# ▲ About the *Ontario Mathematics Gazette*

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# ▲ Editor's Message



MARILYN HURRELL, EDITOR

I have a pet peeve and now I have a forum to really get this out into the open.

While I was pondering whether or not to air this, I read our local newspaper last evening and this reinforced my idea. It seems they are selling Social Notices for .49¢ per word, maximum 100 words. Just imagine if I sent one in and insisted that my bill was




*Questin: If you bought one unit of each item for sale. What would your change be from a $10.00 bill? A loonie?*

49¢! By the way, including a photo costs $30.50. For years I have been telling the owner of a local greenhouse who advertises bedding plants for .68¢ a pack, that I will show up with $100 and wipe him out. Every year he puts up the same signs; he really just doesn't get it. A few years ago while I was still teaching, and had Gr 9, 11 and 12 classes, I posted an ad from a local grocery store that was selling a litre of pop for .79¢. I wrote above this "How much pop do you get for $1.00?". The answer was obvious, the kids said, you got one litre. Finally someone figured it out. Is this a Thunder Bay only problem? Keep your eyes open.

Now I feel better.

This issue of the *Gazette* marks a full year that I have been on the job. While I am the clearing house for all submissions, I could not do this without a wonderful support staff: the authors of the regular columns; Lynda, Kevin, Joel, Frances, Christine, Fred, Jack, Jacqueline, Stewart (soon to be Gord) and Ron; those who submit articles and then anxiously await the Reviewers' comments; Dave and Sue Hessey for all the OAME information; Frances Schatz for the *Abacus*; my associate editors Todd and John; Dean for the advertisements, Doug for the web site and Penny Clemens, who makes us all look good.

I want to take this opportunity to list the current *Gazette* Reviewers, most of whom have received and returned comments on at least one manuscript this year. Thank you! ▲

Ed Antosz
Anthony Azzopardi
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Jay Speijer
Kevin Spry
Lynn Strangway
Susan Stuart
Christine Suurtamm
Tara Tasker
Jack Weiner
Rod and Anne Yeager

To everyone, have a sunny, safe and relaxing summer break.

Marilyn Hurrell

# ▲ Letters to Editor

Dear Editor:

Thank you for the nice review of the (Australian edition of) the handbook, *Teaching with Rich Learning Tasks*, in the March 2004 issue of the *Ontario Mathematics Gazette*.

The one thing that wasn't mentioned was how to get copies. Interested teachers should be referred to the Australian Association of Mathematics Teachers web site: http://www.aamt.edu.au They can order on-line.

Gary Flewelling

Dear Editor:

Thanks for sending us the March 2004 *Ontario Mathematics Gazette*. Great job! Very readable and full of information. I'll pass on to our Ann Carlyle that her article was included.

I did a quick run to the 'Probability by Surprise' site mentioned in Kevin Maguire's article. The Birthday problem was nicely done — but I got 2 in a row, using n=30, with no matches which I found a bit surprising. When I increased n to 40, I again got 2 in a row with no matches. Possible? Yes! Likely? NO! It would be interesting to see their source code on that! Generally with n around 35 my experience has been to have several matches and even some triples.

Also on the Litwiller/Duncan D=RxT problem, I always find it very instructive, with a nod to our PI birthday boy, Dr. Einstein, to make Monique the frame of reference, in which case she sees Danisha swimming away for 10 minutes and then swimming back for 10 minutes (at the same speed since she and water are not moving). All the while she is "still" and shore is moving past her. After 20 minutes Danisha returns and the dock has reached her too, traveling 400 m in that 20 minutes. This gives the rate of the shore as 400m/20min = 20m/min along the still water (or, alternately, the current is moving at 20m/min along the still shoreline — a more comforting thought). The teacher and students are then free to explore further and discover that as long as Danisha's speed is > 20 m/min "the conditions of the problem are fully satisfied".

Keep up the good work.

Mike Contino
Executive Secretary
California Mathematics Council
CMC is an Affiliate of the National Council of Teachers of Mathematics

Dear Editor:

I am teaching MDM4U (Data Management) for the first time. I always try to get my students to see things through Mathematical glasses, from reading the newspaper to going out to a dinner party. I always find the *Ontario Mathematicss Gazette* has many teaching opportunities.

We are not quite half way through the course yet and they get the general sense of the normal curve (which is later in the curriculum) from surfing on the Physics bell curve (U of Waterloo Stories). I gave the Technology Corner (March 2004 *Gazette* "Normal Distributions") as soon as I received my copy of the *Gazette* in March, as a journal response. They were told to write a Letter to the Editor. I received some insights and genuine understanding about their ability to process what they have learned so far.

Some selected comments are:

"I think that the results that were given in the article were unrealistic since the sample was bias including several failing students. The results of the test have such a low average that has effect on the bell curve results." Alex P.

"There are two outlying marks. A mark of 11% and 88.5%. It does not seem reasonable that one student would receive such a high mark, while the rest seem so low. And even if these were the real life marks, I doubt a teacher would bell curve all the marks when they know one student's mark would suffer, when the student was doing well before. There isn't a large range in marks to justify doing curvature of the marks". Jesse H.

"The article was informative to a certain point but in the future I would a) use a larger sample and b) don't take marks that will give a bias result". Jo M.H.

"These marks were all failing marks, except for one mark of 88.5%. This would lead any rational person to think that perhaps the test was way too difficult for the students or the teacher was not living up to his/her responsibilities. The mean test mark was 49.6%, which

confirms my belief that the test was not fair in the first place". Erin W

Thanks to Fred Ferneyhough for his amazing grasp of mathematics and technology and his willingness to share his expertise with us through the *Gazette*.

J. Hill
Port Perry HS

# ▲ From the Editor's Desk...

**MARILYN HURRELL, OMG EDITOR**

This is a tribute to Frances Schatz, Editor for the past nine years of the *Abacus*, a selection af classroom-ready activities and blackline masters, stapled in the centre of the *Ontario Mathematics Gazette*. Frances gave notice a year ago that the June 2004 issue of the *OMG* would be her last as *Abacus* Editor. Trevor Brown will take over as *Abacus* Editor for the September issue. At the same time, Frances and husband Frank are passing the NCTM Representative torch to John Kersely. John is on a steep learning curve as he rookied at the NCTM Display this past week at the Annual Conference in Waterloo.

Here is what Jack Weiner had to say:

"Well, how will we, collectively OAME, survive? We are losing a tremendous very nearly irreplaceable resource. Frances Schatz, tireless, inspiring and ROCKSTEADY *Abacus* editor is passing the baton. Frances Schatz, energetic NCTM representative (with partner Frank) is stepping down. As *OMG* editor when Frances took on the *Abacus*, I marvelled at her creativity and her ability to inspire creativity. She tirelessly visited school after school, teacher after teacher, imploring them to share their own gems. And when the input just wasn't there, too often I am afraid, she always came through with her 8 pages of magic. As a member of the OAME board, I appreciated Frances' informative NCTM reports and her continual and effective efforts to get the best deal on NCTM materials for OAME members. Now she is not leaving us entirely. Frances will contribute a puzzles column to the *Gazette*. She will still continue as a tutor par excellence in KW. Nevertheless, at council meetings, she will be sorely missed. Thank you for all you have been and done and for all you will continue to do, Frances. Be well. Enjoy!"

Another former *OMG* Editor, Louis Lim, writes:

"Frances, thank you for your support, encouragement, and friendship during my reign as editor of the OAME *Gazette*. Your commitment to mathematics education through your involvement as *Abacus* editor and NCTM representative for OAME are truly remarkable. Each issue of the *Abacus* was creative, providing ready-to-use material for elementary teachers, and your editorials were always interesting to read. Thank you for recommending NCTM resources when I was involved in thesis writing for my master's degree. You put Ontario on the NCTM map and I will never forget Rita Janes, former NCTM board of director, describing you as 'Our friend from Ontario'. I treasure our times together on the OAME board of directors. Thank you for impacting on my life. I look forward to your continued contributions to mathematics education!"

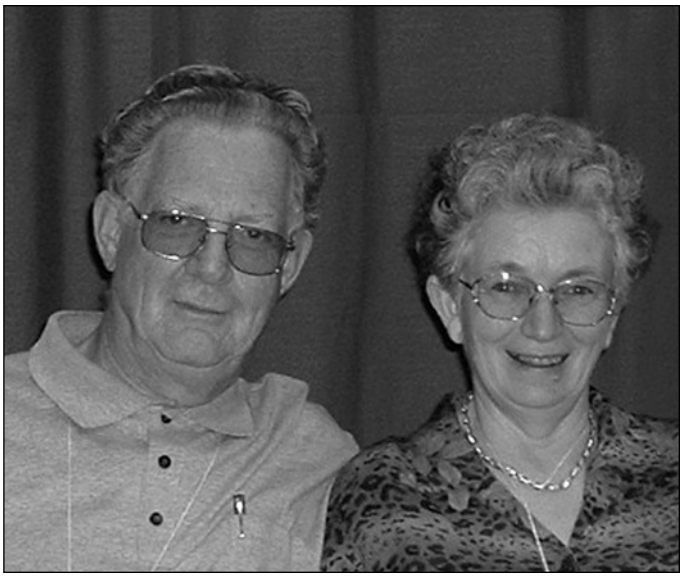
Louis Lim OAME *Gazette* Editor, 1999 - 2003

Marilyn Hurrell concurs:

"I have known Frances for all her years on the OAME Board, but really did not come to appreciate all that she did until I assumed the *OMG* Editorship last year. Throughout this year, Frances has provided me with advice, resources and most importantly, the *Abacus*, edited, polished and ON TIME for each issue. I will miss our chats but know we will stay in contact as she plans to continue submissions to *OMG*."

Thank you Frances!

Marilyn, Louis and Jack ▲



# ▲ Incoming President's Message



GORD COOKE

Welcome? Greetings? Hello there? Being new at this I have no idea how it should start. If I were a journalist I'd have learned about opening lines that catch the readers' interest and involve a witty play on words. Perhaps an introduction: I am Gordon Cooke, the president of OAME for 2004-2005. In the real world I am a classroom teacher with the Upper Canada District School Board. If the name does nothing to help you locate me, the UCDSB stretches from Kingston to the Quebec border and surrounds those Ottawa folk. I am presently the Program Leader for Mathematics and joint leader for Social and Environmental Sciences at Thousand Islands Secondary School, where I have been teaching for 21 years. I also served a stint as English Language Coordinator for the Grade 9 Assessment of Mathematics at EQAO.

I am unused to this one-way form of communication, something you can probably tell by now. I haven't written a paper in a while and almost all of my current communication is in the form of two-way communication; e-mail, online newsgroups, classroom and face to face with colleagues. Those are preferred modes for me.

As an experiment I tried to turn this into more of a conversation. On Easter weekend I had to drive to Ottawa to pick up my son. I had this deadline and lots of other things like report cards to do so I wasn't looking forward to the hour spent alone in the car when I could be accomplishing stuff. So before I hit the 401/416 I fired up my laptop, loaded the speech recognition software and as I drove I dictated an earlier version of this column. Here is an excerpt.

> *"when Everglades and wearing well in New England and reasons leading role in the minimum of 1 and then meaning linens you in turn in lighting running rain and wrong with the Argentine amendment in weatherman known as building in the 99 and 929IX rambling variable"*

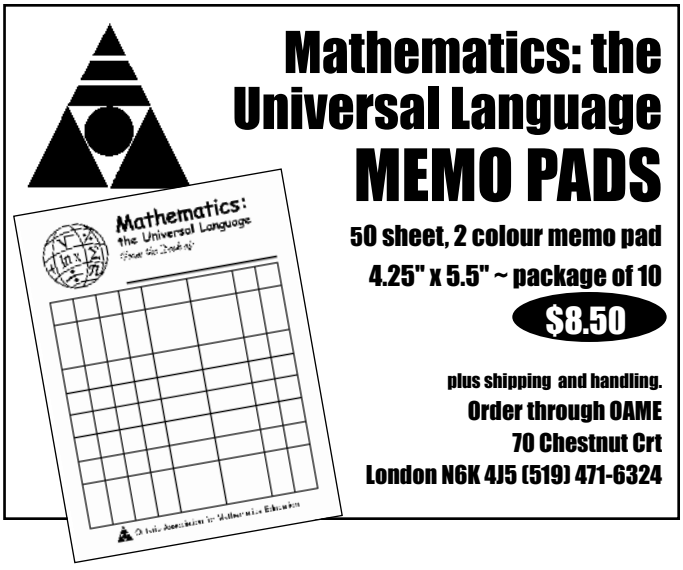
I especially like the last part about the rambling variable. I wonder if that's how I sound to my students? Is that what they hear when I ramble on about a random variable? Fortunately the classroom involves give and take.

Conversations in the classroom have a life of their own, don't they? There is time for the one-sided pontification and oratory. "The history of the number pi is a strange one indeed". But mostly it is two way. "Jenny, what is the sum of the roots of this quadratic?" provoking the reply, "um, 7?" She probably thought I meant a rambling variable. The best classroom conversations are two-way but leave me out of it. Mathematical conversation between students is the sign that I have achieved something. They are engaged in the mathematics in their heads. They have formulated arguments and are justifying their answers. They are thinking!

You have to work hard to get to that point. There has to be a comfort level that is difficult to achieve. It has to exist between the students, between the students and the teacher, and in some sense, between the students and the material. Not that they have mastered it but that they have experience talking about mathematical ideas. Some vocabulary. Some context. And of course once it really gets going, David will add, "Hey sir, it's raining outside." Thanks for the newsflash.

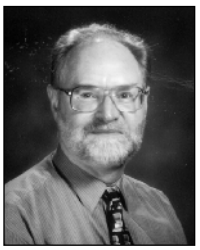
We can engage in ongoing conversations if you wish. You can email me at gordon.cooke@sympatio.ca. Or join me in the Education Network of Ontario online math forum *eno.ped.across.math*. Our (OAME) new and improved web site may have the capability in the near future to host asynchronous conversations. At any rate, the ball is in your court.

Gord

# ▲ Technology Corner: What's The Right Window?

**FRED FERNEYHOUGH**

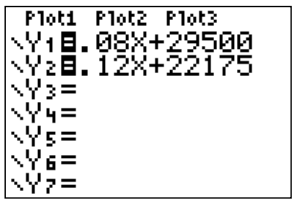


*Fred Ferneyhough is Head of Mathematics at Harold M. Braithwaite SS in Brampton and is a technology consultant for the McGraw-Hill Ryerson texts in Ontario. He is an avid user of, and advocate for, the use of technology in the mathematics classroom.*

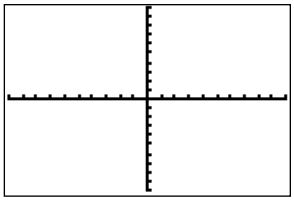
One of the little challenges that I enjoy occurs when colleagues ask me how to correct a problem that they have encountered when attempting to use technology. The feature this month came about from a conversation with Robert Sherk while we were working at OISE together. He wanted to know if there was some way to find a good window to work with to find the point of intersection of two functions when the point of intersection involved coordinates that were very large. Robert's question arose from teaching a MFM2P0 class, but the principles are the same for any class.

Consider the following problem. Sandeep is considering two offers for employment as a salesman. Company A offers him $29 500 plus a commission of 8% on all sales. Company B offers him a commission of 12% on all sales plus a base salary of $22 175. Determine the conditions for his choice of employment.

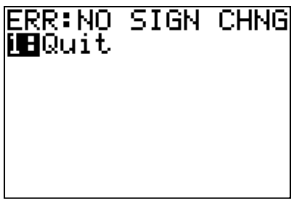
The two offers can be modelled by linear equations and it would be obvious to most students that we get a linear system of two equations in two variables, where x represents sales income.

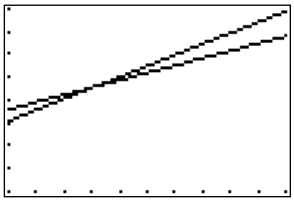



So, let's try graphing the functions to see if we can get a graphical solution. Using the standard viewing window is useless since the point of intersection is not visible. This will not deter some students who will attempt to find the point of intersection anyway using the intersect feature.



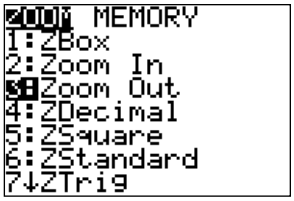
However, since the point is not on the screen, the device will not find it and you get the error message shown to the right. My interpretation of this message is that the device attempts to move across the screen and examines successive x-coordinates and finds the difference between the y-coordinates, looking for a change in sign. Once it finds it, it uses an algorithm, perhaps bisection, to zoom in on the point of intersection.



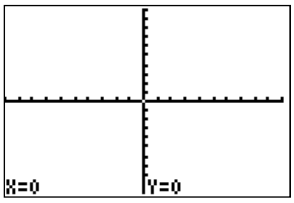



Eventually, we need to find a window that will display the two functions in a way that the point of intersection is visible. However, finding such a window could be an exercise in futility. I can offer three different approaches to this problem.

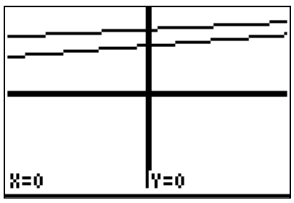
First, we can find the window by expanding the domain and range. Press the θ key and select the third option entitled Zoom Out.




Although it is easy to miss, there is a pixel flashing at the origin that serves as the centre of a dilatation. When you press ⊆, the domain and range will expand by a factor of four about this point. It is good to note that you can move this point to any location on the screen, but, for this example, I am always using the origin as the centre of the dilatation.

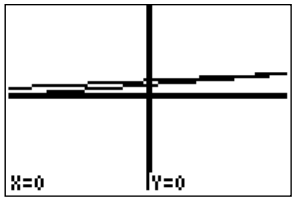



The Zoom Out feature remains active as long as you remain on the screen. You can keep expanding the window by pressing ⊆ repeatedly. After several iterations, you may get a screen such as the one to the right. You want to continue until the point of intersection is visible on the screen.

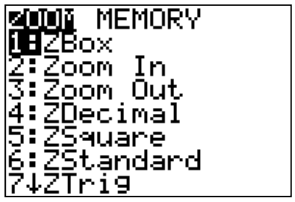



Unfortunately, you may get a result such as the one following. Since the slopes are both relatively small and

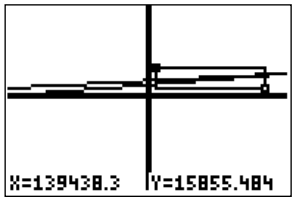
the y-intercepts converge as you zoom out, the lines almost appear to be concurrent.



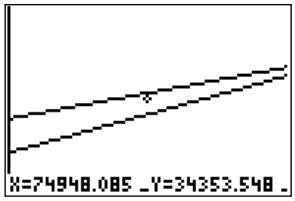

However, there is a way around this problem as well. Another little known feature is the Zoom Box, the first option in the θ menu. This feature allows you to highlight opposite corners of a box on the screen and then adjusts the window variables to these corners.




It does not matter whether you choose to move from the bottom left corner to top right or from bottom right to top left (or the reverse of either of these approaches). All that matters is that you frame the point of intersection.




The next screen shows the problem with this approach. Since the lines were so close together, I was guessing at the location of the point of intersection and obviously I missed it. I could expand the values of Xmax in the window settings to see if I could find a window that includes the point of intersection.




This type of guessing can be avoided by using the built in table of values. Press the ψ key followed by the π key to get to the TBLSET menu. The default values are TblStart = 0 and Tbl = 1. These values control the initial value of x and its increment in the table of values.

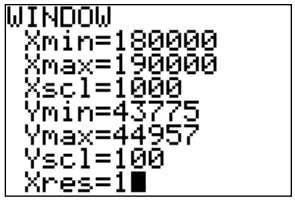



Now, press the ψ key followed by the σ key to call up the TABLE feature. Scroll down the table to see more values. On the screen to the right, the highlighted value shows that Y1 > Y2. However, in the next row, Y1 < Y2. You can conclude that the point of intersection occurs somewhere between these values.

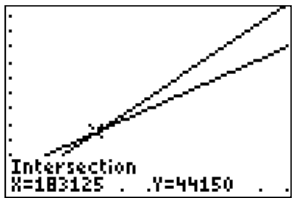
| X | Y1 | Y2 |
|---|---|---|
| 130000 | 39900 | 37775 |
| 140000 | 40700 | 38975 |
| 150000 | 41500 | 40175 |
| 160000 | 42300 | 41375 |
| 170000 | 43100 | 42575 |
| 180000 | 43900 | 43775 |
| 190000 | 44700 | 44975 |

X=180000

Use the values in these two rows to set the window. Notice that the successive x-values from the table above were used for Xmin and Xmax while the values for Y2 where used for Ymin and Ymax.




The graph shows the point of intersection clearly and the CALC menu can be used to find the point of intersection easily, producing a graphical solution. Now, the student can answer the question about the best offer.




The table of values can also be used to produce a numerical solution using a method that will benefit students when they get to calculus.

In the table on thie right, we had an increment of $10 000 with a point of intersection somewhere between sales of $180 000 and $190 000.

| X | Y1 | Y2 |
|---|---|---|
| 180000 | 43900 | 43775 |
| 181000 | 43980 | 43895 |
| 182000 | 44060 | 44015 |
| 183000 | 44140 | 44135 |
| 184000 | 44220 | 44255 |
| 185000 | 44300 | 44375 |
| 186000 | 44380 | 44495 |

X=183000

Let's close in on the answer using the tables by altering the initial value of x and reducing the increment by a factor of 10 each time.




After a few iterations of this process, the same answer can be found. Now, the student has three tools to use to find the point of intersection – one graphical, one numerical and the traditional algebraic solution. ▲

| X | Y1 | Y2 |
|---|---|---|
| 183120 | 44150 | 44149 |
| 183121 | 44150 | 44150 |
| 183122 | 44150 | 44150 |
| 183123 | 44150 | 44150 |
| 183124 | 44150 | 44150 |
| 183125 | 44150 | 44150 |
| 183126 | 44150 | 44150 |

Y2=44150




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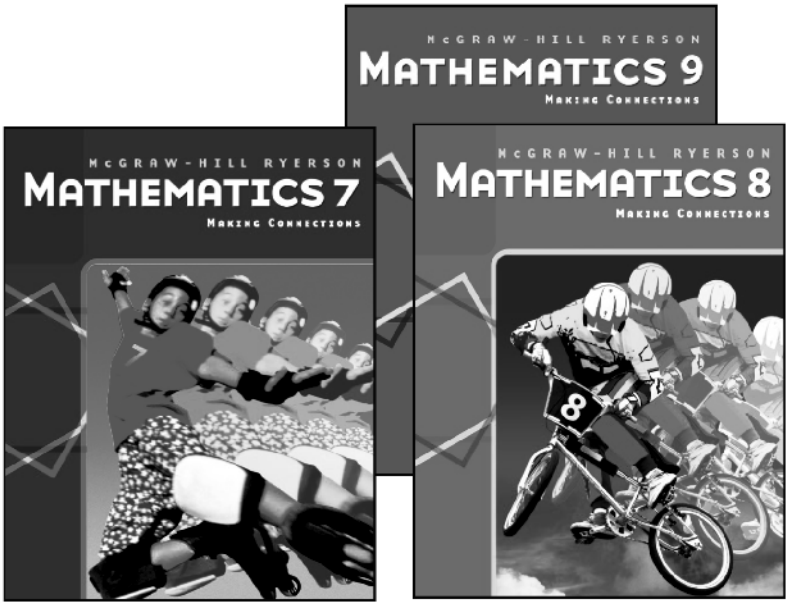
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# ▲ Textbook Use and the Implementation of Ontario's Mathematics Curriculum

GINO STURINO

*Gino Sturino, B.Tech., B.Ed., M.Ed., M.A. teaches mathematics and philosophy in Toronto at the secondary school level. He has a Doctorate in Education from the University of Toronto.*

If educators were asked about textbooks and the implementation begun in 1999 of Ontario's new mathematics curriculum, I suspect they would respond in one of three ways. Some might suggest textbook use is so prevalent at the secondary school level that it would be unrealistic to implement the new curriculum without giving teachers access to accompanying textbooks. Others might take the opposite view. Since current reforms require students to use technology and focus on solving complex problems not typically found in textbooks, they might say textbooks by their very nature cannot help implement the new curriculum. The third position might be a compromise between the two; although textbooks cannot be the only means of implementing the new curriculum, if used "properly", "reform-aligned" textbooks can help in the process.

Given the plausibility of each position, it is curious that current debates about reform rarely refer to textbook use. It may be that educators are preoccupied with solving more pressing concerns such as increasing calculator and computer use in classroom settings. On the other hand, it may also be that they are unsure about the proper role of textbooks in relation to the new curriculum. In any case, failure to debate textbook use is bound to create confusion for curriculum planners and teachers.

This confusion about textbooks and current reforms in mathematics education can be traced back to the American document *A Nation at Risk* published in the early 1980s. Although the document's focus was on large-scale issues such as education as a means of keeping the United States competitive internationally, included in it were references to textbook quality. According to Sosniak *et al.* (1993), following the publication of *A Nation at Risk*, two conflicting opinions about textbooks emerged; some educators believed textbooks would impede reform implementation, while others suggested textbooks would play a vital role in the process.

This issue is also well known by the National Council of Teachers of Mathematics (NCTM). The Council's past-president Glenda Lappan, on the tenth anniversary of the publication of the *Curriculum and Evaluation Standards for School Mathematics* (Standards), acknowledged NCTM had "by no means carried the day in this area" (1999, 651).

Lappan's statement is substantiated when one considers how rarely and in passing textbooks are mentioned in the Standards. For example, in the secondary school portion of the 1989 Standards, textbooks are mentioned only once and with a negative connotation (NCTM, 1989). Specifically, when outlining how it wants instructional practices reformed, the Council stresses decreased attention be given to teachers and textbooks as exclusive sources of knowledge. Among those instructional approaches to be emphasized, textbook use is never mentioned.[1]

This agenda creates problems for many mathematics teachers and may cause them to ask the following: while

[1] *NCTM wants decreased attention given to: teacher and text as exclusive sources of knowledge; rote memorization of facts and procedures; extended periods of individual seatwork practicing routine student tasks; instruction by teacher exposition; paper-and-pencil manipulative skill work; and the relegation of testing to an adjunct role with the sole purpose of assigning grades.*
*The Council wants increased attention given to: the active involvement of students in constructing and applying mathematical ideas; problem solving as a means as well as a goal of instruction; effective questioning techniques that promote interaction; the use of a variety of instructional formats (small groups, individual explorations, peer instruction, whole-class discussions, project work); the use of calculators and computers as tools for learning and doing mathematics; student communication of mathematical ideas orally and in writing; the establishment and application of the interrelatedness of mathematical topics; the systematic maintenance of student learning and embedding review in the context of new topics and problem situations; and the assessment of learning as an integral part of instruction.*

it is clear that reformers want textbooks relied upon less as sources of knowledge, nonetheless, do they condone textbook use in relation to practices they want implemented and/or emphasized? If so, how is this to be done?

Based on research, it seems reformers may not want teachers to use textbooks. Although most of the evidence suggests textbooks impede reform implementation, this is not always the case. For example, studies show textbooks are misaligned with current reform recommendations (e.g., Shield, 1998), do not meet student needs (e.g., Carnine *et al*., 1994), and do not help align instructional practices with current reform recommendations (e.g., Roelofs *et al*., 1997). However, research also exists suggesting textbooks can help implement reform agendas (e.g., Garet *et al*., 1995; Fan *et al*., 1998).

This research, coupled with NCTM's failure to elaborate on textbook use, places Ontario educators in an uneasy position. These educators will need to determine whether textbooks can help implement the new curriculum. At issue is the following: can textbooks continue to be used extensively, while at the same time have their role changed so that the new curriculum is properly implemented?

## Research Questions

Research was conducted to determine first, how Addison-Wesley's 1999 textbook, *Mathematics 9 (Ontario Edition)* (AW-9), was used during the initial stages of implementation of Ontario's new grade nine curriculum *Principles of Mathematics Academic Course (MPMID)*. In particular, the study tried to determine which instructional approaches (reform-based or not) were used and how AW-9 was used in each situation. Second, the research tried to determine how the teachers used AW-9 for planning purposes and whether this use of AW-9 helped them implement instructional approaches proposed in the new curriculum.

A two-teacher, two-school qualitative case study method was used to explore how "Gregory" and "Julia" used AW-9 for classroom and planning purposes. Both teachers had taught the MPMID course in 1999/2000, the initial year of its implementation, and were in the process of doing so again at the time of this study (2000/2001). Teacher selection, teacher questionnaire, observational, document and interview data were gathered. Analysis included triangulating (1) observation, document and textbook data, and (2) textbook, interview and questionnaire data.

## Results

*Teaching Strategies*. The teachers employed three distinct instructional approaches and used AW-9 differently depending on the approach. What follows is a summary of how AW-9 was used in each situation, that is, how it was used: (1) in conjunction with teacher-centred approaches (refer below); (2) when computers were used; and (3) when graphing calculators were used.

Both teachers often employed teacher-centred strategies. In these situations, the teachers were observed standing at the front of their classrooms controlling the unfolding of lessons. Typically, they completed previously assigned problems, presented new topics and concluded lessons by giving students new problem sets. Explicit AW-9 use here was limited to supplying students with questions requiring them to do paper-and-pencil manipulative skill work. Although the teachers had opportunities to use AW-9 in other ways, in these lessons they did not do so. For instance, they omitted using AW-9 features such as "investigations" and problems that required use of computers or manipulative materials.

At other times, the teachers employed different instructional approaches, most notably in lessons where students were asked to use graphing calculators or computers. The instructional approaches teachers chose in these situations were related closely to the particular technology being used.

AW-9 use was quite predictable when students were directed to use computers. In these lessons, the teachers used a textbook/computer-led strategy where student attention shifted away from the teachers and toward computers in combination with AW-9. Students here were required to use computers only for gaining access to *The Geometer's Sketchpad* (GSP) and always to help them complete AW-9 Chapter 11 geometry investigations. The teachers always assigned homework questions from AW-9 but, interestingly, did not require students to use computers to complete the assignments. Although Julia did not use computers the first year and Gregory did not use them the second year, in both cases, the teachers continued to base their geometry unit lessons on AW-9 materials and employed their respective teacher-centred instructional approaches.

In lessons requiring graphing calculators, each teacher was observed using many strategies and AW-9

in a variety of ways. Given that few such lessons were observed, analysis failed to determine the intricate workings of the instructional approaches used. However, in each case, some consistencies were noticed. In Gregory's case, lessons often began with him introducing new topics and assigning tasks in teacher-centred ways. Students were grouped and asked to complete the tasks. These lessons often ended with Gregory discussing aspects of the assigned tasks in whole-class ways. Julia's approach was different. She began lessons by assigning tasks and offering only minimal direction (e.g., she did not tell students how to proceed with the assigned tasks). Students were grouped and given sufficient time to complete the tasks. In a teacher-centred whole-class manner, Julia, unlike Gregory, concluded by having her students watch her as she completed the assigned tasks in their entirety. AW-9 use patterns in these "calculator" lessons were likewise difficult to determine in that AW-9 was not always used and, when it was, not in uniform ways.

Although few in number, these lessons more than others, showed that the teachers were attempting to incorporate instructional approaches recommended by NCTM and suggested in the grade 9 MPMID guideline (Ministry of Education and Training, 1999). For example, students collected data and used graphing calculators to help process and interpret it. Students also worked in groups, solved practical multi-step problems and prepared reports. However, given that these lessons were designed to accomplish many interrelated objectives and that AW-9 use was difficult to determine, it remained unclear the extent to which AW-9 influenced the implementing of these reform-based teaching strategies.

*Planning.* Among many interesting findings to emerge, the following pertaining to planning are applicable to this discussion: (1) both department heads influenced planning in important ways; (2) the teachers had more freedom when planning at the unit and lesson level; and (3) the explicit influence of AW-9 on planning diminished during the second year of implementation.

AW-9 use and teaching strategies employed in classrooms were not only the result of AW-9's influence on planning but also the result of a combination of factors, including AW-9. According to both teachers, department heads greatly influenced planning. Among other things, the department heads wrote and distributed AW-9-based timing guides, developed and provided the teachers with course-specific resource packages, regularly held meetings to help implement the new curriculum, provided the teachers with informal in-servicing related to technology use and made the final decision regarding textbook selection. Given that both teachers had three or less years' experience at the secondary school level, they readily accepted department head mandates.

The more important "combinational" factors (resources) influencing planning suggested by the teachers included AW-9 (primarily the first year), personally developed lesson plans (only in Gregory's case and only in the second year) and collegially developed materials (primarily department head developed timing guides).

Although the teachers used department head developed guidelines based on AW-9 materials, more so during the second year of implementation, they did not adhere to them closely. Both teachers modified the ordering of chapters and sections mandated in each guide. They also combined and/or eliminated sections in ways different than in AW-9 and in their respective timing guides.

Timing guide modifications were even more pronounced at the lesson planning level. In Gregory's case, guide suggestions regarding which instructional approaches to use and which AW-9 problems to assign were not followed closely. Julia had greater freedom planning lessons in that her guide did not prescribe problems to assign or instructional approaches to use. Interestingly, although the teachers varied greatly in the use of specific AW-9 chapter and section features (e.g., investigations and technology references), they both often assigned problems emphasizing development of paper-and-pencil manipulation skills.

AW-9 was used extensively for daily planning purposes during the first year. Department heads also relied on AW-9 when developing overall course structures included in their timing guides (e.g., both heads adopted AW-9's chapter and section structure). During the second year, explicit AW-9 use diminished at the teacher and departmental levels. In both cases, guides developed by the department heads were more important for overall planning purposes than was AW-9 or any other planning resource (e.g., Ministry guideline). At the lesson planning level, Gregory relied more on his own previously developed teaching notes and Julia more on the department head developed guide. Given that both teachers had taught the course before, in the second year, they indicated greater reliance on personal

experience and less on any resource, be it AW-9 or not.

## Discussion

Although Gregory and Julia occasionally incorporated reform-based instructional approaches in their lessons, more often they did not. While this indicates reforms are only partially implemented, it should not come as a surprise (Roelofs *et al*., 1997). Moreover, given that AW-9 was used in both situations, this shows that even though AW-9 assisted teachers to implement aspects of the new curriculum, it was not completely successful or responsible for the reforms that were implemented. It may well be that AW-9 actually impeded reform implementation.

This limited success, in relation to AW-9 use, can be considered from many perspectives. For example, how textbook features align with new mandates; teacher beliefs about textbooks; immediate contextual influences like that of colleagues on teacher planning; and large-scale contextual influences such as Ministry mandates on planning.

First, many reform-aligned features in AW-9 were explicitly used by both teachers. This was most evident when students were required to use AW-9 in tandem with *GSP* and partially evident when graphing calculators were used. Garet *et al*. (1995) suggest embedding textbooks with reform-based materials can help teachers change how they teach. Nonetheless, not all reform-based materials were used. Given that AW-9 is more than 600 pages and includes materials not necessarily aligned with current reform mandates, the teachers here simply had opportunities to avoid using AW-9 reform-based materials (see Chandler et al., 1994). This was most evident when teacher-centred instructional approaches were used.

Although the teachers admitted making minimal use of the Ministry guideline, they believed AW-9 was closely aligned with it. The teachers suggested that if AW-9 were "followed" closely, Ministry mandates would be met. Both teachers also believed that having gained experience teaching the course during the first year, they depended more on that experience and less on AW-9 in the second year.

There were also many important immediate contextual factors influencing teacher planning. In particular, department heads were identified as critically influencing the implementation process. Garet et al. (1995) support this finding:

> *[T]he department chair plays a crucial role in guiding and supporting change … Chairs can play a central role both in facilitating internal departmental processes and in linking departments to the wider network of professional organizations and associations. Change entails the construction and institutionalization of a new community of practice, which is facilitated by departmental leadership that encourages teacher collaboration, collegiality, and shared decision making and supports teachers in developing a new set of values, beliefs, and routines (p. 387).*

Although both department heads did not explicitly "link" the teachers to the "wider network of professional organizations" such as NCTM, they did encourage teachers to, among other things, use different technologies as stated in the Standards.

Lastly, neither teacher was aware of NCTM's existence. However, they were implicitly made aware of its agenda through teacher induction programs, department head mandates, AW-9 features and in-service sessions. While the teachers welcomed the new reforms, they questioned whether it was possible to implement them. For instance, they believed most students lacked prerequisite skills to achieve new Ministry expectations, parents and administrators could act as impediments to reform and the materials given to them, including AW-9, the Ministry guideline and timing guides, were not necessarily aligned with each other. These factors suggest that the teachers were faced with a myriad of expectations difficult to meet. Sosniak *et al*. (1993) believe that when teachers are presented with many sets of expectations, reform is not likely to occur:

> *To the extent that very different points of view about teaching and learning and content of most worth enter into the struggle for teachers' attention, … we believe that no single player (textbook publisher, state officer of education, national policy-making organization, school superintendent, etc.) is likely to make a significant or predominant difference in educational practice. In fact, the multiple influences to which teachers apparently attempt to respond may well be giving teachers permission to do exactly what they want in the classroom . . . (p. 271).*

While this overstates the idea of teacher freedom regarding planning, it may help explain why AW-9 only partially assisted these teachers change how they taught.

## Conclusion

Although this study is not meant to show how Ontario secondary school mathematics teachers in general use textbooks, it does highlight how textbooks can have considerable impact during the initial stages of reform implementation. The evidence demonstrates that the importance of textbooks cannot be underestimated during the early stages of implementation. Nonetheless, their role must be considered contextually, that is, in relation to other factors that influence teacher planning such as the construction of the textbook itself, departmental expectations, teacher beliefs about textbooks and the potential misalignment of large-scale factors like that of NCTM's reform agenda and Ministry expectations. If Ontario educators are intent on implementing the new mathematics curriculum, they will need to debate the issue of textbook use. This will require them to ask the following: What role, if any, should mathematics textbooks have in relation to the new curriculum?

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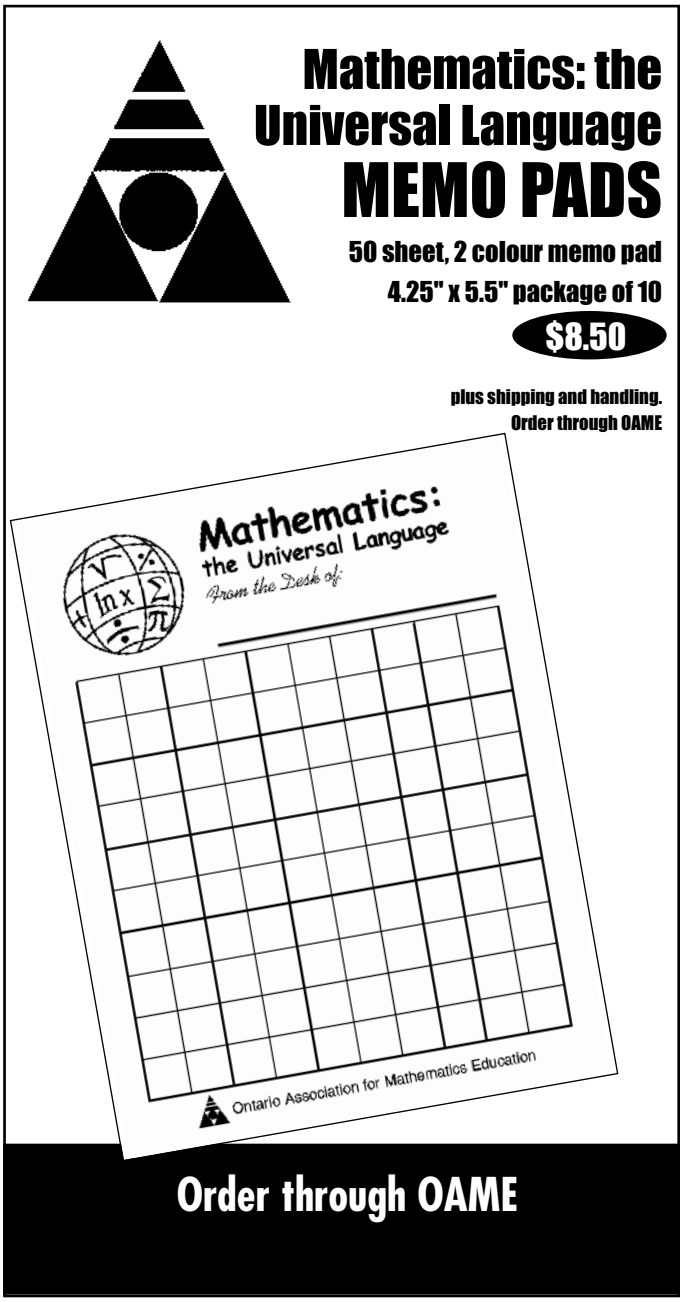
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# ▲ Photo Math – A new way of picturing math

**RON LANCASTER**
**INDEPENDENT MATHEMATICS CONSULTANT**



*Ron Lancaster is a middle and high school mathematics teacher, currently working throughout North America and Asia as an Independent Mathematics Consultant.*

"A picture is worth a thousand words" is an expression that is often used to convey the importance of using images to make a point. The point of this column is to go beyond this notion and promote the idea that in fact, "a picture is worth a thousand numbers". Photos with Math is what readers can expect to find in every Photo Math column and the emphasis will be on seeing and doing mathematics everywhere. Teachers may want to assign these questions to their students as part of an overall effort to make connections between the curriculum and the world around us. Establishing these connections is at the heart of the new Ontario curriculum as well as the new NCTM document, Principles and Standards for School Mathematics. It is hoped that these questions will inspire students to be more creative and playful and that in the end, students will develop an ability to see the world from a different perspective.

Teachers and students are encouraged to pose mathematical questions related to their own encounters and to submit these problems along with photographs to the Author for possible publication in future columns. Photos can be sent via e-mail or by regular mail to the Author of this column.

## Introductory comments

This June 2004 column is a continuation of the March 2004 column. All of the photos were created by Peter Saaramaki, a well known and highly regarded mathematics educator from Toronto. Peter is a former Coordinator of Mathematics with the Toronto Board of Education, he was seconded for two years to work at EQAO, he is a former president of OAME and OMCA and he is a writer and editor for GTK Press. Peter has continued to support mathematics education since his retirement through a number of initiatives.

I have known Peter for many years and often run into him at conferences in North America. The last few times we met I was delighted to find that we were both out independently capturing scenes of math with our cameras. Peter has a wonderful eye for finding math. The photos for this month's column were taken in Whistler, British Columbia. I hope you enjoy his work and that it inspires you to take your own pictures and send them to the Editor for publication in this column.

## ▲ Upcoming Events

For further information please contact the Chapter Representative for OAME Chapter Conferences, and John Kersley, OAME's NCTM representative for NCTM conferences.

See the last page in this *Gazette* for contact information.

### OAME Chapter Conferences and Events

| | | |
|---|---|---|
| June 18 and 19 2004 | University of Ontario Institute of Technology (formerly Durham College) | OMO 2004 hosted by PRMA |
| August 30 and 31 2004 | Ontario Regional TI83+ Conference Brampton | hosted by CHAMP |
| September 30 2004 | St Doiminic School Bracebridge | MAC$^2$ |
| October 14 2004 | Location TBA | Y$^4$MA |
| October 15 & 16 2004 | Sudbury | NOMA |
| November 6 2004 | University of Ottawa | COMA |
| Early November 2004 | Location TBA | QSLMA |
| February 24 & 25 2005 | Thunder Bay | NWOAME |

### OAME Annual Conference

| | | |
|---|---|---|
| May 12 - 14 2005 | York University | hosted by TEAMS |

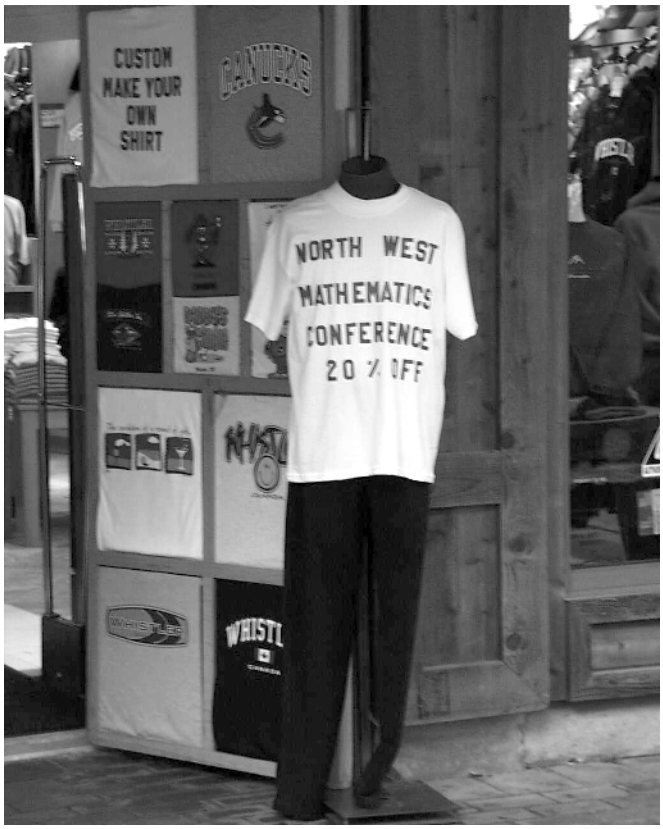
### NCTM Conference

| | | |
|---|---|---|
| April 6 - 9 2005 | Anaheim, California | 83rd Annual Conference |

### OTHER

| | | |
|---|---|---|
| Summer 2004 | StatsCan Summer Institute: MDM4U | Contact Joel Yan for dates |

## Photograph 1




About what percent of your body is your head?

## Photograph 2



Describe the two basic shapes in this bridge sculpture. What is the same about them? What is different?



*©2004, Ron Lancaster. Any commercial use or any use outside of a teacher's classroom requires permission from the author.*

## Photograph 3



The title of this photo is “Infinity”. Why?

## Photograph 4



What is pleasing about these shapes and designs?

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# ▲ Friday Special



JACK WEINER

Here is an awesome Friday special. This page is, BELIEVE IT OR NOT, from two successive issues of my weekly advertising paper, *The Pennysaver* (no relation to our desktop publisher, The PennyClemens.)

Make a transparency and then reveal each ad one at a time.

Start with the RCA 12" Black and White. $333?! This is hardly a great price for a small black and white television. However, you can get a 20" colour TV for $69! The crowds at *Krazy Kelly's* door demanding he live up to the advertised price were Krazy!

So naturally, there was a very contrite correction notice in the next issue of the PennyClemens, er, *Pennysaver*. Now you'd think that if someone is writing a correction notice, he or she would take extra care to get it right.

*"The RCA 20" COLOUR TV for $60…"* For $60? But it gets worse.

*"We are sorry if this has CASUED any inconvenience to our valued customers and readers."* Whew.

Now, I swear, in the very same issue of this *Pennysaver*, we find the ad for sports clothing. Check the bottom right.




*"Children's ANDIGO TRACK SUITS. Reg $24.98. 1/2 PRICE. NOW $19.98"* Hmmm.

And finally, *Mr. Pizza*. SAME ISSUE!

*"Save $1.50 on an 18" large pizza."* Fine, but not too enticing a bargain. However, *"Save $7.00 on a small…"* $7 on a small? At that price at that time, the pizza shop would owe you money.

As I write this, spring has finally sprung. Enjoy. Have fun. ▲


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# ▲ Census at School – A Resource for in-class Surveys and Data Analysis

JOEL YAN, STATISTICS CANADA



*Joel Yan has been part of the Learning Resources Team at Statistics Canada for more than 10 years. As a mathematician he is passionate about developing StatCan resources for math and helping teachers use these resources with their classes.*

### *Census at School* – A Resource for in-class Surveys and Data Analysis
### http://www.censusatschool.ca

*Census at School* is an international online project to teach students about handling and interpreting data. The project began in the United Kingdom (U.K.) in 2000 and now includes participation from schools in Australia, Canada, New Zealand and South Africa.

For the Ontario math curriculum, *Census at School* is useful for grades 4 to 12. It fits very well with the following courses: Grade 4 to 8 Data Management and Probability Strand, Grade 9 Academic and Applied, Grade 12 College and Apprenticeship Mathematics, and Grade 12 Mathematics for Everyday Life.

*Census at School* aims to:

- provide real data about real students for data management activities across the curriculum;
- show how information and communications technology can be used effectively in teaching and learning;
- raise awareness of the national census, how it gathers data, and its benefits to society;
- develop statistical literacy in students.

Students in each participating country anonymously fill in an online survey in class. They supply non-confidential information about such topics as their height, the time it takes to travel to school, the breakfast foods they prefer, and their favourite subject at school. These anonymous responses are submitted to a national database. Information from each national database is added to an international database that is maintained in the U.K. Teachers can access the results of their own class' survey and also request random samples from the databases to make national and international comparisons.

Some of the questions on the Canadian survey are common to all participating countries; others were developed by a team of math teachers across Canada. Once students have completed the online survey, the teacher can obtain the class results, in the form of a spreadsheet, to use in teaching. The resulting data can be imported into Fathom, Quattro Pro or Excel. See figure below.

This project combines fun with learning, to the delight of thousands of students around the world who have already participated, as part of their classroom learning in math, social sciences or information technology.

> *"I believe [the* Census at School*] was a valuable learning experience because it gave me... a better understanding of designing survey questions. Also reading the questions, provided insight as to how the data may be grouped or analyzed later on."*
> Student, Listowel District Secondary School

> *"*Census at School *is an excellent resource. The built-in survey activity requires that students provide their own personal responses and creates a sense of ownership within the task. As students respond to the questions they are experiencing survey design on a deeper level. They are intimately interacting with well-designed questions, allowing them to better internalize the concepts of survey design. Furthermore, having participated in the activity students are already familiar with the method of data collection when they are asked to analyze the data. Students responded positively to the task of data analysis because they now understood how the values were recorded. Students were much less apt to become frustrated with the large data set (50x26) because of their new-found familiarity. The conclusions drawn were more appropriate than their conclusions stemming from secondary data."*

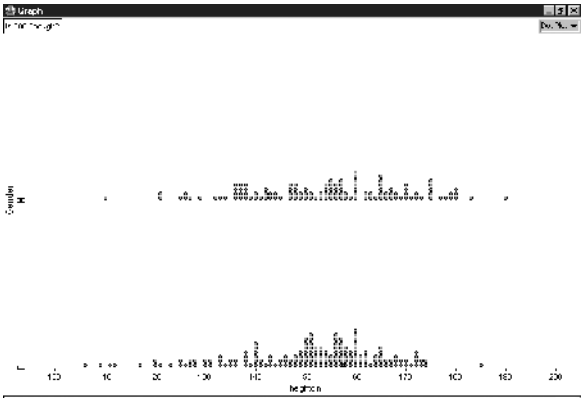
Amy Scales, teacher of the grade 12 College Apprenticeship course; Listowel District Secondary School, Avon Maitland District School Board.

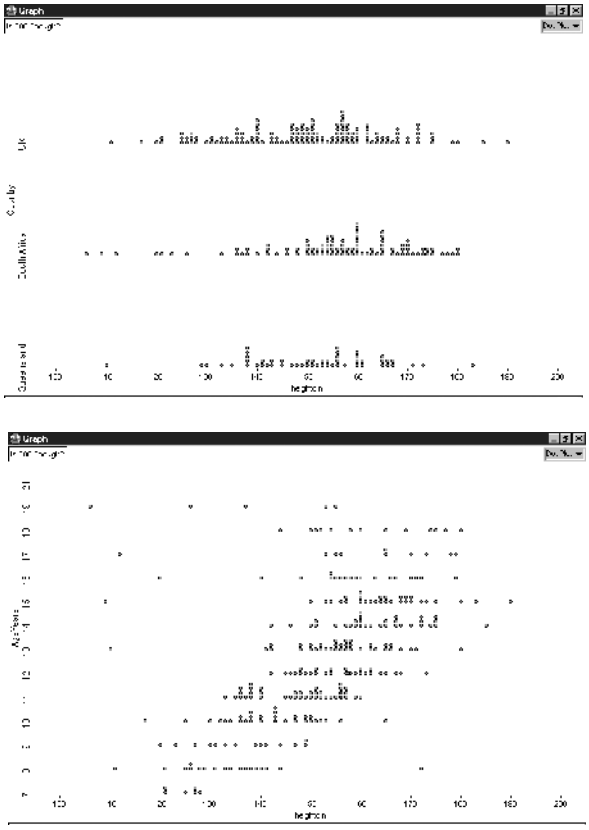
Mary Townsend, manager of the *Census at School* project in Canada notes that Canadian survey results should be available in the summer of 2004. "We will offer a random data selector allowing teachers and students to request Canadian data that they can use to compare with their class data".

> *"Kids connect best with data they can see themselves in. When teachers collects data from their students by hand, most of the time goes into data collection, leaving little time and energy for actually analyzing the data. With* Census at School *collecting data in electronic format becomes painless. The focus can quickly turn to analyzing the data in electronic environments such as* Fathom *or* Tinker Plots*.* Census at School *also gives students and teachers access to larger datasets with as many cases as they want, instead of a maximum of 30 cases that would normally be collected from one class.* Census at School *data has a nice balance of numeric and categorical variables, which allow for a rich array of representations and analyses. Having more data lets students do different kinds of analysis, as demonstrated in the "How many is enough? activity on the web site."*
>
> Tom Steinke, Educational Consultant, Ottawa-Carleton Catholic School Board

## Figure: Height of 300 students by gender, age and country

Below are data displays showing a random sample of 300 students from the United Kingdom, South Africa and Australia, ranging in age from 7 to 19 years. Each dot represents one student.





*Source:* Census at School*, United Kingdom. International database URL: http://worksheet.censusatschool.ntu.ac.uk/random2*

## Learning Activities

There are 10 learning activities available on the *Census at School* site for grades 4 to 12, with more to come. These include activities for the Ontario Grade 9 and 12 curricula developed by Tom Steinke and Stewart Craven. See the sample lesson below by Tom Steinke. Downloadable versions of this activity are available on the web site.

Check out the learning activities at http://www19.statcan.ca/02/02_004_e.htm. From the same page, you can also link to the *Census at School* site in the United Kingdom, with many useful classroom activities.

## Updated Resources for Data Management Course

Statistics Canada has further developed its suite of sequenced lesson plans for teaching the MDM4U course that were described in our previous column. These are available on the following web sites:

- http://www.statcan.ca/english/kits/courses/math.htm

# Exploring Linear Function Models (Grade 9 – Ontario) Student Handout

**Over the next few days, you will be**

- completing an online census questionnaire
- requesting data from an online random data selector
- modelling data with linear functions
- creating and presenting your own data story

**Completing an online census questionnaire**

After your teacher tells you the story behind the Census at School project, go to www.censusatschool.ca Click on the "Student" button and fill in the online questionnaire, using the class ID and password that your teacher gives you.

**Requesting data from an online random data selector**

Refer to your *PowerPoint* Instructions handout.

**Step 1:** Request a dataset of 100 14-year-olds from the *Census at School* web site in the United Kingdom. *Do this at home. Save the file on a disk and bring the disk to school.*

**Modelling data with linear functions**

Use your data file on disk and the PowerPoint instructions.

**Step 2:** Import the dataset into a statistical software environment (e.g.., *Fathom*).

**Step 3:** Construct a scatterplot.

**Step 4:** Use a **movable line** (an informal process) to fit a linear functional model to your scatterplot.

For steps 5 to 9, insert a text box to type in your comments.

**Step 5:** Find the **least squares line**. Reflect on what the **r^2 value** suggests about the appropriateness of this linear model.

*Check out an online Java Applet that helps you understand where the least squares line comes from at* www.keypress.com/sketchpad/java_gsp/squares.html

**Step 6:** Reflect on the meaning of **slope (m)** and **y-intercept (b)** in the equation of your linear model, **y=mx+b**.

**Step 7:** Reflect on the strengths and weaknesses of your linear model.

**Step 8:** Use a filter to explore whether a linear model of just boys or just girls gives a stronger correlation.

**Step 9:** Use a filter to explore whether a linear model of each country individually gives a stronger correlation.

**Creating and presenting your own data story**

**Step 10:** Select two numeric attributes/variables that you think could be modelled with a linear function.

**Step 11:** Construct a scatterplot and fit a movable line to your data.

**Step 12:** Find the **least squares line**.

**Step 13:** Experiment with filtering subgroups (by gender, country, etc.) to improve your **r^2 value**.

**Step 14:** Using presentation software (*Corel Presentation* or *PowerPoint*), create your data story, including your data displays.

**Step 15:** In your data story, include reflections on the strength(s) and weakness(es) of your linear model(s).

*Be sure to save your work.*

- the latest set of math resources (lessons, articles and data) from StatCan, also available in French
- www.vlearning.ca – sequenced set of lessons and datasets
- http://www.keypress.com/fathom/sample_activities/ - activities in English and French for using StatCan data with Fathom software. See also the related Fathom datasets at this site under "Sample documents."
- http://www.ocdsb.edu.on.ca/teacher_res/secondary/tecint/mdm4u.htm - this Ottawa-Carleton District School Board site includes student projects, activities for analyzing STC microdata, and more.
- http://www.datamanagment.tk - MDM4U resources site built by Marlon Coates, Grimsby Secondary School, contains useful links and resources.

Check out these sites, as they will be updated periodically using the latest MDM resource materials from Statistics Canada.

## Data Management Fairs are Working

An exciting new type of math event is spreading across Ontario - data management fairs that showcase outstanding student projects. The second annual Student Data Analysis Fair was held at Statistics Canada's offices in Ottawa in February 2004. Grade 12 MDM4U students proudly presented the results of many months of hard work and analysis on topics such as:

- How does playing video games affect high school grades?
- Is there a connection between obesity and diabetes?
- What's the relation between youth crime and punishment?
- How does the media influence teenagers' development and lifestyle?

There were 30 projects on display from 17 schools representing 5 different school boards across Eastern and Central Ontario. Over 400 students and 25 teachers visited the Fair and participated in workshops showing how to use Statistics Canada data and offering ideas and tips for future projects. Statistics Canada experts who visited the fair were impressed by the quality of the students' analysis and students were thrilled with the feedback and suggestions they received from the StatCan analysts.




*First semester students present their project on Women in the Workforce and the effect on the birth rate to second semester students. Location: the second annual Statistics Canada data fair, Ottawa, February 24, 2004. Photo: Tom Steinke, OCCSB.*

The data fair concept is gaining ground in Ontario; fairs were organized in 2004 by school boards in Halton and Toronto. Other boards are planning student data fairs for next school year. If you are planning a data fair in your region talk to StatCan about organizational tips and a professional development session.

*Stewart Craven, President of the OAME, hopes that data fairs gain popularity across Canada. "Kids don't usually do things that are important to them in math class," he noted, "but these projects are proof that schoolwork can be meaningful."*

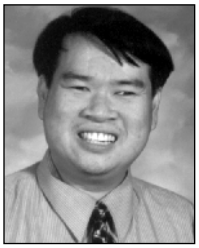
## StatCan Institutes for Teachers of MDM4U and MAP4C

By popular demand, Statistics Canada is running institutes for teachers of MDM4U and MAP4C this summer and fall. The sessions will focus on how to effectively use the Statistics Canada web site (www.statcan.ca), *E-STAT, Statistics: Power from Data* and *Census at School*. Participants will work through a sequenced series of lessons using the latest statistical datasets. All participants will receive a CD-ROM containing teacher resources and exemplary student culminating projects. To receive the schedule or discuss a possible session for your region or board, contact Joel Yan at mdm4u@statcan.ca or 1-800-465-1222.

Note: If you have suggestions on what you like to see in this column or stories to share related to the use of StatCan resources, please email Joel at mdm4u@statcan.ca ▲

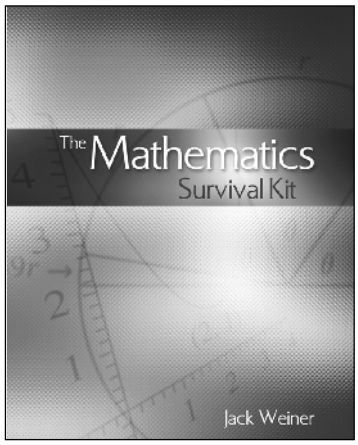
# ▲ Book Review: *The Mathematics Survival Kit*

**REVIEWED BY: LOUIS LIM**



*Louis Lim is department head of mathematics at Unionville HS and a PhD student at York University. He is currently an editorial panel member of the NCTM's* Mathematics Teacher *and was editor of the OAME's* Gazette *from 1999 to 2003. In 2003, Louis was the recipient of the York University Faculty of Education Alumni Association's Excellence in Teaching Award.*

*The Mathematics Survival Kit*, ©2004, is a 236 page resource written by Jack Weiner, a professor in the mathematics and statistics department at the University of Guelph. The kit consists of 115 topics covered in high school mathematics to 1st year university calculus and algebra. Topics are organized into categories such as "Factoring: A Product of Practice", "The Straight Goods on Lines and Planes", and "Angling in on Trigonometry and a Little Geometry Too!", which make identification of the needed skill easy to locate. Also included are "How to Get an 'A' in Math!", "How to Get Extra Help", and several pages of formula sheets.




Each topic follows a two-page format. The first page consists of a brief introduction, and then several worked-out examples follow with commentary. The second page is "Two for you", with two questions assigned to the reader. The majority of the second page is left blank, which allows the reader to write solutions. Answers are provided at the bottom of the page.

Having been away from university mathematics for 8 years, I can honestly admit that I have become quite "rusty" with undergraduate mathematics. Weiner's resource provided me with a quick and non-intimidating review of Rolle's Theorem and Mean Value Theorem as well as a reminder that a calculator's one solution to $\sin x = c$ is $-\pi/2 < x < \pi/2$ and to $\cos x = c$ is $0 < x < \pi$, where c is between –1 and 1. I also appreciate the review of evaluating limits of the form "c / 0" and "$\infty - \infty$" limits, and how to solve $| 2x + 1 | = | x - 7 |$ using the property $| a | = | b | \leftrightarrow a^2 = b^2$.

Weiner has done a valiant job selecting topics that students find difficult or require frequent review. Solutions are presented with attention to detail; for instance, in solving $\sin x = 0.5$, $x = \pi/6$ and a (not "the") corresponding second quadrant angle is $x = 5\pi/6$. I am pleased that the exponent laws, factoring techniques, complete the square, solve quadratic equations, derivatives of $y = e^x$ and $y = a^x$, implicit differentiation, and continuous and differentiable functions are included. The thorough treatment of trigonometry is invaluable since students learn these topics in grades 10 and 11 (not grade 12), and when they encounter trigonometry in 1st year university calculus, they may need some review.

As with any resource or book, suggestions can be made to strengthen the existing product. I encourage the author to include complex numbers, factoring trinomials, matrix operations, and mathematical induction, in addition to more topics from 1st year university algebra, in future editions. To keep the resource from increasing in price, I would suggest using a one-page format (rather than two), with the "Two for you" appearing at the bottom of page 1. I wonder how many readers actually write in the blank space on page 2. That would save 115 pages! Also, solutions to the "Two for you" could be included at the end of the kit.

I highly recommend the resource to readers of the OAME *Gazette*! I have purchased a copy for my mathematics department at Unionville HS. Professional tutors may also find this resource invaluable. High school students could purchase this kit, which can be used throughout their university mathematics courses. Several students in my grade 12 advanced functions and introductory calculus class have asked for some more practice with factoring. Rather than provide them with photocopied pages from a grade 11 textbook, Weiner's resource could be an alternative. *The Mathematics Survival Kit*, published by Nelson Publishers, is available for purchase at: http://hed.nelson.com/products/productpage_s.asp?isbn=0176416188&pubcode=158. ▲

# ▲ Mathematical Centrepieces: An Adventure in Math, Art and Looming Deadlines

**MARIA CASASOLA**
**CLAUDE GARTON SCHOOL**
**LAKEHEAD DISTRICT SCHOOL BOARD**

*Maria Casasola is a Grade 8 teacher of Mathematics, Science and Art at Claude Garton Public School in Thunder Bay ON. She coaches the running team at her school and is a long distance runner herself. Maria is also the OMO coach for NWOAME. Her students enjoyed this project and are very excited about "being published" in the* Gazette*.*

When organizers asked if my grade eight class could make some math centerpieces for the upcoming math conference (hosted by our chapter N.W.O.A.M.E.) my initial consideration was not positive. I thought how typical of high school teachers. Do they think that we have nothing better to do thank make pretty things in grade school? Don't they realize how dense the curriculum is? The conference was two weeks away. How was I supposed to pull this off? I do have a long range plan and this was not part of it.

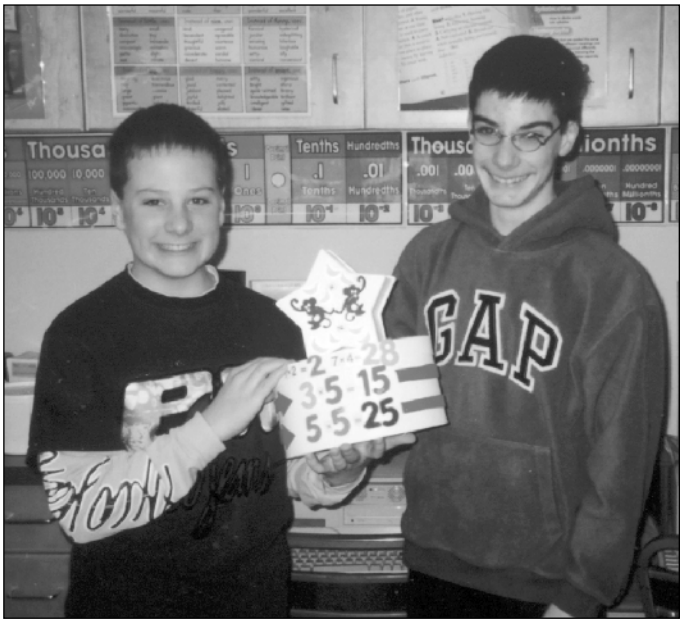
It reminded me of the time that a high school math teacher told me that I taught math well because I occasionally hung out with math teachers. I was incensed. I believed that if I had become a good teacher of math it was through reflection on past practice, research, risk taking and hard work. As far as I could figure, I had not received any math teaching skills through the process of osmosis.

As we were in the middle of a meeting, I couldn't respond right away. So as I sat there, unusually silent, the idea started to take root in my head. If I was going to ask my class to do this, it needed to be meaningful and fit into what they needed to learn. Then I started to think about how I would rearrange our schedule so we could meet the deadline. By time the meeting was over, I was really excited and I had figured out how I was going to make this happen.

As I teach all subject areas, it was obvious that I needed to integrate this with their visual arts program. I have included the assignment as it was presented to my class, including the rubric. I felt it necessary to separate the math outcomes from the art outcomes. I wanted the centrepieces to be mathematically rich. They needed to express complex ideas about math and not just be pretty numbers glued to a box. Students had to be able to mathematically justify every part of their sculpture. Decoration for the sake of decoration went the way of the dinosaur.

They were required to draw labeled diagrams of their creations explaining the math that was found there. While they did not find this part of the project nearly as much fun, it did provide me with an opportunity to assess their communication skills on a wide array of math topics. I have also included some samples of their writing.

This was treated as a commission. A successful project equaled two slices of hot delicious pizza. It was great incentive. As the grade eights had a specific audience to create for, I brought back pictures from the math conference so they could see how it all worked out. I was pleased with the results and they were quite pleased with themselves. I know that they will become part of our student-led-conferences in April. My class will be able to share with their parents the math found in their centerpieces.




*Jamie and Zack holding their centrepiece showing how division and multiplication are related.*

# Mathematical Centrepieces

Your class has been commissioned to create mathematical centrepieces for an upcoming math conference. You and a partner need to create a centrepiece to place on the table. It must please your eyes, as well as your mathematical mind.

You will be making an assemblage. It is like a three-dimensional collage. In a collage, you take different images and words and combine them to make something new. This is similar, except you will be taking actual objects, foam letters, foam numbers etc. and be attaching them to a base. As this is sculptural, ensure that your final product looks good from all viewpoints.

### Expectations

- can reflect on learning experiences and interpret and evaluate mathematical issues using appropriate mathematical language (e.g., in a math journal)
- can produce two- and three-dimensional works of art that communicate a variety of ideas (thoughts, feelings, experiences) for specific purposes and to specific audiences,
- can describe, in a plan for a work of art, the main idea to be communicated and the artistic decisions made to support that message

### Steps to Success

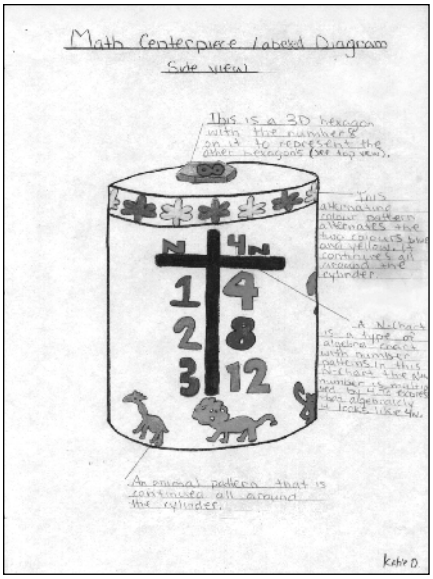
1. Find a partner and brainstorm ideas about math that your centrepiece will communicate. Look at the art materials and the math materials that your teacher has provided.
2. Sketch out some of your ideas. Try a number of different approaches.
3. Select or create a base.
4. Gather materials to bring your math ideas to life. For example, if you chose measurement as your idea, you might find a ruler, measuring tape, graduated cylinders, play money, clocks etc, to help show all the different units of measure.
5. Plan how and where you will attach the materials.
6. Share your plan with your teacher. Make adjustments as needed.
7. Start putting it together.
8. Using a labeled diagram, explain the math idea(s) that you shared in your math centrepiece. Be specific and include the strand.
9. Submit centrepiece and labeled diagram.

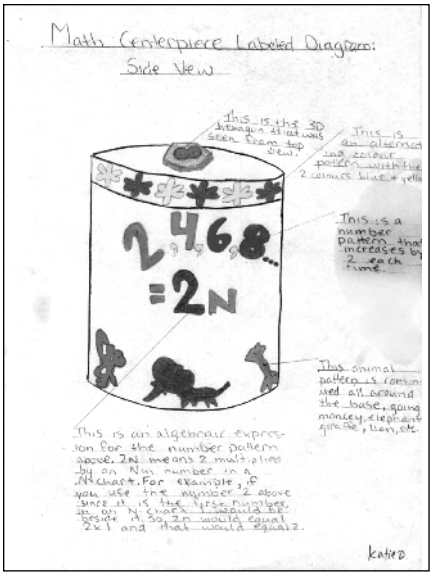
## MATH

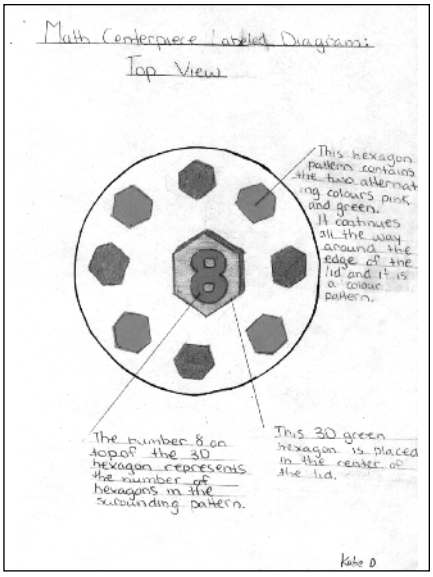
| Level 1 | Level 2 | Level 3 | Level 4 |
|---|---|---|---|
| • gives partially complete but inappropriate explanations<br>• rarely uses appropriate mathematical terminology | • gives appropriate but incomplete explanations<br>• sometimes uses appropriate mathematical terminology and symbols | • gives appropriate and complete explanations<br>• usually uses appropriate mathematical terminology and symbols | • gives appropriate and complete explanations showing many connections<br>• always uses appropriate mathematical terminology and symbols |

## ART

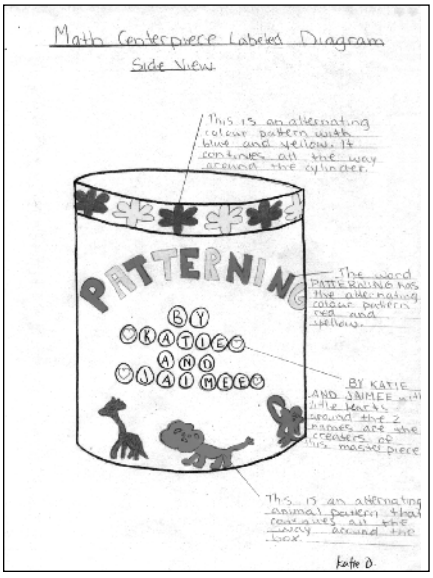
| Level 1 | Level 2 | Level 3 | Level 4 |
|---|---|---|---|
| • applies few of the skills, concepts and techniques taught (assemblage)<br>• communicates math ideas in limited and incomplete ways<br>• centerpiece is only visually appealing from a single view through the limited use of design principles and details | • applies some of the skills, concepts and techniques taught (assemblage)<br>• communicates math ideas in complete but simple ways<br>• centerpiece is visually appealing from some views through a partial use of design principles and details | • applies most of the skills, concepts and techniques taught (assemblage)<br>• communicates math ideas in complete ways with increasing sophistication<br>• centerpiece is visually appealing up close and from a distance through the use of design principles and details | • applies all (or almost all) of the skills, concepts and techniques taught (assemblage)<br>• communicates math ideas in complex and well-developed ways<br>• centerpiece is visually appealing up close and from a distance through the complex use of design principles and details |

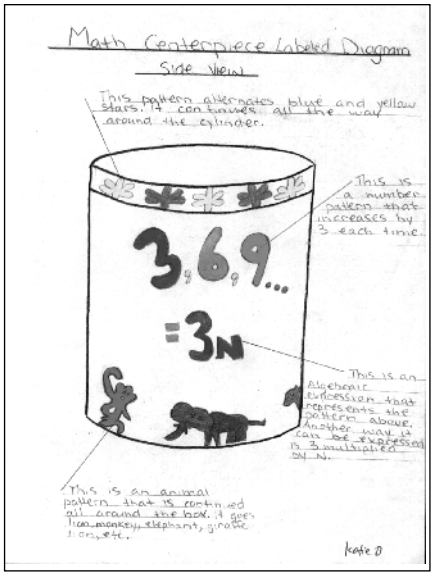



*Labeled Diagrams showing 5 views of a Centrepiece.*





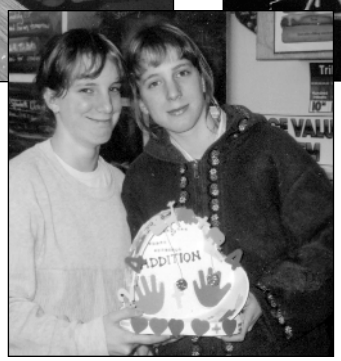

*Above and below: Centrepieces in place at the conference.*




*Above: Robin working on her centrepiece showing how she loves algebra.*




*Above: Erica and Brooke and their algebra centrepiece.*




*Left: Samantha and Dusty with their centrepiece on addition.*






*Above: Sarah and Oliva working on their patterning and algebra centrepiece*

# ▲ Hey, It's Elementary

LYNDA COLGAN



*It were not best that we should all think alike; it is difference of opinion that makes horse races.*

Mark Twain

"Who is this guy, anyway," my teacher candidate implored, "some kind of guru or something?" She continued on, saying, "First we use his text in class here. Then I go out on my field placement and find my associate is hosting a book club using our text. Next, I go to an Early Math Strategy workshop and hear his name in every other sentence. Then the other day I registered for an AQ course on-line and downloaded the course of study. Guess what? We're using his book again. John Van de Walle sure is famous."

There is no doubt that John Van de Walle has played an enormous role and made many signficant contributions to mathematics education in North America. His textbook, *Elementary and Middle School Mathematics: Teaching Developmentally*, is the most commonly-used resource for teaching *Mathematics Curriculum* or *Mathematics Teaching Methods* in Faculties or Colleges of Education across North America. In the text, Van de Walle has done an incredibly impressive job of synthesizing and summarizing the most significant original research to impact mathematics education over the past two or three decades (as well as including some important historical milestones). More significantly, he has compiled an amazing collection of illuminative examples to illustrate theoretical concepts and bring abstract notions to life. And to put the icing on the cake, he has designed some useful tools for instructional and assessment purposes!

There is no doubt that John Van de Walle has reviewed an enormous body of literature from the discrete but complementary fields of developmental psychology, cognitive science, curriculum theory, semiotics and instructional development, to name but a few. He has distilled hundreds of thousands of pages of complex academic writing down to several hundred pages of accessible information, rich in explanatory graphics, actionable recommendations and facilitative classroom tools.

His book is important because he has given voice to many academic researchers who would never be heard by classroom teachers or administrators. This is an amazing accomplishment on many levels. Bridging the theory to practice gap is never simple, and Van de Walle has done it in an exemplary fashion, chapter after chapter. By reading the primary sources in educational psychology, special education, cognition, and curriculum, Van de Walle has clearly garnered considerable expertise on many topics. More importantly, in this day of extreme specialization, Van de Walle can be said to be a true generalist – and a generous one at that. Clearly, he has made it his life's vocation to share his synthesis and analysis of a broad range of literature with classroom teachers in order to improve the mathematics learning experience of children.

The text is an excellent introductory, survey textbook. My teacher candidates, who are required to read each chapter and provide reflections or "key learnings" on each one, are consistently impressed by the new knowledge they gain and the "Aha!" moments that are inspired by the examples, explanations and elucidations. I am confident that the book will find a prominent position on their personal bookshelf of resources and will be well and truly dog-earred by the end of their first year of teaching. It will be the reference of choice at the beginning and end of each unit. It will provide fodder for parent newsletters. It will be a professional support in the absence of a human mentor. It marks the first small step up a steep professional learning curve.

However, even my teacher candidates have noticed that often presenters at workshops and conferences will say things like, "Van de Walle says that invented strategies are important" or that "Van de Walle contends that anchor numbers, such as 5 and 10, are key concepts in the development of basic arithmetic skills." As citation-conscious university students, they are astute enough to recognize that, in fact, Van de Walle did not say these things. Throughout much of his book Van de Walle is echoing or paraphrasing the work of Piaget or Collins or Seely-Brown or Lave & Wenger or Geary.

My teacher candidates have noticed that often the primary researchers who coined learning theories from social constructivism to dyscalculia are not credited with their "discoveries" because they are deeply buried in the survey textbook, and as a matter of course, everything from neural networks (the famous white dot-black dot

diagram) to tactile number recognition strategies (e.g., sandpaper digits) are credited to the coordinating "voice" of one important teacher educator—Van de Walle.

My teacher candidates have also pointed out another problem. "What if every workshop I go to next year uses the examples from Van de Walle? Where will I be in terms of professional development? I want to move forward. Learn more. Experience different things. How can that happen if every board in Ontario is using Van de Walle as their expert authority?"

> *The greatest part of mankind have no other reasons for their opinions than that they are in fashion.* Samuel Johnson

I respect my teacher candidates enormously for being so frank and candid. I also agree with them wholeheartedly. We need to acknowledge that when Van de Walle speaks, he represents a symphony of voices. When a workshop leader says, "Van de Walle says", we must demand to know, "On whose behalf?"

We need to acknowledge the fact that we may need to delve deeper into the research that originated the recommendations he posits. We need to ask, "Under what circumstances was the study conducted? Is it reasonable to assume that the study is scalable—e.g., implementable in 'regular' classrooms by 'regular' teachers?"

We need to acknowledge that other voices are saying the same things as Van de Walle using different examples. We also need to recognize that some voices are dissenting and are still correct, because the leading mathematics educators and researchers have agreed that there is no one right way to teach or learn mathematics.

> *Believe nothing just because a so-called wise person said it. Believe nothing just because a belief is generally held. Believe nothing just because it is said in ancient books. Believe nothing just because it is said to be of divine origin. Believe nothing just because someone else believes it. Believe only what you yourself test and judge to be true.* [paraphrased] Buddha

I believe that my teacher candidates have recognized something that is extraordinarily important: difference of opinion is healthy. If every consultant, teacher educator, associate teacher and publisher is using Van De Walle as *the* voice, representing *the* "right way" to teach and assess mathematics in elementary schools, then as a profession, we are diminished.

As a collective, elementary teachers across Ontario bristled at the implementation of the Harris Government's *Ontario Curriculum: Mathematics 1- 8* because it felt that the standardization represented a loss of professional ownership for the curriculum. The requirement to address the laundry list of expectations, most teachers argued, meant that there was less choice and fewer opportunities for creativity.

And yet, as a province, in an apparent contradiction, the mathematics education community has appeared to endorse Van de Walle and his book as *the* authority with respect to teaching and learning mathematics.

The truth is that as a profession, we need opposing views. We need informed debate. We need a cacophony of voices. As a province we should resist the pressure to become automatons. We should not blindly adopt *any* approach to mathematics teaching and learning because there will always be room for improvement. As Harriet Martineau said, "Readers are plentiful, thinkers are rare."

The Van de Walle textbook is convenient because everything is in one place—the summary of research, the examples and the teaching resources. But other resources need to be considered; their ideas, implemented; and the outcomes, professionally evaluated.

For example, the Marilyn Burns materials are outstanding. From her books, such as *About Teaching Mathematics* to her newsletters, published through her company *Math Solutions*, educators will find resources that are pedagogically sound, rich and engaging.

James Hiebert, Thomas Carpenter and Elizabeth Fennema have recently published a ground-breaking book, *Making Sense*. In it, Hiebert and his colleagues arm teachers with the best current research-based ideas for designing—and defending—classrooms that support students' mathematical understanding. It is based on the authors' work in four separate research programs, all of which investigated the effects of specific instructional approaches. Out of their ongoing discussions emerged a striking consensus about what features are essential and what features are optional, which they share in this book. They also provide glimpses into their individual projects and into the classrooms from which they have drawn many of their ideas.

Judith Shulman and Carne Barnett have authored several books including *Mathematics Teaching Cases: Fractions, Decimals, Ratios*, and *Percents Hard to Teach*

*and Hard to Learn?* These case books (and accompanying facilitator guides) have enormous potential as professional development tools. Patterned after a method long used successfully to prepare lawyers and business professionals, case discussions in education focus on detailed scenarios written about the real life experiences of teachers. Cases are largely based on the recognition that the work of educators is informed not only by research but by experience. Because cases reflect reality, they help teachers learn to connect theories and concepts to the complex, idiosyncratic world of practice. In the math cases project, teachers develop capacity through the careful and exciting process of reflection and inquiry generated by facilitated discussions with other teachers about math cases that portray real-life teaching dilemmas. In one case, for example, a student asks the teacher: "How can 100 percent of something be just one thing?" The question, itself, can give a teacher pause. Although most of us would agree that 100 percent means the whole thing or "one," the concept can be confusing. If you poll 23 people and 100 percent respond that they like toothpaste, does 100 percent mean 23 or 1? What seems obvious on the surface is really quite complex when you're trying to promote understanding of a concept and not just memorization of a rule. As illustrated in that case, many mathematics concepts are more complex than they might initially seem. Prone to being misunderstood in a variety of ways, they are not easily "taught" in the traditional sense of imparting knowledge.

And there are others like Deborah Shifter's series, *What's Happening in Math Class?* that are too rich to be ignored. There are Thomas Carpenter and Elizabeth Fennema's books and accompanying CD's on *Cognitive Guided Instruction*. There is Robert Wright's book *Early Numeracy: Assessment for Teaching and Intervention*. There is John Mighton's book *The Myth of Ability: Nurturing Mathematical Talent in Every Child*.

Our menu of available options is lengthy and each selection is nutritious and worthy of promoting and sustaining professional growth.

The Van De Walle text *Elementary & Middle School Mathematics: Teaching Developmentally* is important because it has been the catalyst for many important grassroots professional development initiatives, including book clubs and study groups.

However, instead of stopping here, using the Van de Walle book as a "jack of all trades" to meet the needs of pre-service and in-service teachers as well as administrators, the elementary mathematics community needs to build on the momentum that the book has generated and initiate new book clubs and other local innovations that broaden the bandwidth of discussion.

Poulsen's Theorem states that "When something is used to its full potential it will break." We cannot afford that to happen to the Van de Walle textbook. ▲




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# ▲ WEB SITES: GET INTERACTIVE

KEVIN MAGUIRE



*Kevin Maguire is an Instructional Leader in Mathematics/Numeracy for the Toronto District School Board. Kevin is also an OAME Director. His particular interests include teaching with technology and elearning.*

In this space, web sites of interest to teachers of mathematics will be shared. In this issue, the spotlight will be Applications of Mathematics in Context. Teachers know that students learn best when problems are presented in a "real" context. Finding such practical problems has always been a challenge, but the Internet has opened up new possibilities for quick research and sharing.

### Project SkyMath: Making Mathematical Connections

http://www.unidata.ucar.edu/staff/blynds/Skymath.html

Project SkyMath is a middle school project involving hands-on study of the weather. In the sixteen activities presented on the web site, a large number of curriculum expectations in the middle years are addressed.

### PBS Mathline: Math and Music

http://www.pbs.org/teachersource/mathline/concepts/music.shtm

Teacher Source on the PBS web site has a huge variety of activities and resources. In Math and Music, three activities for Grades 4-7 explore the link between Mathematics and Music.

### Math: A Guide to Integrated Lesson Plans

http://w3.byuh.edu/library/curriculum/Math/Math.htm

"At long last a guide to planning and implementing integrated lesson plans has been created!"

This site is a Pathfinder, one of hundreds of sites developed by students at Brigham Young University in Hawaii, to assist teachers to locate web resources on specific topics. This Math Pathfinder catalogues a large number of web sites, books, articles, etc. which deal with integrated lesson plans in K-12 Mathematics.

### CIESE, the Center for Improved Engineering and Science Education

http://k12science.stevens-tech.edu/currichome.html

The central aim of the CIESE is to design or sponsor interdisciplinary projects for teachers to enhance their curriculum through compelling use of the Internet. Three different types of projects are available for students to consider joining:

## Collaborative Projects

Projects Using Primary Sources and Archived Collections

### Real Time Data Projects

Three examples of Collaborative Projects currently running are:

**Bucket Buddies.** (Grades 1-5) Students collect samples from local ponds to answer the question: Are the organisms found in pond water the same all over the world?

**Down the Drain.** (Grades 4-8) Students track their water use and compare to other parts of the world!

**The Global Water Sampling Project.** (Grades 9-12) Students compare the water quality of a local river, stream, lake or pond with other fresh water sources around the world. ▲

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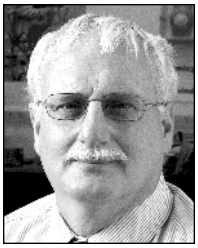
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# ▲ OAME/NCTM June 2004 Report

FRANCES SCHATZ

AFTER JUNE 2004: JOHN KERSLEY



Welcome John Kersley, OAME's new NCTM Representative

I am pleased to introduce John Kersley who will continue to serve Ontario's mathematics teachers as he has done faithfully on the Board of Directors for OAME.

In 1990 I met John when he was a member of the hospitality committee for the joint OAME-NCTM regional conference in Hamilton. His passion for mathematics and his desire that everyone enjoy this conference were truly inspirational to me. When I was named editor of the *Abacus* and later NCTM representative in 1996, John's supportive and enthusiastic leadership through the publications, futures and promotions committees encouraged and motivated me in both of my roles. He continues to review OAME and NCTM publications materials.

John has taught all mathematics courses from grade 8 to OAC. During his thirty-two years at Hillfield-Strathallan College in Hamilton he has noted a few curriculum changes and shifts in school structure. He has many wonderful stories to tell from his passion for teaching. For several years he treated OAME board members to neat packages of motivating and humorous 'classroom ready' pages. Those pages do much to cheer me on. John retires from teaching formally this June and I know he will be a very keen representative in this new work.

## New Publications for Elementary

- *Exploring Mathematics through Literature: Articles and Lessons for Prekindergarten through Grade 8.* #12581 The focus of this collection of articles and lessons is to provide classroom examples of how to use children's literature to effectively teach mathematics in prekindergarten through eighth grade.
- *New Visions for Linking Literature and Mathematics* #12777 This book offers K-6 teachers a wealth of ideas for integrating literature and mathematics.
- *Showcasing Mathematics for the Young Child: Activities for Three-, Four-, and Five-Year-Olds* #12662 Written for all teachers of young children, the purpose of this book is to illustrate activities that promote early mathematics development for children ages three to five and to "showcase" mathematics for the young child. "Listen to children think."

## Navigations Series for Teaching and Learning

This exciting series translates NCTM's *Principles and Standards for School Mathematics* into action. Supplemental CD-ROMs feature interactive electronic activities, master copies of handouts and additional readings. Ask your Ontario representative for Canadian prices for any of the Algebra, Geometry, Data Analysis and Probability and Measurement for PreK-2, 3-5, 6-8, or 9-12.

## Membership Information and Benefits

Too much work...too little time..., then NCTM's members only can help. To access everything on the NCTM web site, one needs to have at least an individual membership. Membership dues support the development, coordination and delivery of NCTM services. For Canadian dollar rates, please email your Ontario rep for a current individual application form. Online with credit/debit card means you pay full exchange rate. In Canadian dollars a one year, one journal membership costs $117.50 including postage and must be paid by Canadian dollar cheque.

## Special Order to Please You

In the March *Gazette* I mentioned a great deal on 'I Love Math' Postcals–a postcard with heart stickers that all say 'I Love Math'. I apologize that the special price stash was almost sold out before most of you received the *Gazette*. NCTM just announced (I am writing this on March 12th) that 'I Love Math' postcals are back and I have ordered more of them. The new price is $1.00 US and CAD price will depend on exchange rate when my order comes.

## New Regional Service Rep

Word just in that Marg Warren is the new Regional

Service Representative for NCTM's Canada Eastern (including Ontario) region. David Decoste, the previous RSC is now n the Board of NCTM. It has been a very long time since Ontario has had a RSC rep. Congratulations, Marg.

## Happy-Sad Time for Me

For the past eight years I've had the privilege and pleasure of being your NCTM representative. This is a happy decision for me because I have new ventures I want to try in education and I'm sure it is time for someone else to bring fresh ideas and new energy to this position. It is a sad decision for my husband Frank and me because we will miss seeing our friends and colleagues in mathematics at the board meetings and conferences from behind the NCTM display.

The professional development that has occurred in my career as a result of this work is immeasurable. Thank you to all who have made these eight years challenging, interesting, and above all a rewarding experience.

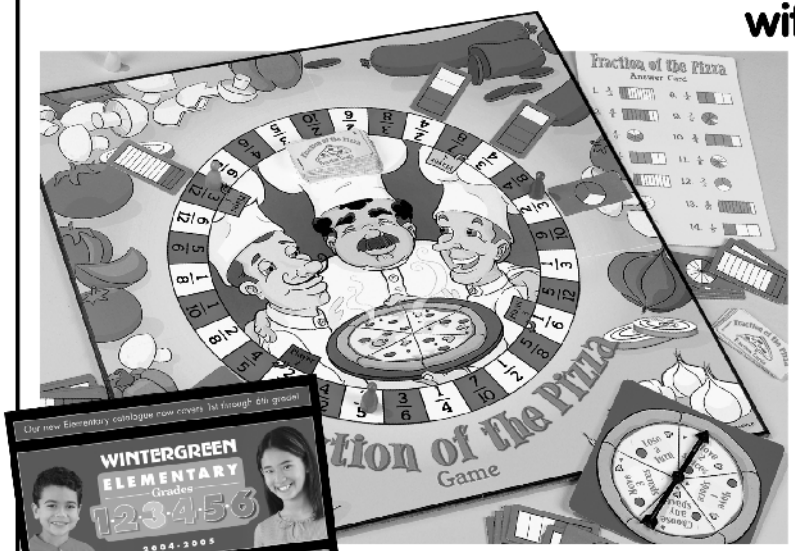
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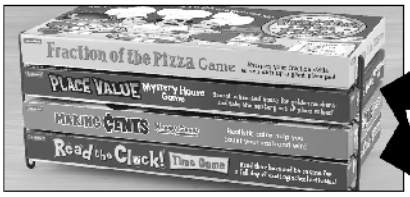
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# CALL FOR MANUSCRIPTS

The NCTM's *Mathematics Teacher* journal has a call for manuscripts for the November 2006 Focus Issue, "Making Mathematics Meaningful". The issue will be co-edited by editorial panel member, Louis Lim. Please see http://my.nctm.org/eresources/mt/calls_mt.asp for further information or e-mail Louis at Louis_Lim@edu.yorku.ca. Articles from classroom teachers are particularly sought.


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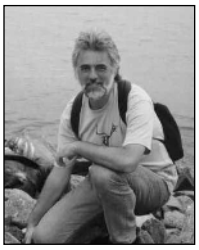
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# ▲ The Double Cohort: Preliminary Research on the Transition from Secondary to University Level Mathematics

**ANN KAJANDER**
**MIROSLAV LOVRIC**



*Ann teaches mathematics at the high school level as well as teaching mathematics to education students at Lakehead University. She also is interested in elementary enrichment and has designed and runs the Kindermath Project in Thunder Bay. Activities from this project are featured in her book 'Big Ideas for Small Mathematicians'.*



*Miroslav Lovric is an associate professor in the Department of Mathematics and Statistics at McMaster University. His areas of research interest include Riemannian geometry and mathematics education. He has worked on a number of projects in education, from studying secondary to tertiary transition in mathematics and effectiveness of use of undergraduate teaching assistants, to promotion of mathematics in contexts of art and architecture.*

## Abstract

This discussion forms part of a larger research project on issues related to students' transition from secondary to tertiary level mathematics courses. In particular we look at initial data related to mathematical preparation of incoming first year students taking a university level calculus course, and compare the performance on this survey of students from both the 4 year and 5 year high school curricula in Ontario. As well, final success rates of the two cohorts in the calculus course are discussed.

## Background

In 2001, the authors started surveying incoming first-year university students on a yearly basis, collecting information on their background mathematics knowledge and skills, as well as their high school experience and expectations of university mathematics courses. This has mainly taken place at McMaster University, but in 2003-2004 students from Lakehead University were surveyed as well. Based on our previous experience teaching first-year calculus at McMaster, and learning from the surveys, we have been publishing yearly updates of a Mathematics Review Manual which is sent free of charge to all incoming McMaster mathematics students during the summer.

The major new factor contributing to the need for a good understanding of the mathematics transition in Ontario lies in the massive reform of secondary education: not only did the secondary curriculum change from a five-year to a four-year program but significant changes took place in the curriculum itself (Ministry of Education, 2000). Much of the initial research on mathematics reform has been at the elementary level, but as students continue to progress through new curricula, further research is needed to connect this early work with subsequent outcomes. The change in the secondary curriculum resulted in universities experiencing the so-called 'double cohort' (two years of high school students entering university at the same time). The university year 2003-2004 in Ontario contains students from both the old and new Ontario curricula. Studying the differences in skills of the two cohorts, in Ontario, is inseparable from studying transition issues.

## Purpose

We see the purpose of this research as multi-fold. University faculty need to be aware of the level of mathematical understanding to be expected of their incoming students, particularly as these students' mathematical backgrounds are changing. Changes to university mathematics curricula need to reflect the changes in the secondary curriculum, and university faculty need to take the opportunity to learn from the experiences of their secondary level colleagues. Conversely, many secondary teachers are feeling the pressure of a 'packed' new curriculum, and are making

decisions about what topics to emphasize most. These decisions might be better informed if we knew the priorities at the post-secondary level. The research under discussion begins to address some of these issues.

## Background Survey

The Mathematics Background Questionnaire (henceforth referred to as 'the survey'), has been given to a sample of between 300 and 400 students since 2001 (depending on the year when it is administered) who take the first year calculus course at McMaster University, and to about 80 students who took the mathematics education course at Lakehead University in 2003 - 2004. Samples of the survey can be found at *http://www.math.mcmaster.ca/lovric/survey/survey/html* Student performance in the latter course is not yet correlated to the initial survey results as that course is a full year course and had not ended at the time of writing this report. The survey was previously field tested with high school students to ensure the terminology and the questions were appropriate.

The survey was designed to help us better understand the specific features of mathematics preparation of our incoming students. It has two parts, roughly described as 'narrative' and 'mathematical'. The survey is administered very early in students' university 'life', usually during their first week of university classes. While arguments could be made to give the survey a bit later, the idea of it is to help us get an idea of the preparation of students before the courses begin.

Besides inquiring about basic demographic data, the 'narrative' part of the survey asks students to describe their experiences with high school mathematics and their expectations about the university mathematics courses. The 'mathematics' part aims to identify students' strengths and weaknesses in the following areas:

- basic technical and computational skills (fractions, equations)
- basic notions for functions (range, composition)
- familiarity with transcendental functions (exponential, logarithm, trigonometric functions)
- written communication of mathematics ideas ('explain' type of questions)
- proficiency in multi-step problems
- drawing and interpreting graphs of functions
- applied problems (computation and interpretation).

Information on students' experiences with mathematics in high school is still being examined for correlations with their success in their first-year mathematics course. It is hoped that having the two perspectives of students from both the old and new curricula in Ontario will give us insight into changing features of students' expectations, and their mathematics knowledge and skills as they undergo the process of transition to university. The information on students' background preparation and experience in mathematics should be very valuable to university faculty, some of whom are not in touch with changes in the incoming student population.

## Survey Results

The fact that in 2003 we surveyed two 'cohorts' of students, crystallized one of our major conclusions: students' performance is correlated to the time they spend doing mathematics in high school. The 5-year cohort students not only spent one extra year in high school, but they also took more mathematics courses during their final year in high school (average of 2.39 courses per student for a 5-year cohort student group, vs. average of 1.81 courses for a 4-year cohort student group). The 5-year cohort students, on average, were (not surprisingly!) one year older than the average 4-year cohort student. This one-year difference is also believed to play a significant role in transition, due to a number of reasons (difficulties in adjustment, maturity, requirements of social life, etc.).

Our survey shows that incoming 4-year cohort university students had more difficulties with questions that required basic techniques and computational skills. For instance, although the 4-year cohort students were slightly better than the 5-year cohort at identifying the formula $\ln(2x) = 2\ln(x)$ as incorrect, they did very poorly on the question that required the use of properties of logarithms to solve the equation $\ln(x) + \ln(x+7) = \ln(4) + \ln(2)$. Only about 11% gave the correct answer, whereas 22.3% of the 5-year cohort students solved the equation correctly. Both results, of course, are distressingly low. Similar performance was observed on the two questions involving quadratics: the 4-year cohort students were better at identifying the intercepts of the function $f(x)=(x+a)(x+b)$, whereas the 5-year cohort students were superior in sketching the graph of $y=(x-1)^2+2$.

It is encouraging to note that even though the grade 12 students had taken significantly fewer math courses in total in high school, there were some areas of the initial survey where they out-performed their OAC peers.

For example, even though the OAC students tended to be better at traditional, computational style questions on the survey, the grade 12's out-performed them on questions to do with interpreting graphs, relating real world situations to graphs, interpreting velocity, and understanding and finding the roots of quadratics.

In summary, the survey data from the calculus students suggests that OAC students were better prepared for technical questions directly related to traditional calculus content, whereas grade 12 students were somewhat better at interpretive or conceptual questions.

The survey also pointed to some general problems with students' understanding in mathematics which need to be addressed. For example, while the education students at Lakehead University were largely able to compute a fractional division question such as $1\frac{7}{8} \div \frac{1}{2}$ correctly, virtually none were able to give an explanation, example or model related to the calculation.

Another problematic example is a very common assumption that incoming university students often make - namely, that all (or most) functions are linear: too many students use ideas such as $\frac{1}{(a+b)} = \frac{1}{a} + \frac{1}{b}$, or $(a+b)^2 = a^2 + b^2$as truths. A true/false question of this nature was included each year on the initial survey. Although a student could very easily convince herself/himself that, for instance, $\frac{1}{(a+b)} = \frac{1}{a} + \frac{1}{b}$ does not work since $\frac{1}{(2+2)}$ is not equal to $\frac{1}{2} + \frac{1}{2}$, they seemed not to be aware of the meaning or how to test the idea with an example, or are simply not able to make appropriate use of the generalization. Evidence of a lack in understanding of fundamental ideas such as the example above was present in both cohorts. While the use of concrete materials such as fraction manipulatives or algebra tiles might give the grade 12 students the advantage in understanding such questions, they were either not remembering how to make use of them, were not transferring the understanding from the concrete to the symbolic, or perhaps had simply not received enough exposure to the materials to help them thoroughly learn the concepts.

## Performance at the University Level

While some changes in content were made to the university calculus course, such as teaching trigonometry from the basics, the course remained fairly traditional in nature. This may not be ideal, but at this point is related to class size. This traditional approach may have been an advantage to the OAC students. In the first year calculus course at McMaster, in which roughly 300 students participated in the survey, the OAC group did perform better in their final course average by about 5%. Further research is needed to see how these students fare in other courses such as algebra or applied mathematics. Data from education students at Lakehead University is not yet available as that course runs for a full year.

## Implications

We realized that at McMaster, even though the Review Manual was provided, we could only go some distance to help students with the transition. Students need to realize that it is their responsibility to prepare, as much as possible, for their future as university students. Those that take initiative in the summer before coming to university by taking 'cram' (intense review) courses, or by using various web sites to practice and/or for self-diagnosis, or by actually working through the 'Mathematics Review Manual' do significantly better in our courses. The usual complaint is that students work during summer, and have no time for much else. In our opinion, working one hour per day for 3-4 weeks before classes start (as suggested in the 'Manual') is usually quite sufficient.

We have noticed that most high school students adopt a surface-learning attitude (which, by the way, does not prevent them for obtaining very high marks in high school!). As an example, they could easily have checked that truth of $\frac{1}{(a+b)} = \frac{1}{a} + \frac{1}{b}$ by substituting simple values for a and b. Students themselves admit to this type of superficial learning frequently on the survey. Their comments on their expectations from the calculus course typically included comments such as:

- '… fun but different from high school in that we may have to think more rather than just regurgitate information' [OAC]
- '…I'm expecting to think more and use less formulas' [gr 12]

University courses expect them to change this attitude, e.g., to get involved into the deep-learning activities (Crawford et al. 1998). Deep learning involves thinking, and ability to transfer to new situations. Other

evidence that most of our incoming students are not deep learners lies in the fact that they usually experience a 'fear of new.' This was very evident in their learning of new material. Talking about the difficulties in solving a problem with inverse trigonometric functions[1], students often say that 'they did not do this in high school' and thus they found it scary.

Hyperbolic functions (except for a name), do not contain new material. As a matter of fact, discovering the properties of sinh(x) and cosh(x) is one of the best ways to practice the properties of the exponential function $e^x$. Students, in large part, find the topic quite difficult, lacking the ability to connect to the previously learned material about $e^x$.

Furthermore, it is very difficult, in university, to make up for an inadequate high school experience. High school really matters because it gives students an opportunity to better develop a variety of mathematics-related skills over longer periods of time in small groups (Wood, 2001).

Analyzing the narrative responses to our survey, we found a correlation between students' positive experience in high school and their good performance in university mathematics courses. Here is a sample of students' statements:

- 'Math was never my best subject but I gained confidence in my ability through my high school years.'
- 'I learned a lot in calculus and algebra and geometry through the lectures.'
- 'My experiences were pretty good.'
- 'The work was easy, and it interested me. The math was fun to learn.'
- 'Enjoyed math in high school and found it to be interesting.'

Although some of the students with a positive high school experience did not do so well on the survey (implying that they needed to work to improve their background knowledge), they were able to recover, and obtained good marks in calculus. However, students with a negative high school experience have, as a rule, a hard time in university. One student said in his survey:

- 'In grade 11, I had a teacher […] my mark dropped from 99% to 79% and so did my interest and enthusiasm for math.'

We found out that students with a negative high school experience quite often do not fully recover, and end up with mediocre to low marks in university mathematics courses.

It will take some time before we are able to assess the impact of our efforts at easing the transition for our students. Several major issues–time devoted to doing mathematics, mode of learning (surface vs. deep), and psychological factors (experiences in high school)–make us fully aware of the fact that, without a good collaboration with high school teachers, our efforts will be of very limited success.

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*1 Inverse trigonometric functions are not covered in high schools in Ontario.*

# ▲ Union Gas Awards

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**AND STEWART CRAVEN**
**PAST-PRESIDENT OF OAME**

In early January, directors of each of the seventy-two school boards in Ontario were invited by the Ontario Association for Mathematics Education (OAME) to nominate three employees who have made an outstanding contribution to student learning of mathematics. All three award winners were publicly recognized at the annual OAME conference held at the University of Waterloo on April 30. The awards were presented by Rob Cadieux, Human Resources Manager, Waterloo Area, *Union Gas*. Together with their parent corporation Duke Energy, *Union Gas* has a mandate to focus on building leadership capacity in not for profit organizations, encouraging employee volunteerism, and supporting Mathematics and Science Education. *Union Gas* sponsored these new awards for the last two years and has provided financial support to OAME because of their belief in a strong foundation in Mathematics for Ontario's workforce. Because of their commitment to mathematics education, *Union Gas*, through David Rosenbloom and Paul Shervill, was honoured by OAME with the award for outstanding contribution to OAME/AOEM and Mathematics Education in Ontario at the University of Waterloo as well on April 30.

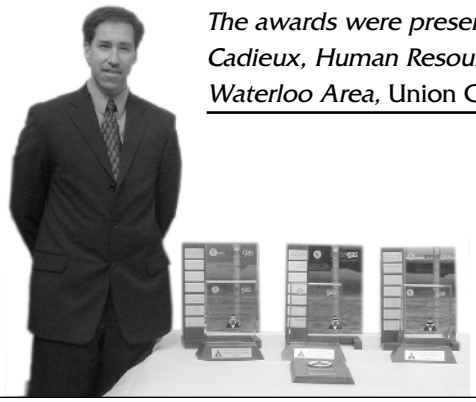
OAME recognizes the critical role that teachers play in creating an atmosphere for learning mathematics. They do this by preparing motivating lessons that often employ manipulatives or technology, by encouraging students to talk with each other to construct their understanding, and by using rich and varied assessments to inform their teaching and improve students' learning. These teachers invariably go the extra "kilometre" to help students individually, to participate in extra-curricular activities, and to communicate with parents. The first two *Union Gas* awards are specifically for an elementary and a secondary teacher. The third *Union Gas* award recognizes a lead teacher, a department head, a resource teacher or teacher-consultant, or an administrator who has a strong commitment to a progressive vision for mathematics education and has played an influential role in motivating mathematics teachers and to facilitating their professional growth.

Special congratulations to the 2004 "Ontario Mathematics Educators of the Year":

- The *Union Gas* Award for Teaching Excellence in Mathematics (elementary), awarded to **Beata Myhill** of the Ottawa-Carleton DSB .
- The *Union Gas* Award for Teaching Excellence in Mathematics (secondary) awarded to **Heather Boychuk** of the Rainbow DSB.
- The *Union Gas* Award for Outstanding Leadership in Mathematics Education awarded to **Dave Lamontagn**e of the Durham Catholic DSB.

Congratulations to the following Ontario educators who were nominated by their boards in 2004. They are all deserving of recognition as outstanding mathematics teachers and/or leaders.

| BOARD | Elementary Nominee | Secondary Nominee | Leadership Nominee |
|---|---|---|---|
| CSDC de l'est ontarien | | | Rodrique St-Jean |
| Durham CDSB | | | Dave Lamontagne |
| Halton CDSB | | Marjorie McArthur | Eugenia Ploszczansky |
| Huron-Perth CDSB | | | Brian Marcy |
| Huron-Superior CDSB | | Anthony Filice | Larry Marsh |
| Kawartha Pine Ridge DSB | | | Laurie Moher |
| Lakehead DSB | Chris Whitehurst | | AJ Keene |
| Ottawa-Carleton CDSB | Cathy Vachon | Pat Kehoe | Tom Steinke |
| Ottawa-Carleton DSB | Beata Myhill | | |
| Peterb. Vic. North. & Clarington CDSB | | | Alison Macaulay |
| Rainbow DSB | Ted Smith | Heather Boychuk | Nancy Burdeniuk |
| Trillium Lakelands DSB | | | Shelley Yearley |
| Windsor-Essex CDSB | | | Frank DiPietro |
| York Region DSB | Ellie Manimanakis | | |



*The awards were presented by Rob Cadieux, Human Resources Manager, Waterloo Area,* Union Gas.

# ▲ Directors' Dialogue



*Jacqueline Hill is a teacher of mathematics at Port Perry High School. Her involvement in the mathematics education community includes Course Profile writing, Workshop Leader, Pine Ridge Math Association President, and writer for Nelson Thomson Learning.*

Win! Win! Win! This is the Winner's Corner!

All you have to do is be one of the first 10 people to e-mail me, and tell me two different ways you are going to implement ideas from the June 2004 issue of the *Gazette/Abacus* into your classroom in the fall.

This edition of *Directors' Dialogue* highlights events at the Friday and Saturday February 6 and 7 2004 OAME Board of Directors' Meeting at the Delta Airport West Hotel in Mississauga ON.

The Friday February 6 2004 Board Meeting was called to order at 6:52 pm. President Stewart Craven welcomed all Board Members. A Forum discussion took place to address a proposal to blend the *Gazette* and *Abacus*. Participants looked at the areas of cover/ideas, types of articles/columns, ideas for uniformity and a range of other suggestions.

## Other Highlights include:

**CHAPTER REPS MEETING:** Featured was the work on the web pages done by the Chapters in the afternoon sessions. All Chapters have OMO co-ordinators in place for the upcoming 2004 competition being held by the Pine Ridge Chapter at the University of Ontario Institute of Technology (formerly Durham College).

**FUTURES:** Brian Raaflaub reported that OMO is being hosted in June 2004 by Pine Ridge (contact person Jacqueline Hill) and in 2005 by NOMA (contact person Heather Boychuk).

**AWARDS:** Judy Dussiaume reminded members that any nomination sits on the table for three years and can be formally updated to add more to the testimonial of the candidate. She also mentioned the ongoing work of the Awards committee to refine and clarify the criteria for each award.

**SHARING:** Thames Valley DSB initiative: "Look Fors": Joyce Tonner reported that Thames Valley DSB has been working on a quality learning document for primary math for 3 years. She showed some digital videos outlining what is available.


Ontario Association for Mathematics Education

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**NOTE:** a great deal of time was spent in Working Groups putting the final touches on the Vision Project.

## Chapter Reports:

**CHAMP – Rep: Fred Fernyhough** Fred mentioned their Oct 2003 "Manipulative Madness" was a great success, and that they are looking forward to sharing final assessment within their chapter. He also noted that TI speakers are looking for opportunities to speak (free). CHAMP is sponsoring the second Ontario Texas Instruments Regional conference in Brampton on August 30, 31 2004 Check the web site for more information.

**COMA – Rep: Peter Lenczewski** More than 120 people attended the COMA mini conference held at the University of Ottawa in November 2003. There was something for everyone, focussing on assessment and curriculum. COMA hosted a forum Jan 19 2004, featuring Tom Steinke. Topic was "Tinkerplots and Census at School". COMA is holding their regional OMO competition May 8 2004.

**GOLDEN – Rep Ed Haines** Golden is hosting a dinner, speaker and workshop in early April 2004. See their web site for more information

**GVMA – Rep: Paul Fennell** Paul reported that all is running smoothly for the hosting of OAME 2004. They had a large turn out (305) for their mini-conference in October 2003. GVMA's new publication, *Evaluation Instruments for MBF 3C* is now available; cost $10.00

**ISOMA – Rep: Brian Raaflaub** Hillfield Strathallan College hosted an excellent conference January 2004. Volunteers are being sought for ISOMA executive. Some have already come forward. Contact Brian if interested. Math Olympiad is being hosted in April by St. Andrew's College. Brian announces that he and his family will be re-locating to Alberta in July. He thanks everyone for his OAME experience and wishes everyone well "until the next time our paths cross in some tangential line".

**MAC$^2$ – Rep: Greg Clarke** Their mini-conference is set for April 22. They are colour coding their materials by Divisions and are giving initiatives if a school sends more than one rep.

**NOMA – Rep: Pauline Therrien** NOMA held a successful Fall Conference Oct 17 and 18 with 317 participants. Tom Steinke was Keynote speaker. NOMA is working with Sudbury's new concurrent Laurentian University Faculty of Education to promote NOMA and OAME. Regional OMO events will be held May 15 2004.

**NWOAME – Rep: Ann Kajander** NWOAME is preparing for their NWO Mathfest 2004, to be held Feb 26, 27 in Thunder Bay. Stewart Craven is Keynote, and there are workshops for all k - 12. Over 230 people are registered. A regional OMO event is planned for April 24 2004. NWOAME will send one team to OMO 2004 .

NWOAME will be electing a new Chapter Rep for the June 2004 Board Meeting.

**PRMA – Rep: Jacqueline Hill** With the new boundaries given to the Pine Ridge Chapter they are hosting a mini-conference a little more North than usual. March 25 2004 a mini-conference is being held in Lindsay: "Know No Bounds – Expanding our Mathematical Perimeters".

**QSLMA – Rep: Robert Sherk** They had a good turn out (100) for their Nov 13 2003 mini-conference, including many participants from Queens University. Future plans include a web site and OMO participation.

**SAME – Rep: Sumintra Koowar** SAME is planning a Spring Conference for May 4 2004.

**SWOAME – Rep: David Petro** They are working towards a TIPS inservice in the spring. SWOAME will send 2 or 3 teams to OMO 2004.

**TEAMS – Rep: Pat Margerm** TEAMS is currently working on OAME 2005. Title: NEXUS reflects the theme of interconnectedness. TEAMS' annual mini conference was held February 12 2004. Tom Steinke was guest speaker. They are also working with SAME on a regional OMO scheduled for April 3 2004.

**WOMA – Rep: John Ferguson** WOMA held a 2-part workshop in Nov and Dec 2003 titled "Dinner and a Minipulative:": About 200 teachers participated. The next event is April 1 2004; "Fool Proof" at Fanshawe College with Dave Mitchell.

**Y$^4$MA – Rep: Rosey Mastrofrancesco** Y4MA held a successful Fall 2003 mini-conference. They continue to update their web site and to offer prizes to new/renewing members. Y4MA will send teams to OMO 2004.

## Closing Remarks

You can look forward to some ideas on how to use your *Gazette/Abacus* in the classroom from our Chapter Reps and Board Members, in future issues.

Yours in Mathematical fun,

Jacqueline ▲

# ▲ 2004-2005 OAME Board

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