like to take this opportunity to wish all readers and everyone who contributes to the *Ontario Mathematics Gazette* a safe and happy holiday season! ■

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▲ President's Message

BEVERLY FARAHANI, PRESIDENT

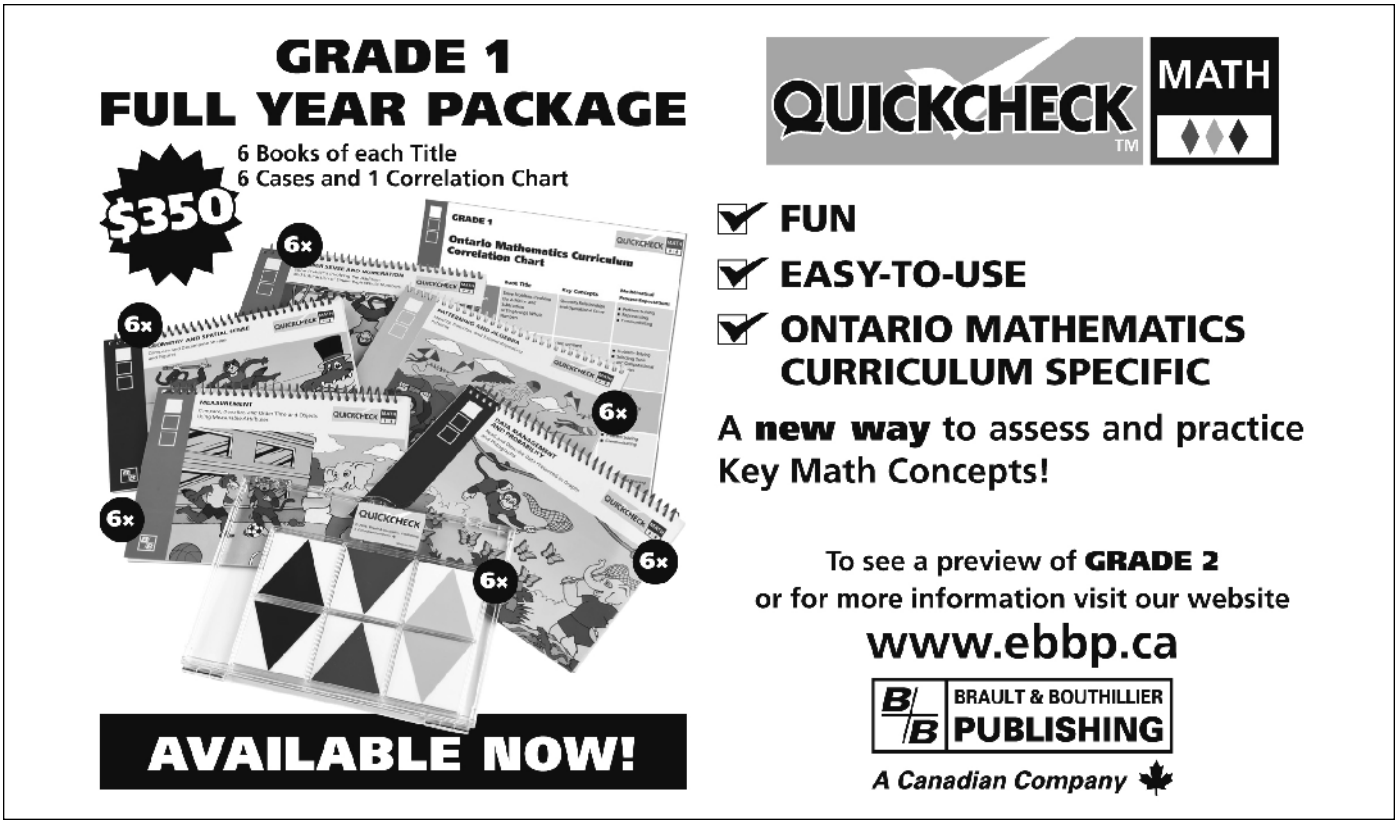


Beverly Farahani is Head of Mathematics at Kingston Collegiate and Vocational Institute. She is also a T³ Instructor and was on the Minister's Task Force.

I have been thinking about the various professional learning opportunities I have had over the years. They have included OAME mini-conferences, leadership conferences, annual conferences, Texas Instruments institutes, Discrete Mathematics and Theoretical Computer Science institutes, and the Park City Mathematics Institutes, to name just a few. I am sure that all of you try to fit in as much professional learning as you can. You may not always remember the speaker or location of the events you have participated in, but all have contributed in some way to the teaching professional you are today.

I always try to take something away from each event that I attend. Sometimes it's something that I least expect to learn! I was at a session where teachers from all four divisions—Primary, Junior, Intermediate, and Senior—attended. We had been asked to sit by division so that members of each group could work on linking-cube activities that were appropriate for their students. After some playtime and thinking, we were asked to share our solutions with the entire group. To be honest, I don't remember what the actual activities were, but I was struck by the neat and orderly display created by the Primary group. In turn, they were appalled at the display the Senior group had created! The Senior group had used linking cubes of various colours, and furthermore, had not even connected them! It had never occurred to me that the colour of the linking cubes might have an impact on whether or not students would understand the mathematical concept I wanted them to learn. Now, when students ask to use linking cubes of the same colour, I let them sort through the box to find the ones they want to use so that colour is not a distraction to their understanding.

Professional learning gives us the opportunity to learn about new technologies or find out about mathematics that we did not study in university. It helps us discover how certain practices might impact student learning. It gives us the chance to learn about new ideas, revisit old ideas, and meet new people. By participating in professional learning, we become the lifelong learners that we are trying to encourage our students to become. ■



▲ What's the Problem? Smell the Coffee!

SHAWN GODIN



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, problem solvers! Last issue, I left you with the following problem:

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%*.

This problem appeared as problem 2682 in *The Journal of Recreational Mathematics,* Volume 33, No. 2. This journal is published by Baywood Publishing Company, and you can find out more from their website at **baywood.com/journals/**.

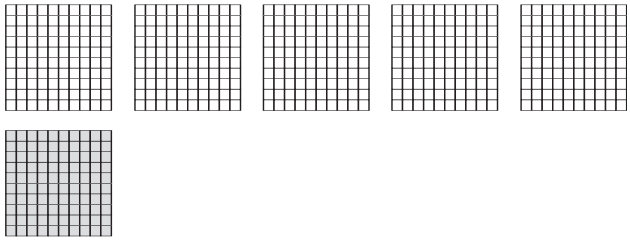
This problem is great because it lends itself to a variety of approaches. You can use manipulatives, logic, guess-and-check, computer simulations, or other techniques. I will introduce a problem-solving technique—*change the numbers*—that can be used by students to help develop a solution, and by teachers to adapt a problem to their classroom.

Very often, I find a gem of a math problem that is either too easy or too complex for my students. Changing the numbers can maintain the essence of the problem while modifying the level of the problem so that it's more appropriate for the students. In most cases, this can be done by making the problem easier, but easier doesn't mean trivial. In many cases, it doesn't even mean that it's easy!

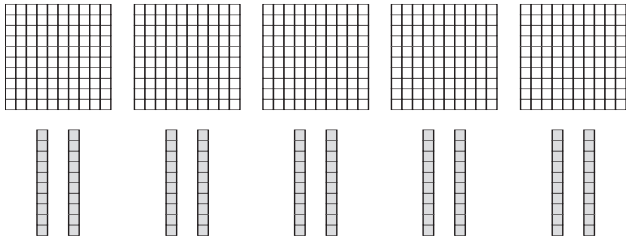
If we change this problem slightly, so that the mugs are 2 cups and 5 cups, the spirit of the problem remains, but we have made it easier to see how to generate some of the numbers. With 2 cups and 5 cups, we can generate 1, 2, 3, 4, or 5 cups in the 5-cup mug and thus, come up with different concentrations.

Here is just one scenario that you can follow to generate a number of concentrations. I will use base-10 blocks to illustrate the solution. The diagrams were generated using the base-10 block virtual manipulatives created for the Geometer's Sketchpad by the PRISM-NEO group several years ago. These tools, and others, are available on the PRISM-NEO site at **www.nearnorthschools.ca/it/PRISMNEO/index.asp**.

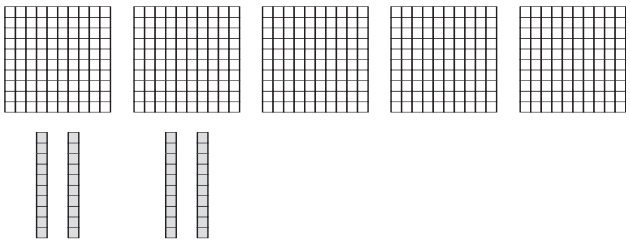
I am using different-coloured blocks for water and coffee. A 100-block of water represents 1 cup of water, and a 100-block of coffee represents a packet of coffee. (However, since we are dealing only with whole glasses of water, we could use something else, like a pattern block, to represent a glass of water.) The diagram below shows what would happen if we put our packet of coffee into the 5-cup mug that is full of water.



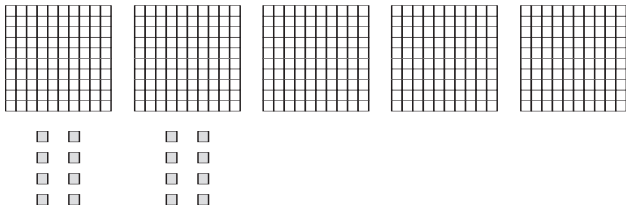
Now the coffee will dissolve and will be evenly distributed in the water. So we will have to replace our 100-block of coffee with some 10-blocks of coffee and evenly distribute the coffee among the water so that it appears as follows:



From this step, we can see that the coffee is now a 20% concentration. Suppose we fill the 2-cup mug with this mixture of coffee and empty the 5-cup mug. Now we pour the coffee from the 2-cup mug into the 5-cup mug. Finally, we fill the remainder of the 5-cup mug with water. Our model should now appear as follows:



Once again, the coffee will redistribute itself so that it is evenly mixed, and we will get the 8% mixture shown below.



We can continue mixing back and forth to get other concentrations. Specifying that the concentrations must be integers provides a stopping point, which you may or may not want. Students will discover certain algorithms that they can use to generate new concentrations. For example, if you have at least 2 cups of a certain concentration, you can fill the 2-cup mug with the mixture, empty the contents of the 5-cup mug, put the mixture from the 2-cup mug into the 5-cup mug, and then add 2 cups of water to the 5-cup mug. The new mixture will be half as strong as the original.

This problem can be changed in many different ways that will allow students to explore other possibilities. You could change the capacities of the mugs (again), or you could add other mugs to the mix. One easy idea is to add a third mug of unknown capacity (but between 7 and 8 cups). It could act as a "mixing bowl" for whatever you have in the two mugs at any point. You could even add several "mixing bowls," and then you could mix your mixtures in different proportions. The possibilities are endless! Have fun!

By the way, the concentrations for the original problem were 1, 2, 3, 4, 5, 6, 8, 9, 10, 12, 13, 15, 16, 20, 25, 50, and 100. For the adapted problem, I got 1, 2, 3, 4, 5, 6, 8, 10, 12, 20, 25, 50, and 100. Can you find others? Check my website, **whats-the-problem.wikispaces.com**, to see if anyone has discovered others, or to comment on variations you have tried with your students.

Now, for your homework:

Clovis likes to take an outing in the natural numbers. Each day, he starts with a natural number of his choice, the biggest possible. Then, during the day, he passes from number to number, using the following rules. Suppose the sequence of numbers is currently at n.

(1) If n *is divisible by 3 without remainder, then the next number is* n*/3.*

(2) If the remainder after dividing n *by 3 is 1, then the next number is 2n + 1.*

(3) If the remainder after dividing n *by 3 is 2, then the next number is 2*n *– 1.*

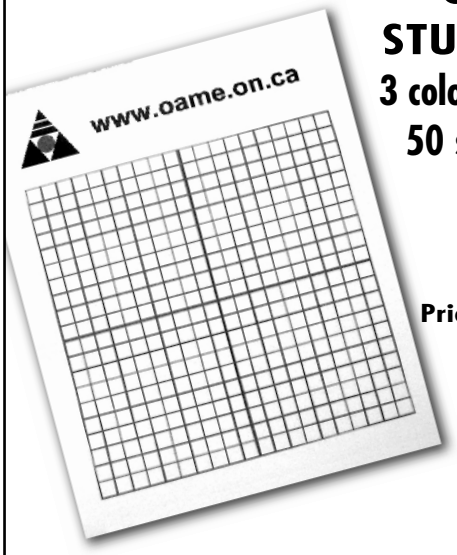
(4) If n *= 1, then the sequence stops.*

Over the years that he has played this game, he noticed that, whatever the starting number, the sequence always ended at 1. Will this always happen?

Until next time, happy problem solving! ■

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▲ Data Rocks – Announcements from Statistics Canada

YVES SAINT-PIERRE
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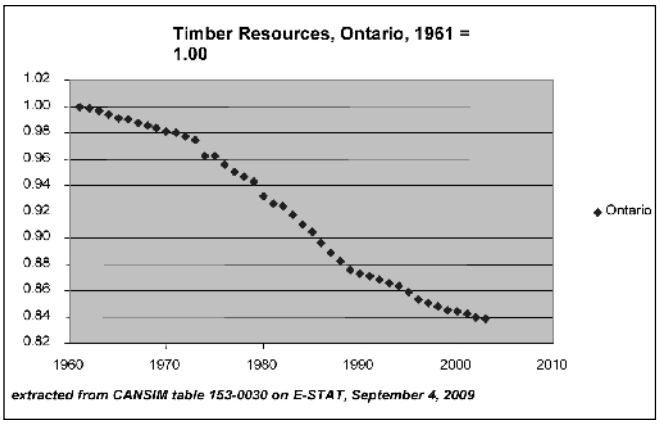


Yves Saint-Pierre has worked at Statistics Canada in many capacities since 1990: questionnaire design, data editing and imputation, analysis, and publication. He has been sharing his knowledge with schools since 2002.

As I write this column, it is the start of a new school year, and there are new releases on the StatCan learning resources website.

Social Justice Page: I spent this past summer preparing a page of data resources relating to Social Justice. You can find this page—entitled *Investigating Social Justice Issues*—on the StatCan website by going to **www.statcan.gc.ca/learningresources** > Teachers > Mathematics > Grades 9 to 12 > Key Resources (Data Analysis). Here, you'll find 28 links to sources of data, organized under eight broad topics: Crime and Justice; Education, Training, and Learning; Environment; Families, Households, and Housing; Health; Income, Pensions, Spending, and Wealth; Information and Communications Technology; and Labour. I've looked at most of these sources of data, played with the data series, and used various math tools (percentages, ratios, averages, probability, function modelling, indexing, and other tools that are particular to time series) to analyze them.

Here is an example of how I would explore one of the themes presented.



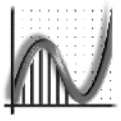
When will we run out of timber resources? To find out, we can create an index and then apply function modelling to the index. What is an index? Well, to demonstrate, I took the level of timber resources in 1961 (the start of our data series) as 1.00 for each province. Then, I divided the value in each subsequent year by the value in 1961. This put all provinces on an equal footing with respect to performance. Then, I took just a few provinces and tried to determine which function best suited the data. I subsequently tried to make predictions from that data. Taking Ontario as an example, the data series shows an initial decline, with a steeper slope from 1970 to 1990, and slowing down after that. A cubic function applied to our series forecasts the return to 1961 levels in about ten years from now. A linear model forecasts the disappearance of forests in Ontario near the year 2180. The R-squared of the cubic model is 0.998, while that of the linear model is 0.982—both quite strong, but conveying radically different conclusions! What other ways could we look at these numbers? Given that there are three different slopes in the 40 years of data, does it make sense to forecast a linear trend, using the trend for the whole period? What if we forecast just the last slope that looks linear (from 1996 to 2003), as if to say: "If present trends continue"? Wow! At that rate, we would lose all timber resources by the year 2400. If, on the other hand, we had continued with our "old" ways (1975 to 1989), it would take "only" until the year 2130! Your students' children will live to see that date. What a difference a slope makes, and how vivid those conclusions are for someone interested in the topic!

While I tried my hand at all of the topics I presented, and used at least one approach and set of mathematical tools, I did not include my method on the web page. After all, your students might well invent their own way of looking at these issues! Just know that they are available. You can write to me at mdm4u@statcan.gc.ca, and don't worry if you are teaching another math course. Anyone can write to this e-mail address! We also invite your comments. Ooohs and aahs are appreciated, but even better would be remarks about how you use this page in class, suggestions regarding other topics that could be added, or ideas about making this page easier to use.

***Census at School*:** We have processed the data

from the last school year and have posted the tables on the Data and Results page (link in the left margin). Thanks to all who participated. If you participated last year, why not go back this year with your new class and compare your class results to last year's data? (See Data and Results at **www.censusatschool.ca**.) The new wave of *Census at School* started in September, and we look forward to your continued involvement. While most participants are in the 11- to 13-year-old age range, there are interesting topics to cover with older students as well (e.g., correlations between/among some of the 16 numerical variables, or the effects of sample size).

I would like to share an innovative idea from a teacher in New Brunswick: She had some of her Grade 12 students go into an elementary school to run the *Census at School* project in a few classes. The data obtained then formed the basis of the Grade 12 students' statistics project. ■



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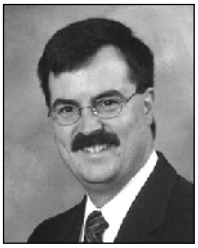
▲ Web 2.0 – Reading and Writing, Part 2

GREG CLARKE

ROSS ISENEGGER



Greg Clarke is the Secondary Programme Coordinator for the Simcoe Muskoka CDSB as well as the OAME webmaster. Currently, he is on assignment with the Ministry of Education (CLIPS and GAINS projects). Check out CLIPS at ***oame.on.ca/CLIPS****.*



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****.*

This is the third in a series of Web 2.0 articles. In the first article, we introduced Web 2.0 and an Internet application called Google Reader. In the second article, we showed you how to subscribe to blogs within Google Reader and we discussed ways in which blogs can be used in the mathematics classroom. If you missed either of these, you can log in to the Members Only section of the OAME website, click on the *Gazette* Archive link, and download a copy of the June 2009 and/or the September 2009 *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**. Speaking of wikis—they are the topic of this issue's article!

What is a Wiki?

Wiki (wee-key) is the Hawaiian word for fast, but the less proper and non-Polynesian web users tend to pronounce it "whicky" (see **committeeofpublicsafety.wordpress.com/2008/12/04/on-the-pronuciation-of-wiki/**). [Note: "Pronunciation" is misspelled in the correct website address.] The name points to the first advantage of wikis: They allow for web pages to be created, linked, and searched very quickly, without requiring knowledge of the deep magic that powers the web. Without a

doubt, the world's most famous wiki is the open-source encyclopedia, Wikipedia (**en.wikipedia.org/**). Like all things Web 2.0, wikis allow for rich collaboration.

People with permission to edit wiki pages can do so, usually with a word processor-like interface or with "wikitext." Typically, they can also discuss the contents of a page in a separate discussion area. For example, the discussion page for the article on Pluto is fascinating (see **en.wikipedia.org/wiki/Talk:Pluto**). Despite the concern of some librarians, Wikipedia has grown to include over three million English-language articles since its formal launch in 2001 and has something like 820 000 active monthly editors.

Increasingly, students are turning to Wikipedia as their first research source due to its currency, scope, and connectedness. Wikis are well suited to smaller collaborative tasks as well—tasks such as planning Summer Institutes (**gains-camppp.wikispaces.com/**), creating a solutions manual (**apcalc2008.pbworks.com/**), capturing course materials (**welkerswikinomics.wetpaint.com/**), presenting material from professional development sessions (**dougpete.pbworks.com/**), listing useful Web 2.0 resources (**web2educationuk.wetpaint.com/**), or even providing a website to support a series of articles in a professional journal (**mathfest.wikispaces.com/ Web2.0+For+Math+Educators**). In fact, almost any document authored by more than one person can be more effectively created as a wiki page than as a document that must be passed around, annotated, and e-mailed to a distribution list.

How do I follow changes to wikis?

In the September issue, we described in detail how to subscribe to feeds using Google Reader. We likened Google Reader to a personal magazine full of interesting articles that are automatically added to your reading list. If you have not subscribed to any feeds yet, you may want to review the procedure outlined in the previous article or have a look at **mathfest.wikispaces.com/Web+2.0+RSS**. Different wiki software programs provide slightly different options for the feeds that are available. Feeds may contain changes to a specific page or to all pages in a wiki, or to the discussion about those page(s). On any Wikipedia article, go to the History tab and look at the "toolbox" section at the lower left. There you will find the RSS link, which is the link that is used to subscribe to the feed. Choose at least one Wikipedia article of interest to you, subscribe to its history, and have a look at the kinds of entries that you'll find. You might even see some vandalism that has been quickly removed by someone watching the history feed. Other wiki software may have options to have notifications of various changes sent to you, using the anachronistic e-mail method.

Tips for Using Google Reader

We have been using Google Reader as our primary Web 2.0 learning application and will include a couple of tips for using it effectively in each article in this series. When you subscribe to a feed, you will see a "Feed Settings" button above the reading pane. There are some useful options there, like "Unsubscribe" and "Rename." There is also the option to place the feed into one or more folders, or to create a new folder. If you subscribe to a number of feeds, this will be useful. You might even want to create a "Low Priority" folder for feeds that you can read only if you have the time. Once you have a folder, it will show up in the list of subscriptions to the left. If you click on it, the reading pane will be populated with all the posts from that folder. You can even click the "Mark all as read" button above the reading pane to eliminate them from the list of unread posts.

Using Wikis in the Classroom

Creating a class wiki page is a fairly easy task, and the page can have varying levels of interactivity, depending on your comfort level. Initially, the wiki page can be used to record information about the class, upcoming homework assignments, tests, and important class events. The real benefit of using a wiki page for this type of information is that it's easy to update and keep current.

You can also link a series of pages for student use to the class wiki home page. Students could be asked to find an example of something discussed in math class, and then add it to a list on the wiki page; e.g., if 3-D solids were reviewed in class, you could ask students to record an example of a cube or sphere they found somewhere in their home, or if you are planning a lesson involving statistics, you might have students record the amount of TV they watched on a particular night.

Students can create or edit existing articles on Wikipedia. Following one or two pages will help them learn about how Wikipedia works, what a good article looks like (e.g., lots of links), and how quickly vandalism is corrected. Many articles have messages, such as: "This article's introduction may be too long. Please help by moving some material from the introduction into the body of the article. Read the layout guide and

Wikipedia's lead section guidelines for more information. Discuss this issue on the talk page." These messages challenge students to understand the editorial conventions used by Wikipedia and to collaborate for the purpose of improving the encyclopedia's content.

Classroom teacher Victoria Davis is a well-known blogger and Web 2.0 advocate (see Cool Cat Teacher blog at **coolcatteacher.blogspot.com/**). Ms. Davis has seven distinct uses for wikis, which she uses extensively in her classroom at Westwood Schools: (**westwood.wikispaces.com/**).

- Lesson Summaries
- Notes Collaboration
- Concept Introduction and Exploratory Projects
- Learn Shares*
- Individual Assessment
- Rewards
- Classroom Organization

*students share their learning with other students

Check out Vicki's personal wiki for more information (**coolcatteacher.wikispaces.com**). There you will find links to presentations she has done about using wikis in the classroom, as well as presentations on a host of other Web 2.0 topics. No wonder she is the first wikiphile quoted on the wikispaces promotional material!

One of the biggest drawbacks of wiki technology is that only one user at a time can make changes to a page. When the "Edit" button is pressed, a page is effectively checked out until it is saved. Hence, if all or several students in a class wish to work simultaneously on a wiki, each student will have to edit his or her own page. If this is impractical, consider using a Google Doc spreadsheet (**docs.google.com**) or Etherpad (**etherpad.com**). The advantage of this approach is that a wiki page can be reverted to any previously saved version, so if someone makes a mess of a page, it can be fixed with the click of a button.

For more suggestions regarding wikis in the classroom, go to **educationalwikis.wikispaces.com/**.

Creating a Wiki

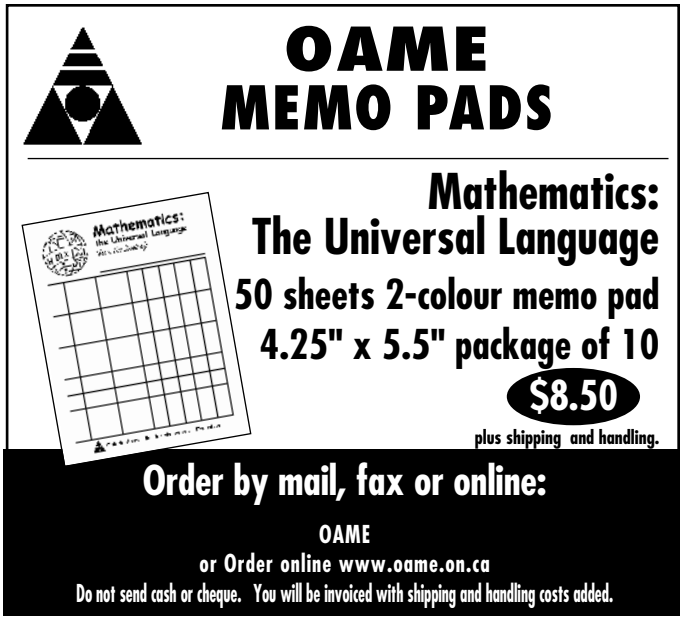
Three teacher-friendly wiki services are wikispaces, pbworks, and wetpaint. There are examples listed above from each. You can set up wikis for free, especially if they are for education, or you can pay for more sophisticated features. To create a free K–12 wiki on wikispaces:

1. Go to **www.wikispaces.com**.
2. Click on "create your own classroom wiki today" (**wikispaces.com/site/for/teachers**).
3. Complete the "Join Now" form. You will need to think about whether your wiki will be *public* (anyone can edit and view the pages), which would allow for a bigger audience and potential collaborators, or *private*, which might seem safer. Remember that you can change your option later and that you can rapidly eliminate any inappropriate content.
4. You can now click the "Edit" button on the main page to add content to that page, including standard rich text, links to other wiki pages or web pages, images, videos, and tables. If you are brave, you can click the "Text Editor" button when editing a page to get a sense of what the wikitext will look like.
5. Click "Save" to commit any changes.
6. To add a page, use the "New Page" link at the top left.

There are many more interesting features of wikispaces. If you are having difficulty, go to the discussion area of our wiki page and tell us about it (**mathfest.wikispaces.com/Web+2.0+Wikis**).

That brings our introduction to wikis to an end. Aloha! If the technology is new to you, we hope that we have provided enough encouragement to get you to try to use a wiki for yourself, to subscribe to a Wikipedia article's history, and to introduce your students to another Web 2.0 tool.

See you next time! ■



▲ Technology Corner — GeoGebra

Mary Bourassa



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.

GeoGebra is free dynamic mathematics software, available for download at **www.geogebra.org**.

It has won numerous awards and is both powerful and easy to use. Quoting from the website:

> *...the idea behind GeoGebra is to connect geometric, algebraic, and numeric representations in an interactive way. You can do constructions with points, vectors, lines, conic sections as well as functions and change them dynamically afterwards. Furthermore, GeoGebra allows you to directly enter and manipulate equations and coordinates. Thus you can easily plot functions, work with sliders to investigate parameters, find symbolic derivatives, and use powerful commands like Root or Sequence.*

Those already familiar with dynamic geometry programs will likely find GeoGebra to be quite intuitive. There are two sides to the window: the left side is for algebra, and the right side is for geometry. The icons along the top are all drop-down menus, and there is an input area along the bottom of the window.

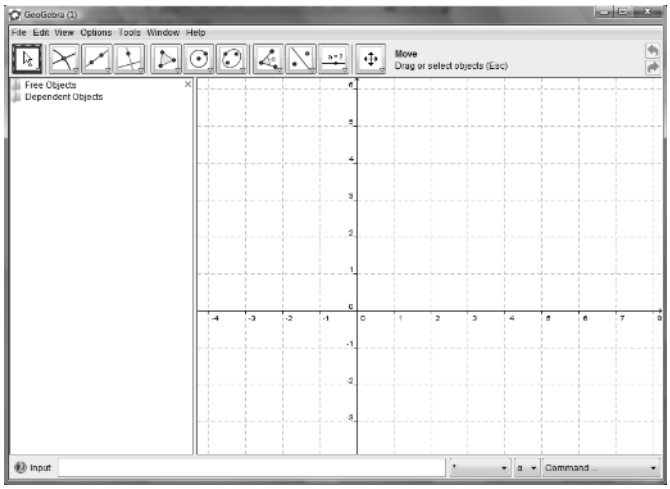


Figure 1.

Let's construct the circumcentre of a triangle. Using the polygon tool, construct a triangle.

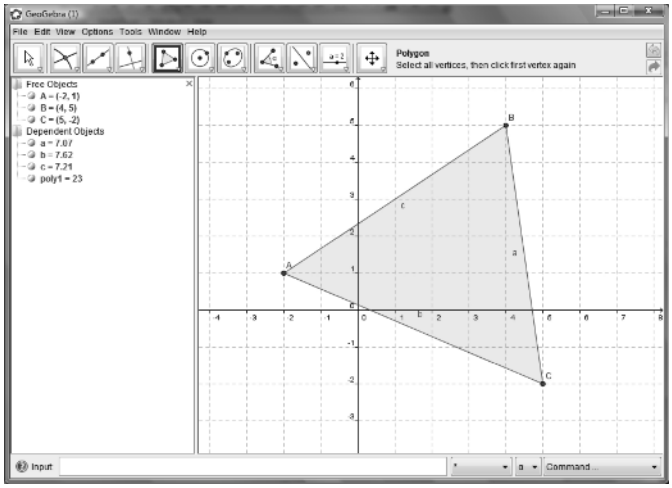


Figure 2.

Notice that the sides are correctly labelled and the coordinates of the vertices and length of each side are automatically displayed in the left portion of the window.

Next, construct the perpendicular bisector of each side:

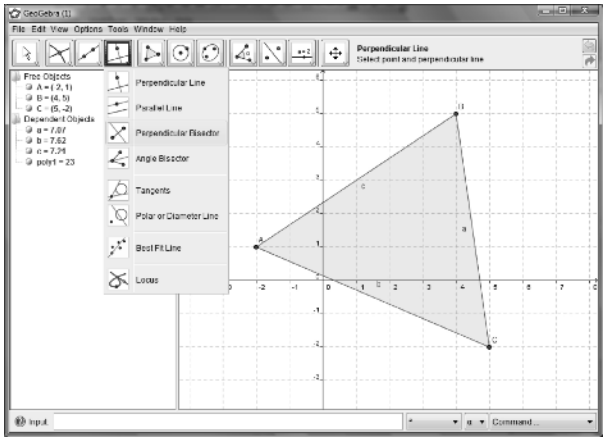


Figure 3.

After selecting each line, you can observe the result, as shown in Figure 4.

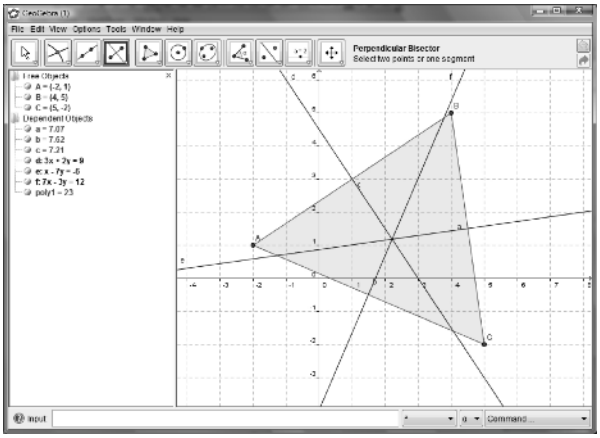


Figure 4.

Notice that the perpendicular bisectors have been named *d*, *e*, and *f*, and that their equations, in standard form, are displayed. By right-clicking on an equation, you can change it to point-slope form:

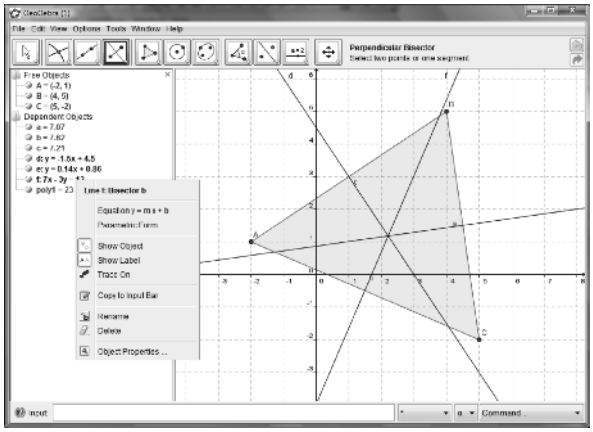


Figure 5.

Create the point at the intersection of two of the perpendicular bisectors, using the "Intersect Two Objects" tool, and then create the circle centred at point D, using the "Circle with Center through Point" tool.

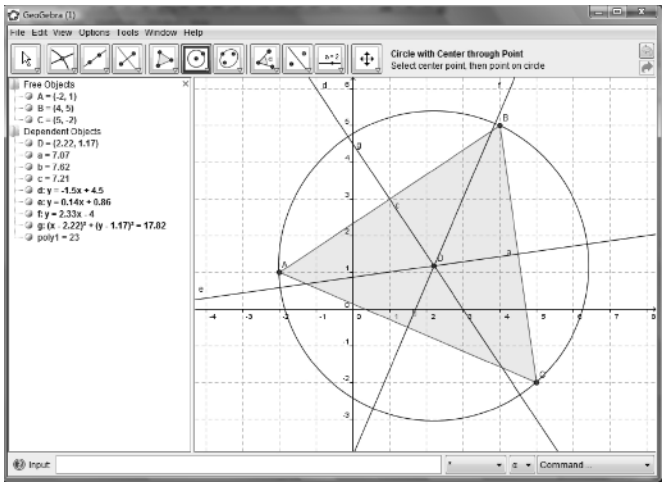


Figure 6.

Now properties of the circumcentre can be investigated, based on the construction. Notice that the equation of the circle is also displayed.

Alternatively, you can construct objects, using the input line. For example, $A = (4.5, 10.3)$ would place a point at coordinates (4.5, 10.3).

Let's look at another quick example. Start by entering the equation $y = 0.2(x + 5)(x + 2)(x - 3)$ in the input line.

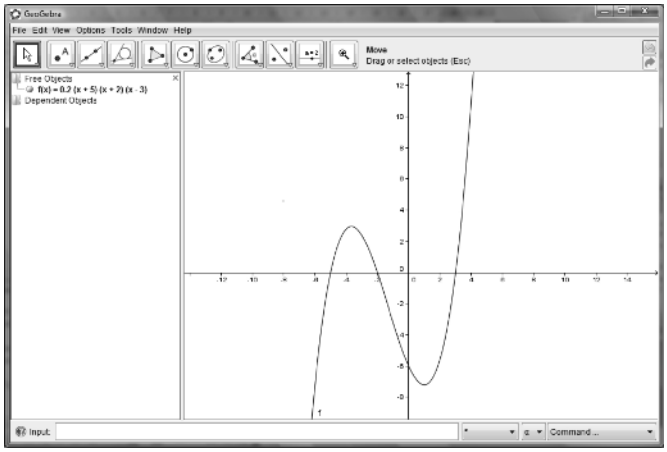


Figure 7.

Next, we will draw the tangent line to a point. Place a point on the curve by selecting the "New Point" tool, and then click on the graph of the function.

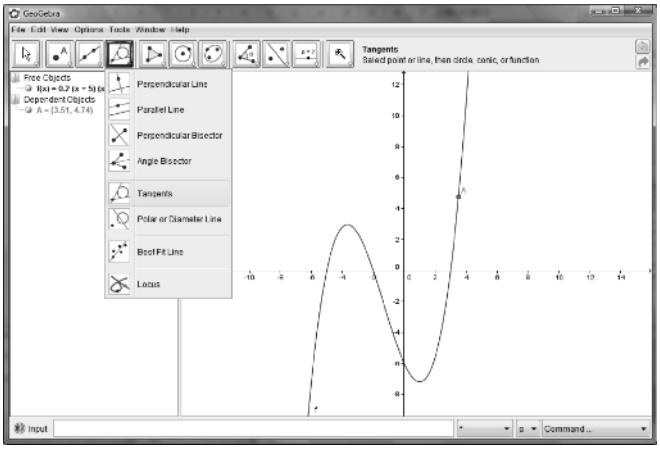


Figure 8.

Choose the "Tangents" tool, and then click on the function and Point A (the order is not important). To display the slope of the tangent and draw its slope triangle, use the input line to enter *m* = *slope*[*a*], where *a* is the name given to the tangent. The slope triangle is nicely shaded and has a base of 1. This is very useful for giving the visual representation of slope.

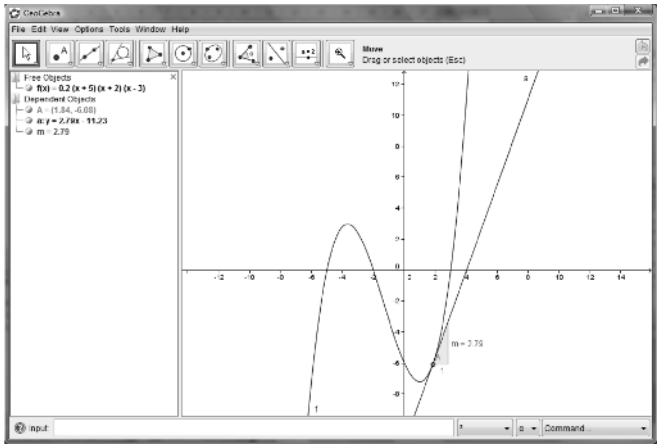


Figure 9.

You can now move Point *A* and see the corresponding change in the tangent and its slope. To see the relationship between the *x*-coordinates and the corresponding slope of the tangent, create Point *B*, defined as follows: *B* = (*x*(*A*),*m*), using the input line. If you then right-click on Point *B*, you can select the "Trace On" feature.

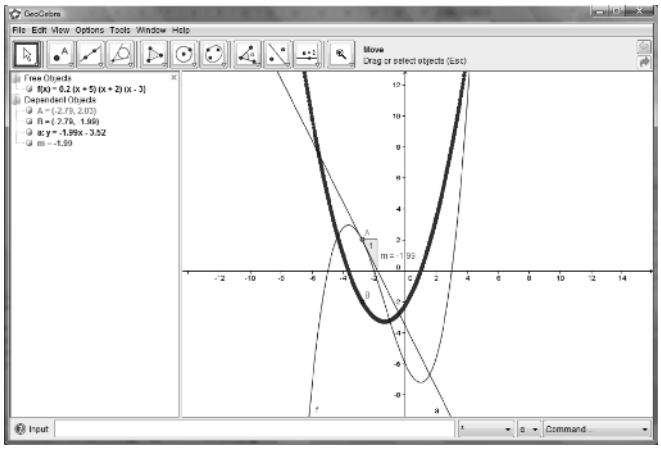


Figure 10.

The derivative at each point is now graphed, and the relationship between local maximum and minimum points and zeros can be explored.

GeoGebra can also directly graph the derivative function for you. Note that you can easily change the original function by double-clicking on its definition (in the algebra area), or by dragging the graph of the function.

GeoGebra is also great for vectors. It will draw them between two points specified by the user and will label them. You can also change the label to a "caption," which you can edit, as demonstrated below.

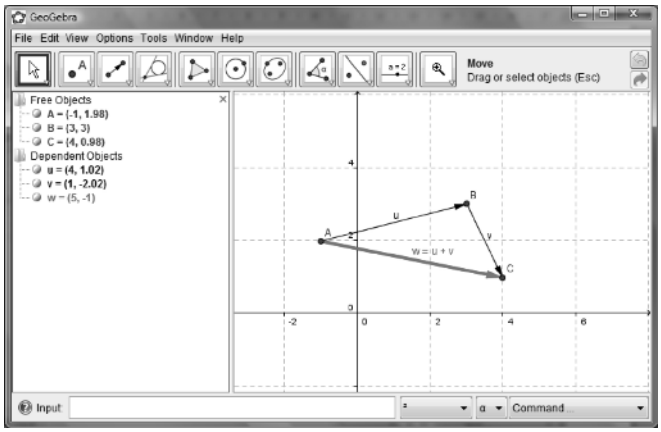


Figure 11.

There are many other great features of GeoGebra, including a spreadsheet, line of best fit, locus, regular polygon, conic sections, transformations, angle measure, length, area, and sliders. You can also add text to your constructions.

GeoGebra is a powerful, easy-to-use piece of software that is applicable to all levels of mathematics, and there are many sites on the Internet dedicated to GeoGebra constructions. I see this as a great tool for

teachers and students alike. Your students will do incredible things with this technology, and—best of all—it's free! ■

▲ Vote Online

To elect Executive and Directors for the OAME Board of Directors, please vote online at **www.oame.on.ca** from **Mar 1- Apr 15, 2010**. Click on Members Only to activate your account if you have not already done so. If you require a written ballot, please contact in writing by Feb 1, 2010:
Dave and Sue Hessey, Exec. Directors

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Workshop Leaders: Fareen Kanji and Jacqueline Hill

Grades 9–12: Building Community through Focused Discussions on Instructional Design.
Workshop Leaders: Shirley Dalrymple and Shelley Yearley

Registration Deadline: Jan 13, 2010

Visit www.oame.on.ca for full details and the registration form

▲ OAME/NCTM Report December 2009

LAURIE MOHER



Laurie 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.

NCTM Focus for 2009–2010

The NCTM Professional Development Focus for 2009–2010 is "Connecting: Linking Concepts and Context." As in the past, NCTM has provided resources for this topic, including Reflection Guides for some journal articles. These resources can be found at **nctm.org/focus**. All NCTM conferences scheduled during 2009–2010 will feature "Learn-Reflect" strands on the topic so that educators can explore the subject matter in greater depth.

In his October President's Message, Henry (Hank) Kepner asks, "Are You Helping Your Students Make Mathematical Connections?" He challenges math educators to make sure that connections play an essential role in students' learning, and he not only discusses the importance of helping students make connections, but also gives examples of how to do this. He then asks two key questions:

- What do you do in your instruction to emphasize the interrelatedness of mathematical ideas and their social and practical value?
- How do you create classroom experiences that value and build on the connections between mathematics and students' knowledge, experiences, and interests?

In his July/August message entitled "Teacher and Students – Learners Together," Mr. Kepner urges teachers to "consider using an evidence-based method to improve what you and your students do together." The strategies and suggestions will sound familiar to many Ontario educators, as they are strategies that are also being suggested by our Ministry of Education and Literacy and Numeracy Secretariat. Mr. Kepner talks about using formative assessment to make daily

instructional decisions that will improve student learning and also touches on providing students with specific feedback and on working with colleagues to study student work.

Publications

NCTM has released a document entitled *Guiding Principals for Mathematics Curriculum and Assessment*, which is available to download for free from **nctm.org**. Although this document was produced as a guide for discussions involving the development of a national curriculum for school mathematics in the United States, it may be of interest to math educators in Ontario as they develop School Improvement Plans, SMART Goals, and other professional development activities involving mathematics. The criteria that NCTM outlines for a national curriculum also align well with OAME's "Vision for Learning Mathematics." Here are two examples of the NCTM Guiding Principles:

- A curriculum is more than a collection of activities: It must be coherent, focused on important mathematics, and well articulated across the grades.
- Students must learn mathematics with understanding, actively building new knowledge from experience and prior knowledge. Learning mathematics with understanding is essential.

Another recent publication, *Focus in High School Mathematics: Reasoning and Sense Making*, is "a conceptual framework to guide the development of future publications and tools related to 9–12 mathematics curriculum and instruction." The goal of this publication is to make "reasoning and sense making foundational to the content that is taught and learned in high school." This document comes with several free online supports, including an Executive Summary, the President's Letter, FAQs, a Teacher's Guide, an Administrator's Guide, a Policymaker's Guide, and a Family Guide. You can view the Table of Contents and some sample pages online.

NCTM's 71st yearbook, *Understanding Geometry for a Changing World*, is now available for purchase through the NCTM website. You can also order yearbooks from previous years. Recently, I came across a reference to two chapters from the 70th yearbook. When I went to the NCTM website, I discovered that I could buy the two individual chapters that I was interested in for $9.00 each. (A reduced rate is offered to NCTM members.) This is the total price—no shipping and handling or tax! Once the purchase is complete, you are given links to downloadable pdfs that you can print or save right away. I had the information I was seeking in minutes!

NCTM E-Workshops

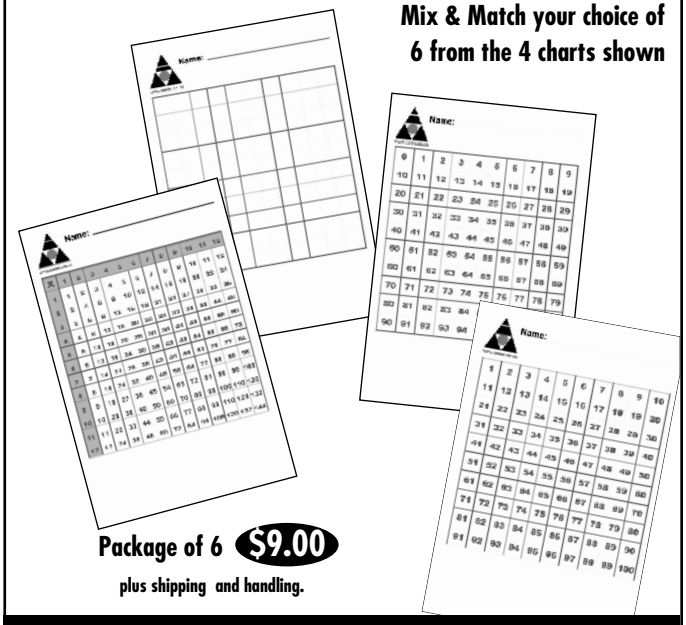
In March 2009, I highlighted NCTM's interactive E-Workshops. These were offered in two formats:

- two 90-minute sessions with time in-between to try out strategies
- one three-hour session

NCTM is now offering "E-Seminars." These seminars are one-time, 60-minute sessions that focus on "hot topics within mathematics." The sessions are accessed through an Internet connection and phone connection and include one electronic copy of the E-Seminar. The cost is $59 (US) and can be shared among several people. I am currently involved in a similar professional development opportunity (five sessions over several weeks) involving the topic of assessment, and it is proving to be a valuable experience for me. If you find a topic of interest to you, it may be worth trying out one of these sessions! ■

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OAME/AOEM AWARDS FOR EXCELLENCE IN MATHEMATICS EDUCATION



The purpose of the Ontario Association for Mathematics Education's Awards is to formally recognize individuals and educators who demonstrate an outstanding contribution to mathematics education in Ontario. The successful candidate for each award enhances the learning environment, providing opportunity for students to do, see, hear and touch mathematics in a profound and meaningful way. If you know someone who qualifies for this honour, please nominate her/him/them for one of the following awards.

OAME AWARDS

OAME/AOEM Life Membership Award recognizes an educator who has contributed in a significant way to OAME/AOEM; demonstrates outstanding leadership in mathematics education; and has accumulated 10 or more years of membership in OAME/AOEM.

Award for Outstanding Contribution to OAME/AOEM and Mathematics in Ontario recognizes an individual who has made a significant contribution to OAME/AOEM, but who is not necessarily an educator or a member of OAME/AOEM.

Award for Exceptional and Creative Teaching in Elementary Mathematics recognizes an exceptional and creative elementary teacher who demonstrates excellence in mathematics education and contributes to the overall development of students.

Award for Exceptional and Creative Teaching in Secondary Mathematics recognizes an exceptional and creative secondary teacher who demonstrates excellence in mathematics education and contributes to the overall development of students.

Award for Leadership in Mathematics Education recognizes an educator who has demonstrated leadership by contributing in a significant way to the development of mathematics teachers and enhancing mathematics education in Ontario.

Kenneth D. Fryer Award* recognizes a secondary mathematics department that fosters collegiality, teamwork, and excellent classroom teaching; contributes to the overall development of students; and demonstrates leadership in the mathematics education community.

Elementary School Staff Award for Exceptional and Collaborative Mathematics Teaching recognizes an elementary school (a school accommodating any or all of Grades JK–8) whose staff fosters collaborative and excellent mathematics teaching; contributes to the overall development of student learning of mathematics; and demonstrates leadership in the mathematics community.

*This award was established in memory of the late Kenneth D. Fryer and is co-sponsored by the Grand Valley Mathematics Association..

OAME/AOEM Awards Nomination Process

1. Complete the Award Nomination Cover Page appropriate to the specific award found at **www.oame.on.ca** or contact the Executive Directors for an electronic version (**oame.hessey@sympatico.ca**). You may include a 1-page letter of recommendation.
2. Provide up to 3 letters of support, of no more than 2 pages each. These supporting documents may be gathered from a variety of sources to reveal a full picture of the nominee. The support documents will provide precise information about the nominee's contributions as they relate primarily to the specific award.
3. Include the nominee's Curriculum Vitae of up to 5 pages. (C.V. not required for K.D. Fryer Award and Elementary School Staff Award)
4. Send the completed cover page and supporting documents by Jan 15, 2010 to: Dave and Sue Hessey, Executive Directors OAME

INCOMPLETE OR INACCURATE INFORMATION MAY CAUSE A NOMINATION TO BE WITHHELD FROM CONSIDERATION.

DEADLINE: Nominations are due by January 15, 2010 to the Executive Directors (contact info above).

The awards will be presented at the Annual OAME Conference in May, 2010.

▲ A Shortcut for Factoring Trinomials

Jeff Gardner

Jeff Gardner has been teaching mathematics for 24 years. He currently teaches at Sir Winston Churchill Secondary School in Hamilton.

I teach factoring trinomials by decomposition—always have. Normally, I don't like shortcuts because they tend to lead to bad habits, especially when it comes to factoring trinomials. Having said that, the "Australian method" (this is how Elena, one of my students, introduced it) may get our students into a practice we would like.

Example 1: Factor $6x^2 + 17x + 12$ fully.

Using decomposition, you would look for two factors of 72 (e.g., 8 and 9) that also add to 17.

$$6x^2 + 17x + 12 = 6x^2 + 8x + 9x + 12$$
$$= 2x(3x + 4) + 3(3x + 4)$$
$$= (3x + 4)(2x + 3)$$

Using the Australian method, you still have to find the factors 8 and 9, but then comes the shortcut…

Write the first term of the trinomial in each binomial pair, based on the coefficient "6" of the x^2 term

$(6x\quad)(6x\quad)$,

and then add in the factors 8 and 9.

$$(6x + 8)(6x + 9)$$

Take out the common factors. From $(6x + 8)$, you get $2(3x + 4)$, and from $(6x + 9)$, you get $3(2x + 3)$.

Now "toss away" the 2 and 3 to get the final answer:

$$6x^2 + 17x + 12 = (3x + 4)(2x + 3).$$

Example 2: Factor $12x^2 - 13x - 35$ fully.

Two factors of -420 that also add to -13 would be -28 and 15,

so...

$(12x - 28)(12x + 15)$ gives $4(3x - 7)(3)(3x + 5)$

Now "toss away" 4 and 3 to get

$$12x^2 - 13x - 35 = (3x - 7)(4x + 5).$$

However, the problem with this method—and the interesting thing for me—can be illustrated in an example like the following:

Example 3: Factor $3x^2 - 21x + 30$ fully.

Two factors of 90 that also add to -21 would be -15 and -6.

$3x^2 - 21x + 30$, when factored using the Australian method, produces the incorrect result

$$(x + 2)(x - 5).$$

So, if the student does not common factor *first* (as, I think, we try to get our students to do when starting any factoring question), this method incorrectly loses the common factor (in this case, 3). Hence, the weakness in the "Australian method" forces students to common factor first. *Interesting!* ■

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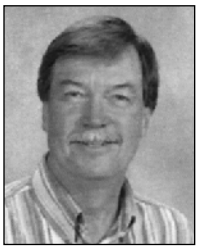
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▲ "Funny Money" Goes National...

JOHN KITNEY



Prior to his recent retirement, John Kitney was the head of Mathematics at Bayridge Secondary School in Kingston. He has always had a strong interest in promoting financial literacy. Working with the Investor Education Fund allows him to maintain this commitment by presenting free workshops and free resources to teachers.

It's not too often that a single presenter, standing in front of a gym full of students in Grades 11 and 12, can command their complete attention for over an hour. In fact, they're eating right out of his hand, and the topic—of all things—is financial literacy!

"How broke is your butt?" James Cunningham calls out from the stage.

If they weren't following his every move before, they certainly are now. They can't quite figure this guy out, but they know that someone in the audience is leaving with a fifty-dollar bill before the end of the program.

"Who's gonna get the 'fitty?' because you know, when you're in the 'hood, you got to call it a 'fitty.'" It's about catching their attention and then challenging their financial savvy.

"How much do you think young people between the ages of 15 and 22 are spending, annually, across North America?" There are various guesses that seem high enough, but James pushes them higher and higher. The answer of 100 billion dollars a year is almost unbelievable, but this is the demographic that buys all the clothing, shoes, fast food, electronics, games, cellphones, and iPods.

"But that's not the big deal. That's not what I'm really worked up about. Try this one on for size. How much of that money do people in your age group actually *earn*?" Once again, the numbers are all over the map, but higher now because they were so far off the first time.

"You're only making 5.6 billion dollars. So what's going on? Whose money are you spending? I think you guys know. How about it? How many of you get most of your money from the Bank of Mom and Dad? Young people are spending almost 20 times the amount of money that they actually bring in! This generation is the highest-spending generation of all time. So, if you're in Grade 12, and you're heading out to work or college or university, who's gonna look after your lifestyle? How many of you have your own credit cards? Do you see where I'm going with this? Your generation has the greatest potential for runaway debt of any generation in history!"

I sat in on this presentation at Lisgar Collegiate in Ottawa while attending the latest OAME conference at Carleton University. James Cunningham is a seasoned comedian by vocation, but when it comes to financial education, he really knows his stuff. With the financial backing of the Investor Education Fund, James has been delivering his financial message to Ontario students over the last three years. This year, the Investor Education Fund, in partnership with the Investment Industry Regulatory Association of Canada, is expanding the program across Canada. This will obviously add to the current demand, so if you would like this program to come to your school, you should book as soon as possible.

The Investor Education Fund promotes financial literacy education at all ages and does this with money from regulatory settlements imposed by the Ontario Securities Commission. The result is that all the Investor Education Fund's resources, workshops, and school presentations, like this one by James Cunningham, are free. I can't think of too many messages that are more important to get out to teachers and students. It's factual information with no hidden agenda, and it's absolutely free!

In the first of two workshops at the OAME Conference, I shared the *Taking Stock in Your Future* guides and other supporting material from the Investor Education Fund with a group of about 30 registrants. James Cunningham was there to give a 20-minute overview of his presentation, and there was no question that everyone felt the impact of his message and recognized James' skill as a presenter. If you are interested in this material, you can go to **www.investorED.ca** and locate the resources under the link entitled "Teachers' Corner."

But back to the message. James knows that to resonate with students, this message can't be too complicated, so he breaks it down into three major themes/messages:

- KNOW YOUR FLOW. This is where you stay on top of what is coming in and what is going out. Everyone thinks budgeting is about tracking their spending, but it also means tracking how much money you have coming in. That includes income from part-time jobs, allowance, and any investment income or gifts. Of course, James also talks about the difference between "needs" and "wants."
- KNOW WHAT YOU OWE. If you don't control your money, your money will control you. Take control of your debt by having no more than two credit cards. Avoid retail cards, as they usually have a higher interest rate. Use debt wisely and build a good credit rating. If you owe money for anything, put it on a list, then keep the list in your wallet so you can't help but see it… every time you think you need to buy something new.
- INVEST SOME DOUGH. Is your money working for the bankers and credit card companies, or is your money working for you? The difference between people who get rich and people who stay poor is the kind of stuff that they buy.

Here, Cunningham gets the audience to supply the key words "depreciation" and "appreciation" and drives home the point of wise investment decisions. Sharing an understanding of exponential growth with an example that is just a compound interest annuity, he gets the point across that the most important thing is to start saving, perhaps modestly, but now!

James is an entertainer with a message that is crucial to this generation of students. Like no other generation, they will be bombarded with powerful marketing campaigns and enticed by easy credit, they will be offered a maze of investment options, and they will need to have saved some money—lots of money—by the time they retire. Anything we can do to help get this message out there is a good thing. For information and bookings for the free "Funny Money" program, contact **lisa durocher@cambridgechamber.com**. For more information about the Investor Education Fund's teacher program, visit **www.investorED.ca**, Teachers' Corner.

**Author's Note: While the quoted speech may not be verbatim, it correctly conveys the style and discourse of the presenter.*

▲ Mathematics and Aesthetics in the Classroom

STEWART CRAVEN



Stewart Craven has worked as a teacher, consultant, and coordinator with the Toronto District School Board and is currently on secondment to the Ontario Science Centre. Recipient of a Prime Minister's Award for Teaching Excellence in Math, Science, and Technology and a former President of both OAME and OMCA, he continues to be actively involved in the Fields Math Education Forum, the Canadian Math Society, and the Canadian Math Education Study Group.

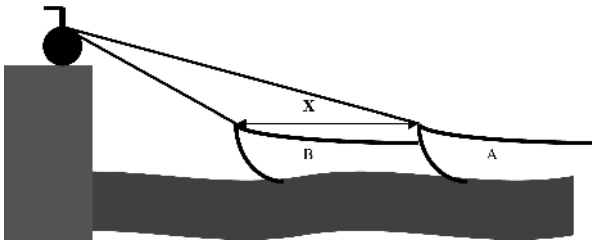
Introduction

What if we lived in an ideal world where all teachers (and parents) understood mathematics and had a deep and abiding love and appreciation for its beauty? What if all children, from the day they were born, were immersed in learning mathematics through aesthetic approaches, and the motivation to learn mathematics stemmed from its intrinsic beauty? Would *all* children come to understand mathematics (not necessarily all mathematics, but at least the important stuff) and appreciate its beauty? Or, is this idea so divorced from reality that all we can hope for is that more young people graduate from our school system understanding at least *some* important mathematics and appreciating some of its beauty, or at least seeing its utility and accepting that it is a subject not to be feared or loathed? Let's look at how mathematics relates to aesthetics.

Mathematics and Aesthetics

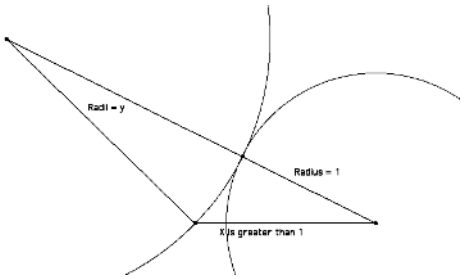
To begin, I'll describe two problems, their solutions, and my responses to each. The first of these problems I'll call "The Painter Problem." I first encountered this problem about 20 years ago, when Dr. Ron Scoins introduced it to a group of senior mathematics students at Marc Garneau Collegiate Institute. Since then, I have used this problem numerous times with students and teachers. What is it about this problem that I find so appealing?

The Painter Problem

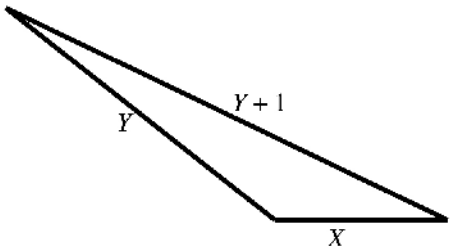


A boat (in position A) is tied to a dock by a painter (a rope) that is taut. The painter is at an angle to the dock, as shown. If exactly one metre of rope is reeled in, the boat moves into position B. Do you think the distance *X* is less than one metre, exactly one metre, or more than one metre? Why?

Solution #1



Solution #2



Triangle Inequality:

$X + Y > Y + 1$

$X + Y - Y > Y - Y + 1$

$X > 1$

When I pose this problem to teachers or to middle school, high school, or university students, and ask them to conjecture whether *X* will be less than one, equal to one, or greater than one, over three-quarters of respondents believe that *X* will be less than one. I then provide the problem solvers with rulers, string, interlocking cubes, paper, and calculators. Of course, some will try to produce a paper-and-pencil response, but many will try to create a simulation to test their conjecture. As it turns out, the solution is counterintuitive for many because *X* is definitely greater than one, except in the case where the winch is at the same level as the bow of the boat. I like this problem because the result is counterintuitive, but also because its solution is accessible to virtually all students. That is, students can use concrete materials at one end of the spectrum, or apply abstract mathematics, using paper and pencil, at the other.

What does this problem have to do with aesthetics? Consider the three solutions. Many problem solvers start with the concrete approach by constructing a "boat," attaching a string, dragging the boat, and making a number of measurements. Quite often, though, problem solvers will attempt to find a paper-and-pencil solution. This suggests that the problem solvers are intrinsically motivated to seek solutions that are more general than solutions based on observations of physical experiments. From my point of view, the two solutions are elegant because they are so concise and simple to understand. The first proof is visual and very compelling, while the second proof is based on an idea that, in my view, is one of a few fundamental relationships—the triangle inequality—that all numerate citizens should know and understand. Furthermore, the manipulation of the inequality requires only three lines and is therefore sublime in its simplicity.

The Three Daughters Problem

Host: Welcome to my party!

Guest: It's been a long time! I hear that you now have three daughters?

Host: I do, indeed.

Guest: Tell me a little about them.

Host: Now that I think about it, I realize that the product of their ages is 72.

Guest: Tell me a bit more.

Host: Well, I know that the sum of their ages is my address.

Guest: I know your address, but that's not quite enough information.

Host: Of course, I should have said that my eldest loves banana cream pie!

Guest: I now know their ages!

What are the ages of the three daughters? Justify your answer.

CASE #	PRODUCT	SUM	COMMENT
1	72 x 1 x 1	72 + 1 + 1 = 74	
2	36 x 2 x 1	36 + 2 + 1 = 39	
3	24 x 3 x 1	24 + 3 + 1 = 27	
4	18 x 4 x 1	18 + 4 + 1 = 23	
5	12 x 6 x 1	12 + 6 + 1 = 19	
6	9 x 8 x 1	9 + 8 + 1 = 18	
7	18 x 2 x 2	18 + 2 + 2 = 22	
8	12 x 3 x 2	12 + 3 + 2 = 17	
9	9 x 4 x 2	9 + 4 + 2 = 15	
10	6 x 6 x 2	6 + 6 + 2 = 14	"I know your address, but that's not quite enough information." The two entries that total 14 are the only ones that do not have unique sums. The word "eldest" infers that the other daughters must be younger. Hence, the daughters are 8, 3, and 3 years of age.
11	8 x 3 x 3	8 + 3 + 3 = 14	
12	6 x 4 x 3	6 + 4 + 3 = 13	

This problem intrigues me for quite different reasons. The solution provided is not really short and elegant, but it is probably the best approach. For example, when students or teachers try to solve this algebraically, they should discover that there are too many variables and not enough independent equations. The solution provided is an organized list of all "positive integer triples" that have a product of 72. A well-organized list takes advantage of some very nice patterns. What I find exciting is the fact that the final conclusion must take into account all of the key statements in the narrative and then use a logical argument to establish the validity of the answer. The beauty and the power of mathematics is evident in solutions to problems like the Three Daughters Problem.

Comparing Ideas

Nathalie Sinclair, in her book *Mathematics and Beauty: Aesthetic Approaches to Teaching Children* (2006), provides a detailed definition of aesthetics, based on the writings of David Pimm. Pimm (2006) describes the elements of aesthetics as "*What* to attend to (the problems, elements, objects), *how* to attend to them (the means, the principles, techniques, methods), and *why* they are worth attending to (in pursuit of the beautiful, the good, the right, the useful, the ideal, the perfect, or simply, the true)." This set of criteria is necessary if one is to try to make sense of aesthetics in the mathematics classroom, since dictionary definitions tend to focus on broad ideas such as the appreciation of beauty or responses to artistic experiences (*Canadian Oxford Dictionary*, 2004; *Nelson Canadian Dictionary of the English Language*, 1997). Sinclair addresses questions such as the following:

a) In what ways do aesthetics in general define what it is to be human?

b) What are aesthetics as they pertain to mathematics?

c) How do mathematicians view aesthetics as they pertain to mathematics?

d) How do teachers view aesthetics as they pertain to mathematics?

e) How can/do school-aged children employ aesthetics as they pertain to mathematics in their learning?

"Humans everywhere, in a manner unlike other animals, differentiate between an order, realm, mood, or state of being that is mundane, ordinary, or 'natural,' and one that is unusual, extraordinary, or 'supernatural'" (Dissanayake, 1992). Sinclair sets out to establish that people are wired in such a way that beauty/aesthetics is *automatically* one of the lenses through which we make sense of our environment. How many of us, for example, remain emotionally neutral when looking at the Taj Mahal, an orchid, an Islamic mosaic, the Grand Canyon, the Sydney Opera House, the Rocky Mountains, or a lake in Killarney Provincial Park? People naturally react with a sense of pleasure to balance, symmetry, scale, and so on:

> *…not only do humans distinguish images, sounds, and tastes that appeal to their senses more than others; they also distinguish elements such as repetition, symmetry, and proportion that appeal to their cognitive faculties* (Sinclair, 2006).

How does this innate appreciation for aesthetics have impact on how we learn mathematics? I'll come back to this question after I explore how mathematicians see aesthetics in terms of their own work. Sinclair (2006) cites Joseph (1992):

> *The ancient Greeks marvelled at the elegance and purity of deductive geometry, while the Chinese revelled in the balance and complementarity of magic squares and Vedic mathematicians wove transcendent theories of infinity.*

Sinclair lists five criteria—***connectedness, fruitfulness, visual appeal, simplicity, and surprise***—that can be used to determine what is aesthetically pleasing in terms of mathematics. What do these criteria mean, and how do they apply to the doing or learning of

mathematics? Based on the example that Sinclair uses, ***connectedness*** is primarily about how one problem or inquiry in mathematics is related or connected to/with other ideas in mathematics. In other words, if one is investigating the structure of the binomial theorem, then one can't help but see the beautiful patterns found in Pascal's triangle. I would also suggest that not only are connections across mathematics exciting, but that connections with other disciplines and real-world phenomena can be as well. For example, what person/student would not be in awe of the relationship between the Fibonacci sequence and the arrangement of seeds in a sunflower? ***Fruitfulness*** suggests that the doer of mathematics sees what has been accomplished up to a point and senses that these learnings/products will lead to additional meaningful inquiries, e.g., What if? What if not? ***Visual appeal*** can mean vastly different things to different people. Having stated this self-evident truth, it is also fair to say that often, when people see a visual representation of a proof in the form of an imaginative drawing or model, they can't help but sense the pleasure of a deeper understanding. An excellent example of this, found at many science centres, is the model of a right triangle with three squares on its legs. The largest square contains coloured water that fills the other two squares as the triangle is rotated to demonstrate the Pythagorean Theorem. ***Simplicity***, which, in my mind, can be equated with elegance, is also something that often evokes pleasure. Similarly, some people derive great satisfaction when they encounter a result that is ***unexpected***.

Looking back at the two problems discussed at the beginning of this article, I suggested that the following elements were involved: In the case of the Painter Problem, I referred to the ***connection*** with the triangle inequality, the ***visual appeal*** of the geometric solution, and the ***simplicity*** and ***elegance*** that both solutions provided. In terms of the Three Daughters Problem, solving the problem involved the ***connection*** between ideas in number and logic. Furthermore, many people find a solution that depends on a connection between narrative and logic to be ***surprising***. I certainly did.

Motivational, Generative, and Evaluative Stages

Sinclair subdivides the process of doing mathematics into three stages—the motivational, the generative, and the evaluative. In her discussion of the motivational stage, she refers to children working in computer environments (e.g., the *Meeting Lulu* microworld and the *Colour Calculator* interface). In her first example, a middle school student explores Cartesian coordinate systems by creating a "path" and its reflection in the *Meeting Lulu* microworld. As the student explores, she is intrigued by the designs that emerge (e.g., trees). These designs appear to encourage her to create more and more complex rules, which, in turn, create additional images. Sinclair then turns her attention to students who are studying the decimal structure of fractions by using the *Colour Calculator* interface. The *Colour Calculator* interface allows students to input fractions and represent those fractions in an array (the dimensions of the array are variable and can be chosen by the student) in which each digit is replaced with a unique colour. The students start by investigating the fraction 1/7. By adjusting the dimensions of the array, the students see different colour patterns (e.g., stripes or "staircases"). One student, in particular, discovers that he can control the colours, the number of elements in the period, and the sequence of colours that he wants by appropriately using the denominators 9, then 99, then 999, and so on, thereby constructing whatever "rainbow" he wants. In both of these cases, the students who were observed were motivated by symmetry or colour patterns to investigate well beyond the apparent parameters of the initial activity. Sinclair argues that the students were intrinsically motivated to persevere with their inquiries because their internal sense of aesthetics was activated by the mathematical environment in which they were working. She maintains that "…by beginning with the aesthetically rich situation and asking what is interesting and/or significant to know about fractions and their decimal representations—note the reversal of order—a radical departure from conventional objectives might ensue" (2006).

What is it about such a task that motivates students to learn mathematics more deeply than they would through a more traditional approach? Does the deep learning occur because the students are more drawn into their investigations, and through perseverance and concentration, begin to make sense of new ideas? Would such environments captivate the interest of *all* students? If not, how much choice would be required to interest the *majority* of students? Although Sinclair does not provide specific answers to these questions, she does explain why she believes that aesthetically oriented tasks are more effective vehicles for learning mathematics than more standard, straightforward tasks:

> *By presenting students with tasks that are always clear, coherent, and as efficient as possible, they are deprived of the possibility of feelings of confusion, doubt, ambivalence, and dissonance,*

the very feelings that produce the tension and frustration necessary for mathematical inquiry.

Furthermore, she states, "…it is the reducing of surprise and complexity to simplicity and predictability that evokes, in learners, first reflection, then pleasure." From my personal experience, I will provide an example that would tend to substantiate these statements. Every Saturday, there is a "number cross" puzzle in the *Toronto Star* that can be solved by trial and error. I believed that there was an underlying rule that could be used to solve the puzzle efficiently. I struggled with this problem, and over time, I found a rule that always appears to work. I derived a great sense of pleasure from this accomplishment.

I am convinced that most children are intrinsically motivated to work in aesthetically rich environments, but that to do so, they require the support of a knowledgeable teacher who is comfortable with facilitating open-ended mathematical tasks. There are, of course, students who would still struggle with such activities. Such children might work better when tasks are highly structured, or they may simply require some form of additional extrinsic motivation. Nevertheless, a number of questions come to mind:

- Do students generally persevere when mathematical tasks evoke feelings of confusion, doubt, ambivalence, and dissonance?
- Do certain conditions (e.g., class size, availability of materials/technology, the school timetable, and the layout of the classroom) make it difficult for teachers to provide rich, aesthetically oriented opportunities for learning?
- Within the existing school structure, what proportion of mathematics classes should be devoted to rich, aesthetically oriented tasks?
- Would students become bored or frustrated if they were frequently challenged to work in such environments?

These questions notwithstanding, I contend that students are frequently deprived of learning mathematics in aesthetically oriented environments, and that they should be given at least some opportunity to do so.

The generative stage is difficult to separate from the motivational stage. The difference, as explained by Sinclair, seems to be based on when each of these stages occurs. The motivational piece occurs at the front end of the inquiry, and therefore, the generative stage occurs when little discoveries that take place during the inquiry drive the student to continue to explore. For example, the student who was exploring the fraction 1/7 by using the *Colour Calculator* interface, initially chose dimensions for columns that were divisible by 6, thus generating a pattern of stripes. When he changed this dimension to a value not divisible by 6, the *Colour Calculator* generated a staircase pattern. This dramatic change was an impetus for him to try different fractions, and it encouraged him to "play" with the dimensions of the array.

What is important during the generative stage is that students are encouraged to notice changes that crop up as they adjust the parameters. In reference to Ellen Langer (1998), Sinclair states: "She shows how traditional ways of imparting information––that is, speaking as if something is absolutely true, independent of context––deprives one of the need or impetus to notice anything. Such a style closes down invitations to further thought." Sinclair believes that "…the process of inquiry has its most cohesive shape—starting and ending in play." The notion of establishing an environment in which children feel that it is safe and desirable to take risks or play with ideas is, in my mind, absolutely necessary for learning mathematics.

However, it is at the evaluative stage that aesthetics may play the most important role.

In the classroom, this is the time devoted to comparing, discussing, and valuing solutions produced by the students. Some students may value solutions that are comprehensive and easy to follow, some may prefer concise responses or solutions that are truly creative or unique or that reveal a surprise, and others might appreciate a response with "visual appeal." Learning to discriminate among solutions and to evaluate each solution according to its strengths, weaknesses, and aesthetic characteristics is not necessarily natural. Students need many opportunities—in non-threatening, supportive environments—to engage in such conversations in order to learn how to critically analyze, and then comment on, different solutions. Sinclair quotes a teacher, Gaynor Williams (1994), as she describes the nature of her classroom:

> *Students have realized there are many ways to approach the same problem. Right from the beginning of the year, even in aspects of the course where I did the teaching, it has been understood that, if anyone can see a neater, faster way to get the same answer, we want to know about it… They value responses from groups who have found an original and elegant way to approach a solution and will question until they understand the process.*

Values in Mathematics Education

What values do mathematicians espouse, and are these values different from the values espoused by those in other disciplines? Furthermore, what values *should* be addressed in school mathematics classrooms? Sinclair writes, "I believe that part of learning mathematics should involve becoming aware of and being able to develop a critical stance towards its values and their effects on both personal experiences and social norms." This is a very important statement because many people believe mathematicians' work is sterile, abstract, and devoid of context. But mathematics is just one of a number of lenses through which human beings attempt to make sense of their world. By definition, then, *context* is inextricably connected to the study of mathematics. What sort of context? Context could be mathematics as it is used in science. Context could be embedded in the study of social sciences or the arts or sports or commerce or architecture. Context could be defined in terms of the ways that mathematicians actually do mathematics. Students need opportunities to explore meaningful connections between mathematics and social issues such as global warming, the AIDS pandemic, the greening of their school, or the plight of refugees. Students also need to experience the pleasure of the beauty of mathematics and to see how mathematics manifests itself through natural phenomena such as sunflowers, gemstones, and galaxies. Sinclair refers to the following statement by Ivan Illich (1994), "…this extreme abstraction is one of the root causes of social malaise in the modern world, which is moving farther and farther away from a worldview that is sensitive to the proportions between human beings and nature." By no means is mathematics devoid of values; rather, it is an important vehicle through which teachers can help students develop a strong sense of their own values.

Final Thoughts

Mathematicians view the relationship between aesthetics and mathematics in many different ways. Some mathematicians appreciate the beauty of an elegant proof (e.g., when a proof flows logically, using a minimum of steps), while others appreciate mathematics that is visually appealing, as in a pictorial proof of the relationship between the arithmetic and the geometric means of two values. Some mathematicians relish results that are surprising (e.g., the Monty Hall problem), while others value proofs that have a timeless quality to them, either because they required years of effort to resolve (e.g., Wile's proof of Fermat's Last Theorem) or because the proof has, and likely will, stand the test of time. Then there are the mathematicians who revel in the ingenuity or the cleverness of a solution, and yet others who believe that the beauty in a proof lies in its connectedness to other branches of mathematics, to other disciplines, or to "real world" phenomena. If, according to any of these interpretations, aesthetics is important to the people who do mathematics as an avocation, shouldn't students also be given the opportunity of having similar affective experiences when doing mathematics?

It goes without saying that if teachers do not understand and appreciate the beauty that exists in mathematics, they are not likely to expose their students to it. Hence, a large proportion of students who graduate from the school system will continue to think that mathematics is an arbitrary, bland, abstract set of rules to be memorized and promptly forgotten at the earliest possible convenience.

Sinclair writes,

> *Again, I believe that many teachers already do shape [students'] values implicitly, and they do so by denying the mathematical aesthetic in the classroom. I think this antiaesthetic can be seen in students' repeated complaints about hating math or finding it boring* (Sinclair, 2006).

But when students are engaged in rich, open inquiries where aesthetic qualities emerge, they begin to see mathematics in a different light. They start to see that mathematics has intrinsic beauty and that it really does provide a different lens by which they can make sense of their world.

If students are participants in an environment in which the mathematical tasks that are chosen have solutions that reveal an intrinsic beauty, then, in many cases, the students' own sense of aesthetics will serve to motivate them to engage in the mathematics. But the intrinsic motivation that comes from the mathematics itself should not be the only means of engaging students. Connecting the mathematics to context (e.g., Islamic art or beautiful architecture) can also be a valid and efficacious way to interest and attract students, as long as the context does not subsume or obscure the mathematics to be explored. Having said that, it is still fair to say that as students explore rich mathematical tasks, it is likely that certain aesthetic stimuli (e.g., unexpected symmetry or fascinating designs) will drive them to investigate further. Furthermore, it is critical to provide an environment where children will freely engage in doing mathematics. According to Sinclair, this environment must honour children's sense of aesthetics by ensuring that tasks are

rich and open-ended, that many and various tools are available for use, that collaboration is the norm, and that critically comparing solutions, proofs, and ideas is always the natural conclusion to any exploration. But what we, as teachers, should be most concerned about at the end of the day is how students' values and their connectedness with the human condition are affected by our teaching. In short, we must be able to answer the all-important question, "Why do mathematics?"

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▲ 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.

▲ Learning Mathematics from Place[1]

GLADYS STERENBERG AND THERESA McDONNELL

Gladys Sterenberg is an Assistant Professor in the Department of Elementary Education at the University of Alberta. Her research interests include mathematics and story, teacher professional development, and curriculum studies.

Theresa McDonnell is a teacher at Siksika Nation High School. She is interested in curriculum development and learning from place.

Introduction

Changes to mathematics curricula across Canada now include directives to consider Aboriginal perspectives. For example, the *Common Curriculum Framework for K–9 Mathematics: Western and Northern Canadian Protocol* (Alberta Education, 2006) mandates teachers to consider the Aboriginal learner in its Program of Studies, and *The Ontario Curriculum, Grades 1–8: Mathematics* (Ontario Ministry of Education, 2005) states:

> *Learning activities and resources used to implement the curriculum should... enable students to become more sensitive to the diverse cultures and perceptions of others, including Aboriginal peoples. For example, activities can be designed to relate concepts in geometry or patterning to the arches and tile work often found in Asian architecture or to the patterns used in Aboriginal basketry design.* (p. 28)

Over the past two years, we have taken on the challenge to consider Aboriginal perspectives in Theresa's middle school mathematics classes at a Blackfoot Nation school. In this setting, we focused on the perspectives of the Blackfoot people. As their knowledge has accumulated over the millennia in one place, it is fair to suggest that Blackfoot perspectives arose from their interaction with the land, now called Southern and Central Alberta, Eastern Saskatchewan, and Northern Montana. Thus, one possible approach to

[1] *This project was supported by the Canadian Council on Learning.*

teaching from an Aboriginal perspective is through learning mathematics from place. Learning from place recognizes the intimate relationship that Indigenous peoples have with the land. Furthermore, learning from place continues to be a valid and meaningful method of interpreting and understanding the world, including mathematics.

By taking students to sacred sites within the Blackfoot Confederacy and bringing some lessons outside, the land became a very present third party. Lessons taught outside did not follow a carefully planned schedule, and suddenly, factors such as weather, animals, unexpected guests, and an abundance of student curiosity came into play. This approach to teaching from an Aboriginal perspective was challenging because it required a plethora of planning, a field-trip budget, awareness of protocols, support from culturally knowledgeable staff and/or community members, a flexible and supportive administration, and a willingness to relinquish some power and structure in teaching.

How each teacher meets the new goals set out by provincial curricula will be varied and unique. For us, teaching from an Aboriginal perspective involves discovering that which is meaningful and relevant to the students, while honouring the ancestors of the host territory in which the students live and learn. It also means imparting the curriculum by revering the people and land from which the students came. We believe this can be accomplished by finding meaning in places and by inviting students to see the world mathematically and intuitively.

Drawing on the Blackfoot community's historical connections to the Big Rock near Okotoks in southern Alberta, we consider the experiences of nine Grade 9 Aboriginal students as they used digital cameras and Global Positioning Systems (GPS) to investigate the trigonometry, coordinate geometry, and topography of the land. In this article, we describe our teaching ideas and the students' responses as we demonstrate how learning from place can be used to encompass Aboriginal perspectives.

Learning from the Land

Our project was situated in a Blackfoot community in southern Alberta. The preliminary lessons took place at a First Nations school, and we selected the site of the Big Rock in southern Alberta for our field trip. This choice was shaped by the Blackfoot community's historical connections to the place. Located west of Okotoks, Alberta, the Big Rock is the largest glacial erratic in the world and is part of a series of boulders stretching from Jasper to Montana. This site was significant to the Blackfoot community, and the splitting of the Big Rock by Napi's actions is a story still told today[2]. Because the Big Rock is part of a 700-kilometre erratic chain, we could not visit the entire route of this glacial rock. However, by using GPS technology and digital cameras, the students were able to develop an in-depth understanding of the land and its vastness.

Students were asked to find examples of mathematics in the landscape. Using their observations, we designed mathematical tasks that focused on the geometries found in the land. The students' observations were then compiled into a photo book that was shared with the community. The use of GPS technology and digital cameras helped the students understand the ways in which mathematics and the land are related, and we believe this made the mathematics more relevant to the students.

Measuring Shadows

One of the preliminary lessons we designed for the students involved identifying a benchmark, measuring shadows of trees and bushes in the landscape near the school, creating and sketching similar triangles, and calculating heights of tall, natural objects. Students took photographs of the objects and shadows as they related mathematics to the land.



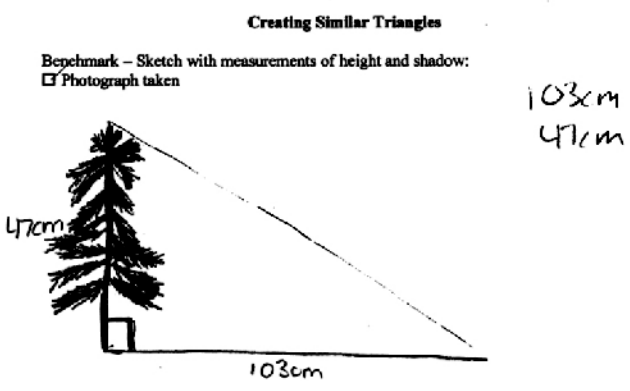
The students were very successful in working with ratios of similar triangles, one concept essential to understanding trigonometry. We noted that the students loved working outside with shadows. We were concerned that it might seem childish to take them

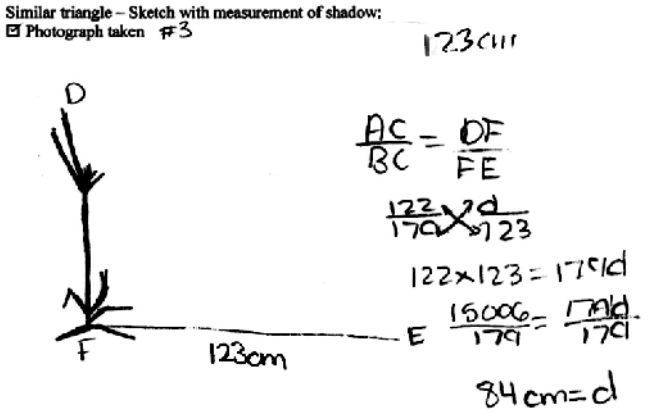
[2] *A version of the story as told by Blackfoot Elder Stan Knowlton is recorded by Humble (2007).*

outside and have them measure shadows and work from a historical perspective of how similar triangles could be created. However, we decided to proceed, and the students did not hesitate to engage in the task.



Much of what we do in Grade 9 involves drawing models on the board, while expecting students to know how the triangles represent reality. When the students were outside, they were highly engaged in the mathematics. They were measuring: they had to measure and find a benchmark, and then they had to find something they could not measure the height of, and calculate it, using similar triangles. Then we asked the students to draw and label the triangle. What was interesting to us was that their drawings did not reflect their perspective. Rather than drawing according to how they were standing in relation to the shadow, they would flip the triangle back to the way that it was typically represented in the textbook. They did this mentally. They tended to draw the triangles so that the height was vertical and the base was horizontal out to the right, even though that was not the perspective from which they had viewed the actual object.





The students had absolutely no problem with identifying similar sides and angles. They could draw similar triangles while they were outside looking at objects from different perspectives.

Orienteering and Storytelling



After working with similar triangles at the school site, we took the students on a field trip to the Big Rock, a sacred site. We had invited an Elder to come with us, and he led us in prayer and told us stories about the place. After his introduction, we gave a brief lesson on how to use the GPS units. The students amazed us by eagerly experimenting with the technological features and working with the coordinates to better understand their environment. They were given a scale drawing of the perimeter of the site and were asked to figure out how to map the topography, using coordinates and elevations. Our intention was to have them construct three-dimensional maps when we returned to the classroom. Part of this task involved using similar triangles to calculate the height of the Big Rock. Although it was a very cold and windy day, the students willingly participated in mapping the site. They actively engaged in applying coordinate geometry, topography, and trigonometry.

Following this activity, the students were invited to participate in a scavenger hunt that involved finding specific places, based on coordinate clues and GPS

mapping. All group members were engaged in this task, and we noted the students' increased confidence as they learned about and used the GPS and digital camera technologies. The students seemed impressed that they were able to figure out the technology so quickly and that they were soon able to demonstrate their capabilities in this area.

One unanticipated finding was that the students felt proud and respected because they were entrusted with such costly and complicated technology. We noted that they seemed impressed that we let them take the GPS units without lecturing them about taking care of the expensive and breakable machines and that we had assumed that they would be able to figure out how to use the technology. The students commented that they felt successful and more confident; their pride in learning was expressed in their reflections: "I liked using the GPS," and "I never learned orienteering before. I just learned that in our field trip."

Another unanticipated finding involved the concept of triangulation within a Blackfoot context. In contemporary education, teachers often cite examples of Aboriginal concepts that are circular (e.g., tipi rings, cycles of the seasons, the medicine wheel, the stages of life). While circles are culturally significant, we did not expect that triangulation would come naturally to the students, nor were we aware at the beginning of the project that it was practised historically by the Blackfoot people.

When we explained how GPS technology worked using triangulation, we talked about how the Blackfoot ancestors would have travelled and used specific sites as points of reference. The students were introduced to the rich history of First Nations people using the land and sacred sites to navigate their way across the land. To the Blackfoot ancestors, the angles of triangulation became an intuitive way of living with the land, and when we introduced this idea to the students, it made complete sense to them. This amazed us because triangulation seemed like such a difficult concept. When we returned to the classroom and assigned the trigonometry exercises that asked the students to find the missing side of the models presented, they did so with ease.

The pedagogical strategies that we used emphasized an integrative and relational way of learning mathematics. We planned hands-on projects that linked language arts, social studies, cultural studies, science, and mathematics. Central to the field-trip experience was a story told by an Elder at the site of the Big Rock. This story impacted the students tremendously. As they reflected on their experiences, they commented: "I learned that this rock is important to myself as a Blackfoot" and "The reason why the trip was fun was because just being up close to the rock and knowing more about it just made me feel that I could picture Napi running from the rock and asking animals to help him." Other students wrote: "I also learned not to be a trickster like Napi" and "I did not know the rock was a part of us."

We believe that integrating the curriculum and learning mathematics from place made the students feel more connected to their land and community. They expressed pride in their history, concern for the care and treatment of traditional sites, and certainty of their place in the Blackfoot Territory and in Canada. The students demonstrated a positive change in their ability to express themselves mathematically, in their confidence in their mathematical knowledge and skills, and in their attitude toward mathematics. We believe that they felt that mathematics was more human and more social than they had previously thought and that their ways of knowing were valid and could carry them into any subject.

Perhaps the most significant part of the field-trip experience was the students' interaction with the land and the pride they felt in their heritage. While we were at the site, a reporter from the local newspaper arrived. In follow-up interviews with the students, he asked them for their impressions. One student said that the trip to the Big Rock had an impact on him:

> *I did not know that it was a part of our First Nations culture, but now I know, so it is a part of me. I know our territory is huge. I would bring my kids to go see what is a part of the culture, and I would tell them the story that goes with the rock.*

Another student said that learning how the rock was used to help her ancestors was an indication of how much history there is with her people: "I didn't know it was really important to First Nations, because there is a lot of stuff to learn about our people."

In this instance, learning from place had significant impact on the students. When the students were asked to reflect on their experiences involving mathematics during the year, many of them indicated a change in attitude: "I learned that you can use math in a fun way or use math at home," "What I learned about myself was that I'm good at math and it's fun to do," and "I learned that I'm good at math." Others wrote: "[I was most proud] when we were actually doing the work in the physical. When we went on that trip," and "[I] like doing the actual

thing instead of just doing it on paper; it's more fun." The students' understanding of mathematics increased, and their enthusiasm and confidence grew as they began to see themselves as learners of mathematics.

Conclusion

Based on our findings, our recommendations for learning mathematics from place include the following:

1. Provide students with applied, hands-on experiences in the environment.
2. Allow students time to reflect as they process ideas and respond to questions.
3. Incorporate practical experience and knowledge by interweaving Aboriginal culture and Aboriginal stories that portray an intimate understanding of natural phenomena into the lessons.
4. When visiting sacred sites, allow the land to teach and the students to respond. Be flexible with the planned curriculum.
5. Facilitate the use of technology to enhance interactions with the land and to bridge historical and contemporary ways of engaging in mathematics.
6. Find culturally relevant ways of knowing and practising mathematics that connect to the Western curriculum (e.g., triangulation for navigating the land).
7. Link mathematical experiences in the classroom to those encountered when visiting the site.
8. Encourage relational links by integrating mathematics with other content areas.
9. Involve Elders and community members in the educational process.
10. Understand that the process to plan and teach a mathematics unit focused on learning from place is time-intensive and sometimes daunting, but the rewards to the local and broader community are far-reaching.

If students relate mathematics to their environment, they will experience mathematics as relevant. It was our hope that these students would develop a robust understanding of mathematics in school, thereby increasing the likelihood that they will choose mathematics studies and related careers that might directly benefit the Aboriginal community. We believe that this project played a significant role in this process.

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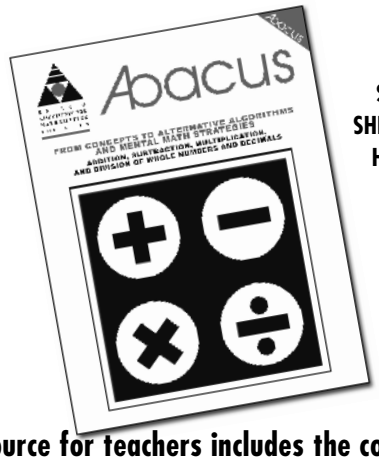
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▲ More about SMART Boards™

William Lundy



Bill Lundy is the Mathematical Literacy/IWB Lead with the I.T.S. Department of the Hastings and Prince Edward District School Board.

I read Mary Bourassa's column in the Sept 2009 *Gazette* with great interest. Having been virtually immersed in the world of SMART Boards™ for the past two years, I have experienced much and learned more about the uses of technology in learning than I did in the previous 30+ years before that. I therefore feel compelled to respond to some of the points she made, and to add some of my own. Having trained and supported nearly 95 percent of my system's current SMART Board users (at the Elementary level), I would like to advance the following ideas, based on my training, first-hand observations, and close association with SMART Technologies and its resellers.

Mary is quite correct in her assertion that the SMART Board allows teachers to "move away from the front of the room...," however, in the Elementary area, where this is not necessarily a desired thing, there has actually been a movement back to the front of the room. There are many who find that directing from the front has become easier now that there is a tool that makes it so. This is not to say that teaching from the front is better or worse than teaching from anywhere else; it's just a statement of what I have observed.

Not only does the SMART Board permit teaching from anywhere in the room, the SMART Board permits teachers to produce and use exceptionally high-quality learning materials. Not because it's a SMART Board, but because it's a computer application that has made it fantastically easy to access one's files, whatever their format. The technical quality of most gallery items and Lesson Activity Toolkit implements is higher than the vast majority of teachers can produce in short order, considering their other responsibilities; furthermore, such lessons act as models of clarity and organization for their students.

The SMART Board saves teachers time in a number of ways. For example, Primary teachers who wish to use lessons with base-ten block images can produce one set, which can be (a) saved, (b) broken apart or grouped, (c) cloned ad infinitum, (d) shared with colleagues, (e) linked to the Web, and so on. Because a lesson can be saved, it is worth investing a little extra time to make a set, knowing that's the last time one will have to do so, and because it can be shared, everyone saves time, thanks to the work of that one person. And no more overfilled canvas tote bags to lug from school to home! One USB stick will conveniently hold more than a reasonable person can create in an evening.

Teachers who take advantage of sharing interfaces, e.g., The SMART Exchange™ (**exchange.smarttech.com**) or local intranet applications such as SharePoint, save time because they can harvest the fruits of the generosity of others. There are thousands of already-made tools, lessons, and even entire courses available for the persistent to uncover. However, in my experience, many teachers want more. They find something that almost works, and then they tweak it to fit their students' exact needs. Sometimes, said tweaking is radical; that is, they harvest images and basic ideas, and then use them as ingredients in something that is virtually new. Still, they will often assert that it's not the approach, but just getting that initial idea that takes time, so their harvesting is as much of ideas as it is of files.

The fact that teachers can link to other SMART Notebook files, other types of files, and even the Internet helps lessons become seamless; thus, more efficient use is made of precious instructional time, not only in the absolute, but because student interest can be maintained without awkward breaks to open up a web browser, set up TV, or find a supporting document.

I was pleased to note Mary's positive comments about all the ways in which SMART Notebook files (and others) can be saved to various formats, printed, or even recorded. Not only are those functions useful for addressing student absence and IEP needs, but they also give teachers a powerful non-paper-and-pencil assessment tool. Consider recording students as they solve linear equations on the SMART Board. This would provide a visual record of the steps the students used (and an audio record if one uses SMART's additional recorder), which could be used for professional reflection prior to the next lesson, or to supplement assessment data obtained in other fashions.

We must, though, keep our eye on the ball, as it's not about the technology; it's about how the technology can add value to already-good teaching. My high-end SMART Board users are not necessarily technophiles; they are first and foremost exemplary practitioners, whose skills have

largely been augmented by the benefits that SMART Boards have brought into their classrooms. However, those married to traditional methods of instruction, outmoded understanding of mathematics education, undue reliance on textbooks and packaged programs, and death-by-worksheet and/or PowerPoint simply have a larger surface upon which to project their rather uninspiring wares to often-somnolent students.

Thus, we need to guard against using the SMART Board and other new technologies to do the same old thing. In my role, I spend a lot of time sampling lessons from literally dozens of web sources, ranging from home-grown blogs and wikis to slick, industry-sponsored repositories of notebook files. I have harvested countless ideas; often, these lessons need tweaking (e.g., to align with the Ontario program), and alas, only a few stand out as exemplary SMART Notebook lessons or learning experiences.

I will be the first to admit that I have high standards, but I don't see the point of investing in a SMART Board solely to show videos or PowerPoints or to display page after page of factoids. Yet cursory examinations of the offerings posted far and wide on the Internet reveal that many SMART Notebook lessons are simply that, and less. The vast majority of Elementary-level numeracy and literacy lessons are geared toward facts, procedures, and compartmentalized knowledge and recall. Some are simply a collection of scanned textbook pages! Some use a few "SMART" tools (e.g., some of the match games in the Lesson Activity Toolkit, dragging objects to match, show-hide tools) to deliver content. Very, very few "pre-made" SMART Notebooks deliver much more than that.

Some applied media literacy skills would also likely reveal that the agenda of some commercial repositories of these notebook files is to showcase the uses of the tools first. It is apparent when one views lessons available at sites such as TeqSmart (**community.teq smart.org**) that the certified users who have posted lessons have been expected to showcase their adroitness with a variety of SMART Notebook tools first, then toss in a little content afterward. That is not to say that there aren't good things to be found at that site and others, but by and large, the fare is disappointing.

One often hears the terms "SMART Board" and "student engagement" being used concurrently, nearly synonymously, in a sense. Oftentimes, when one sees a YouTube video showing a class that is "highly engaged" in a demonstration lesson, one sees lots of excitement, but not necessarily *cognitive* engagement. Excitement and action usually seem to follow the installation and even basic use of a SMART Board; however, the matter of engaging students cognitively and even emotionally is much harder. I say that because I rarely see it done, and only then, with a great deal of thoughtful application.

In focusing on mathematical applications of SMART Notebook files, one encounters, time after time, files that jump headlong into the time-honoured algorithms and procedures. Search nearly any web source of SMART Notebook files for "area," and I guarantee that nearly everything you find will—by the second or third page—be flogging the standard A = L x W formula. Yes, it may do some lip service to non-traditional methods of determining area, but seldom, if ever, will there be any file that stresses conceptual understanding, either exclusively or primarily.

At the risk of belabouring the point, I could offer up many more specific examples. So take the time to look at what's out there, and do so with a critical, curriculum- and student-needs-focused eye. Be prepared to harvest good ideas and unique graphics, but be wary of utilizing web-sourced lessons without a great deal of adjustment.

My final response is that many articles about SMART Boards overlook the fact that one needn't ever use SMART Notebook! The board is one's desktop, and every application available on the attached computer is available on the SMART Board. So, one can take *The Geometer's Sketchpad*, the NLVM, or a spreadsheet out in the classroom and use it as a teaching tool! (During my training sessions, the single most common "aha" moment has revolved around the fact that the software can be used for instruction, not just for project work in the computer lab.) What better way for teachers to expand their fluency with applications than by using them more often? Not only will their own skills improve, but they will be better equipped to respond to student inquiries and issues. And those most familiar with online tools and tools available through OSAPAC-licensed software might even find that additional extra-cost tools aren't really necessary at all.

In conclusion, I agree with everything said in Mary's article, and hope that I have added some ideas that will initiate discussion, as well as reasoned action. I encourage you to look for what the SMART Board brings at the cognitive level and urge you to use the SMART Board with circumspection. Ask yourself, "How can I use this technology to add value to my already-brilliant lesson?" and "What can the SMART Board do that isn't as easily done with other instructional media?" When you can answer these questions, you are well on your way to becoming a top-flight SMART person. ■

OAME Financial Statement 2008/09

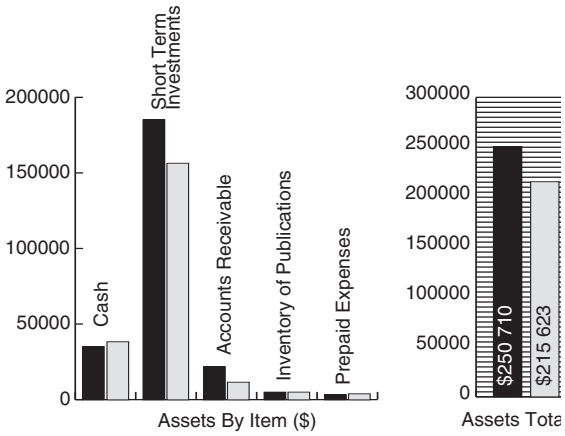
Notice to Readers

On the basis of information provided by management, I have compiled the balance sheet of the Ontario Association for Mathematics Education (Association Pour L'Enseignement Des Mathematiques) as at August 31, 2009 and the statement of operations and operating fund balance for the year then ended. I have not performed an audit or a review engagement in respect of these financial statements and, accordingly, I express no assurance thereon. Readers are cautioned that these statements may not be appropriate for their purposes.

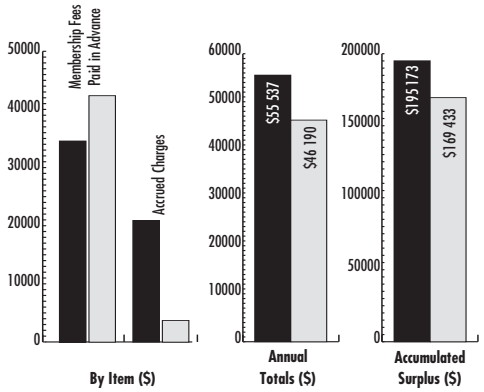
London, Ontario, September 15, 2009, PHILIP J. GRIFFIN Chartered Accountant

2009/2008

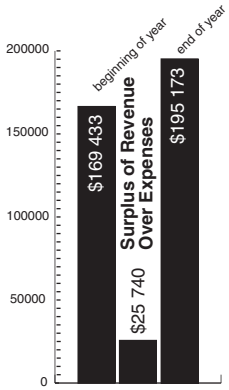
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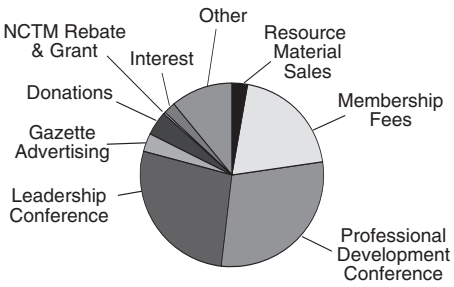
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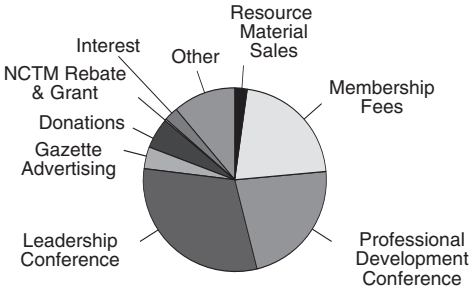
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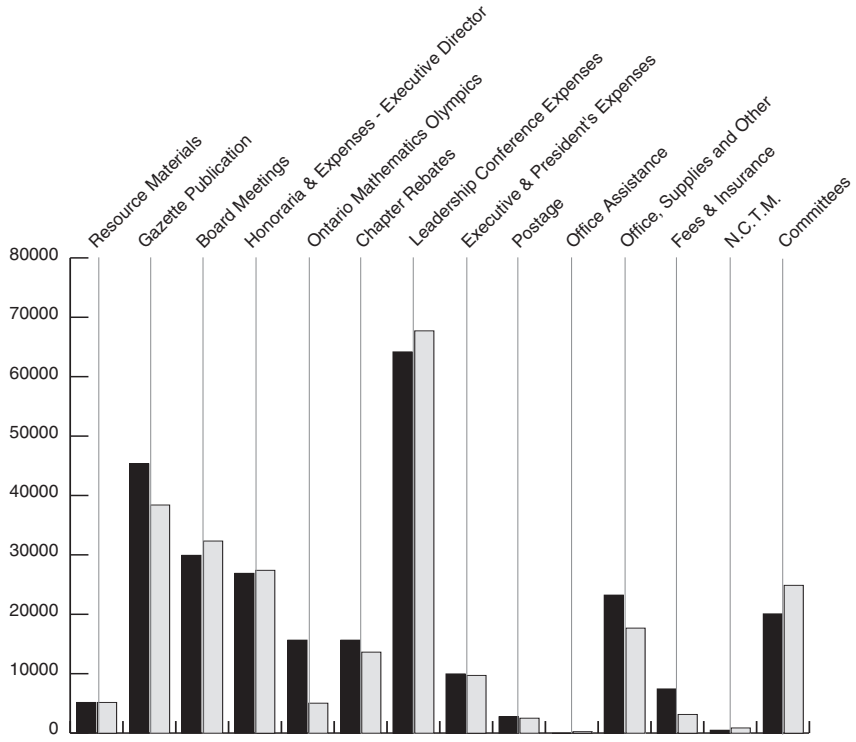


2009 ($279 221)



2008 ($251 555)

Expenditures



NOMINATIONS FOR OAME/AOEM BOARD OF DIRECTORS 2010–2011

Each year, elections are held for a President-Elect, a Vice-President (3-year term), and 6 to 9 Directors (3-year term) of OAME/AOEM. Based on their personal experience, expertise, and interests, OAME/AOEM members running for Director will declare their intention to work on issues involving either Grades JK–6 or Grades 7–12.

Nominations for these positions are to be submitted by 4:00 p.m., January 15, 2010, to:

Anna Jupp, Past-President OAME/AOEM

Please include the nominee's qualifications with the Nominations Form. A nominee must be a member of OAME.

A slate of candidates, including candidate qualifications, will be published on the OAME website by March 2010. Voting will be on the website and is open to all OAME/AOEM members. The election results will be released in May 2010 at the Annual General Meeting of the OAME/AOEM in St. Catharines.

NOMINATION FORM

I nominate _____

for the position(s) of:

☐ President-Elect ☐ Vice-President ☐ Director

If for Director, area of personal experience/expertise, interest: ☐ Grades JK–6 or ☐ Grades 7–12

Nominee's Address: _____

_____

E-mail: _____

Telephone: H (_____) _____

Telephone: Home (_____)_____ Work (_____)_____

Nominator's Name : _____

Nominator's Address: _____

_____

E-mail: _____

Telephone: Home (_____)_____ Work (_____)_____

▲ Directors' Dialogue

ANN MICHELE STENNING



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.

Meeting of the OAME Board of Directors October 23–24, 2009

Friday, October 23, 2009

OAME's president, Beverly Farahani, thanked the board members for their efforts. Dave Hessey, OAME's executive director, welcomed Elio Barbati, who represents Nacora Insurance Brokers. He addressed board members regarding concerns about insurance during events such as the Ontario Math Olympics and annual conferences.

Greg Clarke and Greg Rodrigo, OAME's webmasters, showed board members OAME's redesigned website. The new OAME site is more readable and just as easy to navigate. The website offers updates regarding conferences and continues to offer resources that are both grade and course specific. Next, Fred Fernyhough presented board members with a draft model redefining the organization of OAME's board of directors. Board members then discussed the details surrounding the proposed changes.

Saturday, October 24, 2009

The Equity Committee met prior to the regular Board Meeting. The committee discussed plans to create a list of Differentiated Instruction resources, and members shared book titles for a future book study on Social Justice. Titles included *Math That Matters, Rethinking Mathematics,* and *If the World Were a Village*. Some time was also spent sharing the names of potential speakers for OAME's 2010 Equity Breakfast.

The full board meeting began by addressing OAME's business. Members heard from Cathy Hall, OAME's 2009 conference co-chair, that the annual conference was a success. There were over 900 delegates, with an increased number of attendees for Primary and Junior sessions. Registration was up, budgets were trimmed, and a significant number of last-minute registrants ensured that the conference made money. Jacqueline Hill, the co-chair of OMO 2009, presented the highlights of the Ontario Math Olympics. The students enjoyed the team-building exercises and challenging math problems and had the opportunity to make new friends. Teams performed their own skit/song/poem for other students; these can now be viewed on the OAME website. Students also participated in a crime scene investigation.

Dave Hessey, OAME's executive director, outlined OAME's financial picture. OMO contributed proceeds from the 2009 event to next year's event, and memberships in OAME have increased to a total of almost 1400. Next year's budget includes costs to be paid when the new executive directors take over in 2010. Board members then voted on various motions. These motions included the proposal that the Chapter rebate for 2008–2009 be 30% of the annual fees paid by full members and retirees, with no rebates for student members.

Before lunch, Myrna Ingalls from the Ministry of Education let board members know that the next curriculum review cycle will begin in the fall of 2012 for Business Studies, Mathematics, and Guidance and Career Education. There will be a one-year separation between the release of a new curriculum and its implementation. CLIPS: Critical Learning Instructional Paths Support, available through the OAME website, includes the pre-release version of activities, an interactive keyboard that interfaces with the Smart Board™, and a "What's New?" feature. Teachers are encouraged to provide feedback on CLIPS, and plans for the future include the pre-release of Integer Operations, Radians, and Fraction Operations. TIPS 2.0 now features interactive whiteboard lessons from the Upper Grand District School Board. The Ministry is also providing digital research papers designed by Dr. Cathy Bruce in an attempt to make research findings accessible to classroom teachers. These papers are interactive, allowing users to click on an area of interest to obtain further details. Specific information on Math Talk and Lesson Study is available through theses digital research papers.

Educators can also watch an 11-minute Adobe presentation entitled "Professional Learning for Mathematics Leaders and Coaches" on the GAINS website. One of the immediate goals of this initiative is the modelling and practice of lesson co-planning in a teacher–teacher and teacher–coach environment. This is designed to increase a teacher's capacity to differentiate instruction by posing open and parallel questions (tasks). There is a focus on

addressing "big ideas" within the curriculum, as addressed at Math CAMPPP, Summer Institutes, and Professional Learning for Mathematics Leaders and Coaches (PLMLC). Board members were also shown the improvements in student performance on EQAO assessments at the Applied level. The Ministry has noted improvements in Halton District School Board's EQAO scores in schools that have participated in the questioning and coaching initiatives, compared to those schools that have no professional development for teachers. The Ministry has also observed improvements in schools that have used PRIME resources at the elementary level and Math Talk at the secondary level.

After lunch, board members addressed concerns surrounding the future of the Ontario Math Olympics. The first OMO, created by Jeri Lunney and Rob McLeish of COMA, took place in 1995, and it continues to mentor top math students from Grades 7 and 8. Concerns surrounding OMO include potential liability issues. Board members discussed OMO's future and how concerns about liability might be addressed.

Laurie Moher, the NCTM representative, advised that certain online resources and publications and NCTM's 71st yearbook are now available. *How Pandemics Spread* offers simulations and allows students to manipulate four factors that influence the spread of a virus. It then displays a graph showing how the disease will spread or die out, based on the settings the student has selected. NCTM is now offering "E-Seminars." These seminars are one-time, 60-minute sessions on a "hot topics within mathematics" and are accessed through an Internet and phone connection. The cost is $59 (US), which can be shared among several people, and includes one electronic copy of the e-seminar. Laurie encouraged members to participate, as her experience has been overwhelmingly positive.

Laura Tonin, a co-chair for OAME 2010, reported that Brock University is booked to host "On The Brink," OAME's annual conference. Delegates can expect to hear from Cathy Fosnot, Florence Glanfield, Nick Jackiw, Doug Clements, and Marian Small. A multimedia Math Show and a T^3 Institute are planned for the event, as is a banquet overlooking the Falls.

Greg Clarke reported that OMO 2010 will be held in late May at the Educational Leadership Camp, with a Friday night campfire. The theme is the Vancouver Olympics, with a cool logo using the Olympic rings. All events will have an Olympic theme. A practice contest will be available, and OMO organizers are considering adding on an optional Saturday night stay and activity for $30 per person. Anna Jupp encouraged board members to nominate someone for the upcoming OAME election for board of directors, and Cheryl Geoghegan reported that the Awards Committee has reformatted the nomination forms, which are available now on the OAME website.

Bill Otto reported that The College Mathematics Project (CMP) is a collaborative project involving Colleges of Applied Arts & Technology and district school boards. It was set up to investigate and analyze the mathematics achievement of first-year college students in Ontario, particularly with respect to their secondary school mathematics backgrounds, and to deliberate with members of both college and school communities about ways to increase student success in college mathematics. Funded by the Ministry of Education and the Ministry of Training, Colleges, and Universities, and led by a team of researchers from the York-Seneca Institute for Mathematics, Science and Technology Education (YSIMSTE), CMP 2009 will include colleges and district school boards in all regions of the province. The CMP 2008 research analyzed the school and college records of over 50 000 students who enrolled in the 11 colleges participating in CMP in 2007–2008. Of these, nearly 20 000 took a first-semester mathematics course, and the research focused on a variety of factors, including the choice of mathematics courses taken at secondary school. The CMP final report for 2008 contains highlights of the research and recommendations emerging from the Forum deliberations. The report is available for download from the CMP website: **collegemathproject.senecac.on.ca**.

In 2009, CMP expanded to include all 24 colleges and 72 district school boards in the province. Its goals are basically unchanged from previous studies. Researchers are currently analyzing the preliminary data, executing forum activity, gathering qualitative research from the deliberative forums, and preparing recommendations, which will be included in a final report to be released in February 2010. The CMP also organized nine forums in Ontario in the fall of 2009. At these forums, members of the education community from both schools and colleges received the results of the CMP preliminary research, shared their own best practices related to student success and retention, listened to students' own perspectives on mathematics in school and college, and deliberated over initiatives to improve student success in mathematics. Further information about these forums can be found at **collegemathproject.senecac.on.ca**.

CHAPTER REPORTS

CHAMP – Rep: Shaun Knowles:

Looking ahead, CHAMP is busy planning secondary contests, OMO trials, Grades 7 and 8 Contests, and an Awards Ceremony. Visit our website for further details about these events. We continue to hold our meetings at the Dufferin-Peel Catholic District School Board offices on the first Thursday of the month. We welcome you to join our exciting and enthusiastic executive team. New members are always welcome.

COMA – Rep: Beata Myhill:

Patricia Kehoe, our President, is on leave for the first semester. It is expected that she will return for the second semester. Melissa Black, VP, will assume all presidential duties until her return. COMA is investigating the need for liability insurance for our chapter executive and for council members. We would like to have this in place for OMO, mini-conferences, and math forums. The OAME 2009 conference made a significant amount of money for our local chapter, and we are exploring new ways to support local math teachers in their professional development. Specifics have yet to be decided.

GOLDEN – Rep: Laura Tonin:

Our committee is busy planning next year's conference, OAME 2010: On The Brink. The conference is going to be held at Brock University. Excursions to Niagara-on-the-Lake for a wine tour and to Niagara Falls for the banquet and casino are also planned. Our committee is currently organizing speakers and presenters so that everyone can have an enjoyable conference and come away with lots of new, exciting ideas!

GVMA – Rep: Barry Ferguson:

The GVMA annual mini-conference was held on Thursday, October 22 on the University of Waterloo campus. Approximately 100 delegates attended. The 2010 mini-conference will be held in the first week of November. Planning is underway for participation at OAME 2010 in Niagara..

ISOMA – Rep: Richard Tong:

The ISOMA executive is busy planning our fall mini-conference, which will be held at Upper Canada College on Thursday, November 26, 2009. We are very excited to have Ron Lancaster as our keynote speaker. Ron's talk will focus on encouraging mathematics teachers and their students to become lifelong readers of mathematics books. We look forward to seeing everyone at the conference.

MAC² – Rep: Paul Szczokin:

Our year started out with a very successful fall mini-conference of approximately 85 participants. The focus was on Patterning and Algebra. MAC² would like to thank our keynote speakers—Doug Duff, Crystal Chilvers, Wendy Telford, and Greg Clarke—for their great presentations. Our new chapter President, Kyla Kadlec, is continuing to focus on the goals set out for the year. These goals include new membership and supporting both the English and French communities, educating teachers about who we are and what our purpose is, and the continued use of Adobe Connect during meetings. Our main focus this year will be on the OMO. The regional OMO will be held in March, and our OMO 2010 will be held in May. Co-chairs Danielle Blair, Greg Clarke, and Bill Morrison continue to meet regularly to plan this event. We are well on our way and feel confident with our plans so far. Our spring mini-conference focus has not yet been determined.

NOMA – Rep: Cheryl Geoghegan:

The 2008–2009 school year ended with hopeful outlooks for a restful summer and renewed vigor in the fall. However, once the abundant summer sunshine started to turn toward crisper fall days, it became evident that the challenges would continue for NOMA. Many of the strong, dedicated core members of our Executive have been tested by health issues and urgent family matters, and the start of the school year has found us feeling somewhat broadsided as a team. As we attempt to regroup, we are putting out a call to the NOMA membership at large to rally in support of our planned fall Workshops Series. We hope to offer a selection of workshops that will appeal to teachers with a variety of professional growth interests in any panel. There are many large shoes to fill as we seek to carry on with the planning and implementation of these workshops. In the spring, Lasalle Secondary School will once again host Sudbury's OMO Playdowns. We have some fun ideas and look forward to this annual opportunity to work with an enthusiastic and competent group of Grades 7 and 8 students from the region.

NWOAME – Rep: Tom Boland:

NWOAME had a busy and exciting second half of the year. Our "Pi-Week" celebrations were a big success with students, teachers, and parents. During the week, we hosted a teacher information night and a full day of pi-related activities for students at one of our local schools. We will definitely be repeating this event and likely expanding it to more than one site in March 2010. Our local Regional

Math Olympics were also a huge success, with close to 150 students participating. The winners went on to compete at the provincials and thoroughly enjoyed and appreciated the experience. 2010 will mark the 15th anniversary of our regional Math Olympic Competition, and as such, we are planning to make it an extra special event with increased participation. We have chosen a new venue to host the anniversary event—Thunder Bay's newest high school, Superior Collegiate and Vocational Institute, which opened its doors in September of 2009. We are looking forward to a great show. Lastly, NWOAME's prime focus for the coming year will be on membership recruitment and retention. We are considering bringing in a variety of speakers for a mini-conference, perhaps co-planned and co-sponsored with Lakehead University's Faculty of Education. Likely dates are early in the New Year. Details about this and other regional events will be posted on the website as they become available.

PRMA – Rep: Sarah Khattab:

After hosting the provincial OMO for the last two years, we are focusing on the professional development of our members. We are using a chapter grant from OAME to allow our members to participate in a book study. Chapter members have suggested several books for study. Once one is chosen, we will set up our meetings to facilitate discussion of the book. It is our hope that interested teachers who are not currently members will consider joining PRMA in order to participate in the book study.

QSLMA – Rep: Robert Sherk:

Our executive now has a subcommittee, which will begin planning for the provincial OAME conference in May 2012. We also continue to promote QSLMA/OAME activities through our e-mail newsletter to all QSLMA/OAME members and other interested educators.

SWOAME – Rep: Nicholas Cevalier:

SWOAME has recently been awarded the OAME conference for 2011. In preparation for this event, we have elected a new president, David Petro, and we have had a number of meetings discussing the theme and location for the event. We are also planning to participate in OMO 2010 and are organizing the local Math Olympics as well.

WOMA – Rep: Ann Michele Stenning:

WOMA will again be hosting an annual fall mini-conference. The format will remain unchanged, with snacks offered during registration and a pizza supper that will follow a 50-minute PD session. A keynote speech may be included during the supper hour, and registration will be facilitated by MCIS.

Y^{4}MA – Rep: Ada Cartaginese:

Y^{4}MA has been quite busy this fall. On October 1, 2009, we hosted our fall Mathematics Conference. Dr. Marian Small presented "Teaching the Big Ideas in Patterns and Algebra throughout the Grades." Teachers were divided into small groups by division and worked together to explore big ideas. Participants explored a variety of interesting and immediately usable patterning and algebra activities. Thanks to all who attended. In the spring of 2010, we will be hosting another conference, which will focus on integrating technology into mathematics instruction. Additional information will be forthcoming.

SAME- Rep: Freda **Liu**

At the start of this school year, SAME was off and running, busy organizing their Fall conference "Starting a Year or a Career in Math" held on October 1, 2009. The conference was well attended and teachers left with innovative and practical strategies to implement into their teaching practice. Our committee is still hard at work as we are now planning for our next big event, our local Math Olympics, which is scheduled for March 25, 2010. Finally, we would like to congratulate Merilyn Fox, our new President for 2009-2010.

TEAMS- Rep: Ken Maheu:

TEAMS is currently in the final preparations for its annual mini-conference which will be held on Thursday, Novr 5th at Bathurst Heights Learning Centre and Dante Alighieri Academy. The theme of the conference is Differentiating the Mathematics Classroom and will offer sessions at all levels. We are beginning to plan the local Math Olympics for our chapter which will be held on Saturday, April 22nd at the Catholioc Education Centre, under the co-ordinators Anthony Meli and Michelle Govieia. We have begun the process of planning and preparations for hosting the Ontario Math Olympics on June 3 and 4, 2011 at Victoria College of the University of Toronto. The contracts are about to be inked any day and committees have been established for the various committees responsible for bringing together such a large event. ■

▲ 2009-2010 OAME Board

OAME website www.oame.on.ca

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