Submission of Articles

The *Ontario Mathematics Gazette (OMG)* is looking for articles, news and "good ideas" useful to mathematics teachers or mathematics teacher education. We are seeking submissions from mathematics teachers K-12 and tertiary, that describe teaching mathematics content in an innovative way.

The criteria for manuscript submission to the *OMG* includes the following:

- The ideas/activities are of interest to the readership
- The article/ideas are not widely known or practised and are innovative.
- The mathematics content is appropriate for the readership.
- The mathematics content is accurate.
- The article is well written and grammatically correct.
- The article/ideas are free of sexual, ethnic, racial and other bias.
- The article has not been published previously, nor is out for review by other publications.

Articles must be original. Your article must be word processed, preferably using *MS WORD*, double spaced on one side with wide margins, not exceeding 10 numbered pages of text and prepared according to the *Publication Manual of the American Psychological Association Fifth Edition*. Diagrams and figures should be drawn by computer if possible or neatly drawn in black ink in camera-ready form. Embedded images should also be submitted separately in jpeg or tif format. Proof of the photographers' permission is required. For photos of students, parent or guardian permission is required.

You must submit **4 hard copies** of your article to the Editor **Marilyn Hurrell** whose address appears on page 2. Your name may not appear anywhere in your article, including websites. Your name and full mailing address and e-mail address must be included on a separate sheet. Your article will be sent out for blind review. If it is accepted as is, or with major/minor revisions or rejected, you will be notified. Once an article is accepted for publication, computer files of text, original graphics and photos will be required. E-mail submissions are welcome but must be followed by hard copies.

The Editor reserves the right to edit manuscripts before they are published. Once an article is published it becomes the property of OAME.

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

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

Advertising Rates

Advertising Rates are available by telephoning, e-mailing, or writing to the Advertising Manager.

▲ Editor's Message

MARILYN HURRELL, EDITOR



At a recent NWOAME dinner meeting, which included guests Anne Yeager and Anthony Azzopardi, we got into a discussion of how we each became involved with technology, especially computers and calculators. The age range of the group was about 35 years, with some fairly new teachers and some close to retirement. One person recalled his parents buying him a *Lil' Professor* when he was a child. A few others recalled as students, marking punch cards and submitting them for printouts in some mysterious way. Being the only superannuated one in the group, I recalled carrying stacks of those cards for delivery and the heartbreak of dropping them! One Christmas we tried to recycle these by bending one corner of each card and overlapping these around a coat hanger that had been shaped into a circle. We sprayed these with gold paint, added a few pine cones and sold them as wreaths.

The purpose of this meeting was to plan the next professional development opportunity for teachers in NWOAME's region. As I looked at this group of diverse-aged people, I realized how fortunate NWOAME and every other chapter of OAME is to have a mixture of seasoned members along with young and enthusiastic new teachers.

This leads me to the following anecdote: last week I had the pleasure of tutoring a young man who is in grade six. He came to my table with a copy of *Book Two, Lord of the Rings*, under his arm. I looked at him and said disbelievingly, had he really read this? He said yes. I asked him how he could keep all the characters, locations and events straight. He said his teacher, Ms X (whom I know is at the start of her career) had shown him how to draw up a chart and graph to organize the information, so now it was easy for him to keep track of it all And then he added how much he liked the Brain Teasers she gave at the end of every class. Try these:

By adding one line in each equation, make each of these true statements:

$5 + 5 + 5 = 500$

$10\ 10\ 10 = 950.$

I gave up after 20 minutes; you have the whole summer ahead to figure out he solutions. (And $\neq$ is trivial!) Answers in the Sept 2005 *Gazette*.

Enjoy this issue of *OMG* and enjoy your summer break.

Marilyn

▲ Letter to the Editor

Dear Editor

I read with interest the article by Judith Koeller in the March 2005 *Gazette* 'Math Swap – An Online Library of Resources for Teachers of Mathematics'. It is a wonderful idea and opportunity for teachers to be able to share resources with each other.

Thank-you for providing a place to accomplish this and I am confident that these will be excellent resources that can be put to use in classrooms across Ontario and even Canada.

One thing that caught my eye was a reference to TI-80 programs. I wonder if that is a typo, as I believe virtually all teachers would be using either a *TI-83 Plus* or *TI-84 Plus* graphing calculator in their classes and with students. Indeed there are many programs and applications available for these calculators. A quick search on *Google* will turn up numerous public and commercial programs and applications, such is their prevalence among educators, especially in Ontario.

I look forward to the growth of this online library of resources, including the *TI-83 Plus* and *TI-84 Plus* graphing calculators.

Thanks!

Kevin K. Spry
Teachers Teaching with Technology
Professional Development Content Manager,
Canada, Texas Instruments

PS I forgot to add, that the *TI-80* is no longer in production. It was primarily used for senior elementary. Those looking for a replacement model would be advised to investigate the *TI-73 Explorer*. The *TI-83/84 Plus* has been used in secondary school classrooms in Ontario since 1999. ▲

OAME MEMBERSHIP FEES WILL BE, EFFECTIVE SEPTEMBER 1/2005

In Canada	**1 year**	$45.00
	5 years	$205.00
Student	**per year**	$25.00
Retirees	**per year**	$30.00
Outside Canada	**1 year**	$65.00
	5 years	$300.00

▲ President's Message

KATHY KUBOTA-ZARIVNIJ



Kathy Kubota-Zarivnij is currently program coordinator of mathematics for TCDSB, senior elementary mathematics textbook author, mathematics AQ course instructor, and doctoral candidate. She has been an OAME director for 5 years and served on the OAME Executive for 3 years. She has a variety of mathematics education experience, such as: elementary school administration; in-service and pre-service mathematics teaching, and mathematics curriculum and program consultation, writing, and/or workshop presentations for different organizations, such as CCC, EQAO, MoE, NCTM, OAME, OCC, and TLP.

Greetings! And A Special Welcome To New OAME Members!

Let me introduce myself. I have been an OAME Director for 5 years and served on the OAME Executive for 3 years. My other mathematics education experiences include: elementary school administration; in-service and pre-service mathematics teaching; mathematics curriculum and program consultation; writing and/or workshop presentations for different organizations within and outside of Ontario. Currently, my activities in mathematics education include program coordinator of mathematics for TCDSB, senior author for an elementary mathematics textbook program, AQ mathematics course instructor, and doctoral studies in mathematics professional development.

However, it is through my school board and doctoral work, that I have become fascinated with the ways that complexity science notions offer an alternative perspective about mathematics teaching and learning, in terms of its dynamic and interdependent relationship. Other OAME members, like our past two OAME presidents, Stewart Craven and Gord Cooke, have been dabbling in these ideas as well. In February 2005, Gord organized the OAME Leadership conference, *Emergence: Independent Educators Collectively Bring Into Focus A New*



Vision Of Mathematics Education. In May 2005, Stewart co-chaired the OAME provincial conference, titled *Nexus*, signifying the interdependence and interconnectedness of math teaching and learning within a community.



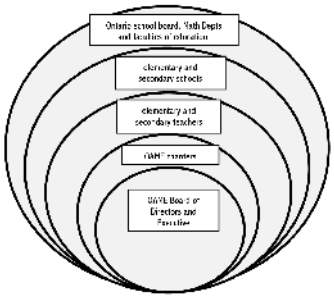
Over the last few years, I've been reading books and articles about complexity science such as *Understanding Learning Systems: Mathematics Teaching and Complexity Science. Journal for Research in Mathematics Education, 34*(2), 137-167 by Brent Davis and Elaine Simmt (2003), *Hidden Connections* by Fritjof Capra (2003), and *Emergence: The Connected Lives of Ants, Brains, Cities, and Software* by Steven Johnson (2001). From such readings, I've come to appreciate that any learning organization like OAME can be described in terms of these ideas:

- learning organizations are adaptive and self organizing learning systems.
- learning is ongoing, recursively elaborative, adaptations through which systems maintain their coherences within their dynamic environments.
- learners can spontaneously cohere into functional collectives, under particular conditions; that is, they can come together in unities that have potentialities that are not represented by the individual learners themselves.

So, using this complexity science framework, I'd like to tell you about the OAME community, in terms of its members, dynamics, and collective activities.

Who Is Part Of The OAME Learning Community?

Our OAME community includes members from all parts of Ontario, from public school boards, private schools, math departments, and faculties of education.



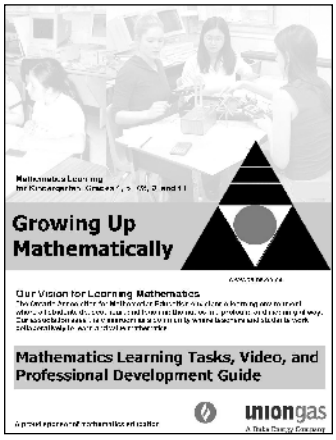
Think about OAME members as being located within a collection of nested learning systems. From a complexity science perspective, such nested learning systems makes possible the complicated processes of individual, mathematics sense making of OAME members and collective, mathematics knowledge generation and inquiry as an OAME learning community.

What Are The Dynamics Of Our OAME Learning Community?

Because complexity science understands learning to occur simultaneously across several layers of organization, we can understand OAME community's work as a result of collective practices.

Davis & Simmt (2003) explained that emergent events, such as collective knowledge and practices cannot be caused, but only occasioned. OAME's collective knowledge includes our knowing of mathematics content K to 12, and our collective practices includes our advocacy for effective mathematics pedagogical strategies. They identified five interdependent conditions for the activity of such collective work and learning: internal diversity; redundancy; decentralized control; organized randomness, and neighbouring actions.

Internal Diversity



Davis & Simmt (2003) explained that all complex collectives have abundant diversity. Diversity is the source of a system's flexible response—its intelligence. As an expression OAME's diversity and creative possibility, OAME's Vision project, *Growing Up Mathematically* was conceived. In developing this resource document, OAME board and executive members, representing all grade divisions: primary, junior, intermediate, senior contributed to the creation of the grade-specific, classroom tasks, images of mathematics learning from K to 11, and a professional development guide. The diversity of contributions from the OAME collective exceeded those of any individual OAME member.

Redundancy

OAME's capacity to maintain coherence is related to the redundancy expressed among its members. Sameness in beliefs and goals of the membership contribute to OAME's robustness as a learning system. OAME's redundancy is rooted in its constitution that outlines its mission statement and goals. Most recently, OAME's vision statement and project, *Growing Up Mathematically* was conceived. Here is OAME's vision statement:

"The Ontario Association for Mathematics Education envisions a learning environment where all students do, see, hear, and touch mathematics in a profound and meaningful way. Our association sees the classroom as a community where teachers and students work collaboratively to learn and value mathematics.

In such a classroom, students engage in meaningful mathematical experiences through the use of concrete materials and manipulatives, visuals, technology, and other resources. Students build on their prior knowledge of key mathematical concepts and connect these concepts to their world. They understand the purpose of their learning through clearly defined expectations, goals, and assessment criteria. Students engage in inquiry, pose questions, and actively discuss their understandings with one another. Students demonstrate their understanding on a regular basis and strive to become independent and collaborative mathematics problem solvers.

Teachers use a variety of strategies that accommodate different learning styles and use resources to develop the investigative process in mathematics. They provide multiple opportunities for students to learn and apply mathematics in creative, purposeful ways while assisting and supporting students to help them achieve success in both independent and collaborative tasks. To facilitate student learning, teachers provide feedback to students throughout the learning process. Teachers engage in opportunities for professional growth and continuously reflect on their teaching practices and classroom experience.

The learning of mathematics is supported through the active and ongoing involvement of students, parents, educators, and the community at large.

The learning of mathematics should be based upon the following beliefs and principles:

a) Learning is structured around the key concepts of mathematics.

b) Learners build on prior knowledge and understanding, and work at a developmentally appropriate level to construct new personal meaning.

c) Learners are better able to transfer and to use knowledge meaningfully when new ideas are presented within rich and meaningful learning contexts, and when learners make connections both within and outside of school.

d) The learning process is enhanced when new ideas are presented in a variety of ways and when all learners have access to "hands-on" and "minds-on" activities and opportunities. This includes the use of manipulatives, computers, calculators, and hand-held data-collection devices.

e) Learning is enhanced when students experience a variety of instructional approaches, ranging from direct instruction to inquiry-based learning.

f) Learners require opportunities to interact with each other during the learning process, to teach others, and to explain and justify the processes of mathematics. Learning is enhanced when the learners are encouraged to communicate their understanding.

g) Effective mathematics education requires strategies that engage and motivate learners that help students develop positive attitudes about themselves and about mathematics, and that encourage learners to make positive contributions to the learning environment.

h) Learning is enhanced when students and teachers understand learning expectations and assessment standards and participate actively in assessing and evaluating their personal growth.

i) Learning is enhanced when teaching, coaching, assisting, supporting, and feedback is planned and designed to improve specific learning and mental processing skills and to accommodate different learning styles and needs.

j) Learning is enhanced when teachers plan and reflect together.

k) Learning is enhanced when all participants in the process are active partners within a community of learners (e.g., parents, educators, students, and the community)."

Decentralized Control

OAME, as a complex system, has no centralized controller. The OAME executive, 3 vice presidents and 3 presidents (incoming, elected, outgoing), and executive directors develop meeting tasks and agenda that occasion member interaction, idea development, and

discussion for chapter reps and elected board members. As a result of ongoing OAME board and executive meetings and working group meetings outside of the board meetings, the OAME vision project, *Growing Up Mathematically*, was created. This complex product was a matter of collective authoring rather than external authorizing. Though the set of tasks, video, and PD guide were anticipated, the actual content of the final product was not predetermined.

Organized Randomness

All complex systems contain structures to organize the random (or seemingly random) products of the agents. Such enabling constraints in the OAME collective include the board and executive meetings, OAME chapter meetings, OAME participation in province-wide initiatives, such as Ministry of Education curriculum writing, curriculum training sessions, province-wide conferences of newly released Expert Panel reports. Participating in the OAME mathematics community is enabled through variable entry and open-routed experiences. Every OAME member can participate in some aspect of the mathematics community, in accordance with her/his experience and interest.

Neighbouring Actions

In a complex learning system, the agents of the system need to "bump up" against one another (Davis & Simmt, 2003). In a knowledge-producing system, like OAME, the "agents" aren't people, but ideas. There are numerous ways that ideas can be bumped against one another and blended to give rise to more complex understandings about the work of the student and teacher in mathematics education. Below are some examples:

- OAME *Gazette* and *Abacus* (journal published four times a year, by our dedicated editors, Marilyn Hurrell and Trevor Brown)
- OAME *Gazette* reviewers
- OAME website (constantly updated by our amazing webmaster, Greg Clarke)
- OAME's newly released vision project, *Growing Up Mathematically* – an OAME collective endeavour
- OAME chapter conferences and membership drives from September 2005 to June 2006
- OAME Leadership conference in February 2006, focused on the K to 12 learning system
- OAME annual provincial conference in May 2006

How can our mathematics learning community continue to grow?

Through the individual work of the OAME members and the collective practices of the OAME community, I hope that our mathematics learning community will continue to grow in membership, in shared knowledge, and be a collective voice that supports student learning through improved teacher professional development experiences

I look forward to meeting and/or chatting with you throughout the year. In my role as President of OAME, I am honoured to have the opportunity to serve and support you and other mathematics educators across Ontario.

KKZ ▲



Ontario Association for Mathematics Education
PUBLICATIONS

Linking Assessment & Instruction in Mathematics: MIDDLE YEARS (Grades 6-8)

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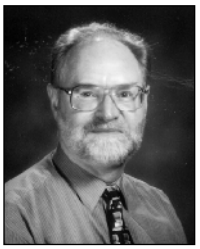
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Do not send cash or cheque. You will be invoiced with shipping and handling costs added.

▲ Technology Corner: Grade 9 Graphing Projects

Fred Ferneyhough



Fred Ferneyhough is a mathematics department head at Harold M. Brathwaite SS in Peel and an author and tech consultant for several books. He is an avid user of and advocate for the use of technology in the mathematics classroom.

Recently we had our grade 9 academic students working on graphing projects where they used sets of coordinates to draw a picture. We started the activity by distributing an existing project to all students showing an example of the type of picture that we were expecting of them. This project used one set of points to draw a picture of Homer Simpson, a character that all kids seem to know, regardless of their various cultural backgrounds. Students were given the opportunity to select their own choice of character or picture to draw with the following guidelines;

Their diagram had to:

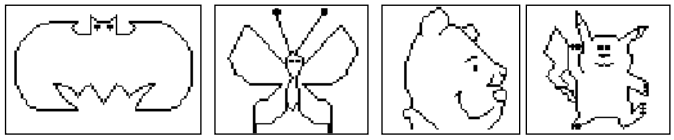
1) Use more than one set of points.
2) Use points in all four quadrants
3) Produce a picture, not something such as their name, initials or a phrase.
4) Use points spaced relatively closely connected to avoid a "boxy" appearance caused by corners made by long line segments.

Students were told that their project would be completed in four distinct stages:

1) Submit a sketch of their character. It could be hand drawn, traced or printed from a computer. This was submitted for approval and feedback.
2) Draw their sketch on graph paper. No points were expected yet.
3) Submit a completed digram on graph paper with their sets of points on a separate sheet of paper. The first sheet was to have their Student ID number rather than their names. We made two photocopies of these sheets and distibuted them to two students in another class.
4) Using these sheets of sets of points, they were to draw the diagrams and assess the work of their peers using a rubric. Each student then had one week to check over the work of two other students. We had hoped that having students draw and check over each others' projects would verify the accuracy of the projects.

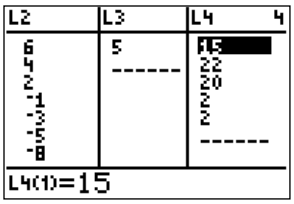
The end result was an unmitigated disaster. While there were many good diagrams, every student made at least one error in the list of their points. In each diagram, an incorrect point might send the drawing off to a different quadrant and then back again. Students checking another student's work gave up since they couldn't make sense of the diagrams. Even worse, students wrote so faintly that the photocopies of sets of coordinates could not be read. In the end, teachers resorted to checking over each diagram themselves, a process that took ten to fifteen minutes per student. Obviously, kids did not check their own work carefully (if at all) and a good idea had turned into a lot of work for teachers. A different approach was needed in order to save the idea.

Quite innocently, somone asked me if this type of project could be done using one of the technologies at our disposal. I was off sick for several weeks and had time to play with the idea. What I found was that the *TI-83 Plus* has a feature that connects two points with a line segment, just what we needed. I then wrote a program that uses data stored in the lists to draw the students' diagrams on the screen of the *TI-83 Plus*. Each student can use the program to connect the dots quickly, thus checking their own work before submitting it. Some of the results are shown below.

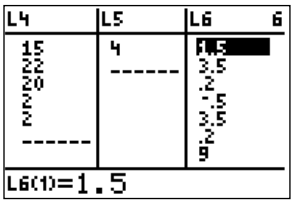


Pikachu was a very popular choice. Just in case you haven't seen enough of him, the sample of the student work is shown here. The variety of characters that students selected was quite interesting.

In order to use the program students have to know how to enter data into lists and edit them later as they find errors. The program determines the window that will properly plot the diagram for students, but they have to provide several pieces of information. List 1 and List 2 hold the x-coorinates and y-coodrinates respectively of the points.



List 3 holds the number of sets of points. List 4 shows the number of points in each of the sets. The screen to the left is taken from the butterfly drawing. This student needed five distinct sets with 15 points in the first set, 22 in the second and so on.

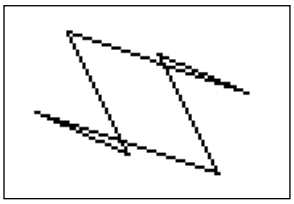


Many students also wanted to add circles to their diagrams in order to draw eyes. To accomodate this request, we introduced the idea that drawng a circle meant that the students would need to provide information about the number of circles and the centre and radius of each circle. We realize that this is not normally done until grade ten but all that we wanted to do was draw circles, not find their equations. List 5 shows the number of circles that the diagram needed. List 6 gives three pieces of information for each circle – the x and y coordinate of the centre and the radius of the circle.

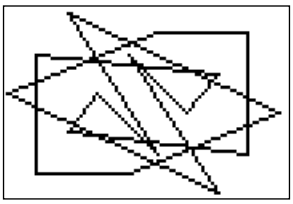
The calculators are only one medium that could be used for this project. Large graph paper is always very popular and *The Geometer's Sketchpad* could be used to add colour. The same is true of the next project.

Using Repeating Decimals to Generate Graphs

For four years, I had the privelege to work with and for Ray Nowak at Bramalea SS. Ray is one of the most creative people I have ever come across. One of the little projects he created used the digits from repeating decimals to generate graphs.



Let's take the example where 3 is divided by 7. In the result, the block of digits 428571 repeats endlessly. In this process, successive digits are used as x and y coordinates. The points from this result would be: (4,2), (2,8), (8,5), (5,7), (7,1) and (1,4). The last point joins the final digit in the repeating block to the first digit. Now, join these by a dot-to-dot process and you get some unusual patterns. The diagram is shown above. Axes are not shown as the diagram is drawn entirely in the first quadrant.



The next drawing comes from points after dividing any numerator by 17. Kids were astounded to find out that the numerator did not make any difference. I was astounded to find out that kids no longer know how to do long division and I had to teach them that skill in order to even begin this project.

Once a student has a good representation of his/her project on the calculator, it can be transferred onto *The Geometer's Sketchpad* and saved as a graphic. These projects allow some of the weaker students to do some creative work that raises interest in mathematics classes. Feel free to email me at dybydx@rogers.com if you would like either of the calculator programs. ▲

OAME AWARD NOMINATION FORM

Now Available on Line!

OAME/AOEM AWARDS NOMINATION PROCESS

Deadlines

Nominations for awards to be presented at the Annual Conference must be received by January 31 of the calendar year in which the conference takes place.

Nominations received after January 31 will be considered for awards to be presented during the next three calendar years. A nomination will be allowed to stand for three consecutive years. After that time, the nomination must be renewed. A standing nomination may be amended at any time by the original nominator. The nominator need only inform the chair of the Awards Committee in writing of the proposed changes to the nomination form.

The OAME/AOEM Nomination Form

Write a letter supporting the nomination of your candidate for the indicated award. Provide specific and detailed information about the nominee's activities as they relate to the following areas of consideration:

- demonstrates of excellence and creativity in mathematics education;
- specific contributions to mathematics education in the school, region, province or nation;
- demonstrates leadership in mathematics education in the school, region, province or nation;
- support of and contribution to the activities of OAME/AOEM;
- contribution to the development of students both within and outside of the classroom.

Please include any additional information that you feel may be relevant to the nomination, but which is not specifically mentioned above.

The Nomination Cover Page

Complete the Nomination Cover Page and attach your letter of recommendation for the nominee.

Incomplete or inaccurate information may result in the nomination to be withheld from consideration.

OAME/AOEM LIFE MEMBERSHIP AWARD

The Life Membership Award is given to recognize a person who has contributed in a significant way to OAME/AOEM; demonstrated outstanding leadership in mathematics education; and has accumulated 10 or more years of membership in OAME/AOEM.

KENNETH D. FRYER AWARD

In Memory of the late Kenneth D. Fryer, OAME/AOEM, in conjunction with the Grand Valley Mathematics Association, established the Kenneth D. Fryer Award. The award is to be given annually to recognize a mathematics department which fosters collegiality, team work, excellence in classroom teaching; contributes to the overall development of students; and demonstrates leadership in the mathematics education community.

AWARD FOR OUTSTANDING CONTRIBUTION TO OAME / AOEM AND MATHEMATICS IN ONTARIO

This is to recognize an individual who has made significant contribution to OAME/AOEM, but who is not necessarily an educator or member of OAME/AOEM.

AWARD FOR EXCEPTIONAL AND CREATIVE TEACHING IN ELEMENTARY MATHEMATICS

The award is presented annually to recognize an exceptional and creative elementary teacher who demonstrates excellence in mathematics education by contributing to the overall development of students.

AWARD FOR EXCEPTIONAL AND CREATIVE TEACHING IN SECONDARY MATHEMATICS

The award is presented annually to recognize an exceptional and creative secondary teacher who demonstrates excellence in mathematics education by contributing to the overall development of students.

AWARD NOMINATION COVER PAGE

INTENDED AWARD (please check one)

❑ Life Membership ❑ Award for Outstanding Contribution to OAME / AOEM and Mathematics Education in Ontario ❑ Award for Exceptional and Creative Teaching in Elementary Mathematics ❑ Award for Exceptional and Creative Teaching in Secondary Mathematics ❑ Kenneth D. Fryer

Nominee's Information:	Nominator's Information:
Name of Nominee (Principal and Department Head for K.D. Fryer Award)	Name of Nominator
School, Organization, or Business Address	School, Organization, or Business Address
Telephone Number ( )	Telephone Number ( )
Fax Number ( )	Fax Number ( )
Home Address	Home Address
Home Phone ( )	Home Phone ( )

SEND TO: Judy Dussiaume, Education Centre, 275 Loach's Rd., Sudbury P3E 2P8 , Business (705) 523-3308 x210, Fax (705) 523-3314, E-mail dussiaj@rainbow.edu.on.ca

www.oame.on.ca/main/files/awards/awardnom.pdf

SAMPLE

▲ Hey It's Elementary: Let's Make this a Relay and Start Passing the Torch

LYNDA COLGAN



Let me begin by saying that I am not ageist. Like any "ism", ageism reflects a prejudice–in this case it would be a stereotypic and often negative perception of older adults. One of the principal reasons that I am not ageist is that I am now of an age at which I often experience ageism–attributable, no doubt, to graying hair, deepening laugh lines and the occasional curmudgeonly outburst.



Your eyesight has gone!



But you look so natural and lifelike?!!??!!!

Image retrieved from: http://www.webster.edu/~woolflm/ageism.html

Let me also begin by saying that I have great respect for my peers and colleagues across North America who work extraordinarily hard in classrooms, board offices and faculties of education to improve the quality of mathematics education experienced by today's students.

I preface this column with these two provisos because what I am about to say could be interpreted as ageist criticism and that is not the intent.

I attended the NCTM Research pre-session, some NCSM sessions and a few NCTM sessions in April at Anaheim. In May, I attended the OAME conference at York University. And over the past year, I have attended a number of other conferences and workshops across the country. I am a regular reader of the OAME *Gazette* and the NCTM publications and often I have the opportunity to read the publications from other provincial or state organizations dedicated to math education.

The common characteristic shared by the presenters and authors (and yes, that includes me!) across the region seemed to be their vintage–like wine, they are well-aged. The other common characteristic among the organizations is the degree of 'recycling' of folks as speakers and through positions of responsibility and on committees. At international, national, provincial and regional conferences and in their companion publications, many of the same names appear year after year after year as presenters, organizers, and leaders in a variety of capacities. This begs the questions: where are the young leaders for mathematics education? And what are we doing pro-actively, as individuals and as a community to recruit, nurture and mentor new mathematics education leaders–in other words, what are we doing to pass the torch?

The future leaders for mathematics education in Ontario are currently in one of three places: in classrooms as students, in classrooms as teachers or at faculties of education as B.Ed. or M.Ed. students.

At one session I attended at NCTM, a professor spoke about the fact that some children, in both elementary and secondary settings, seem to demonstrate intuitively, many of the characteristics of excellent teachers. These students are 'in tune' with the other children in the classroom community, and spontaneously offer support, guidance and encouragement to those who are struggling with task content or expectations. These students seem to engage others when they explain their thinking to the class and have a knack for decomposing problems into manageable sub-tasks to help other children be successful. These students are positive about school and seem to be naturally aware of the power of the impact of a positive tone to the learning community. She suggested that not only should these students be explicitly encouraged to pursue education as a career and be considered for scholarships and other financial incentives to do so (especially in socio-economic communities where many children will not have the opportunity to attend post-secondary education because of financial and social barriers) their voices should be heard. She recommended that they be invited to be co-presenters at teacher workshops or parent meetings because they could bring a new perspective to the use of

manipulatives or the need for conversation in the classroom. They would bring the classroom through 'the eyes of the child' to the fore in tangible ways. By valuing their contributions to homework clubs or classroom interactions and inviting them to speak about their experiences, not only is their self-esteem enhanced, but they are learning, at a very early stage, the value of teaching and how even experienced teachers need to learn from others–including students.

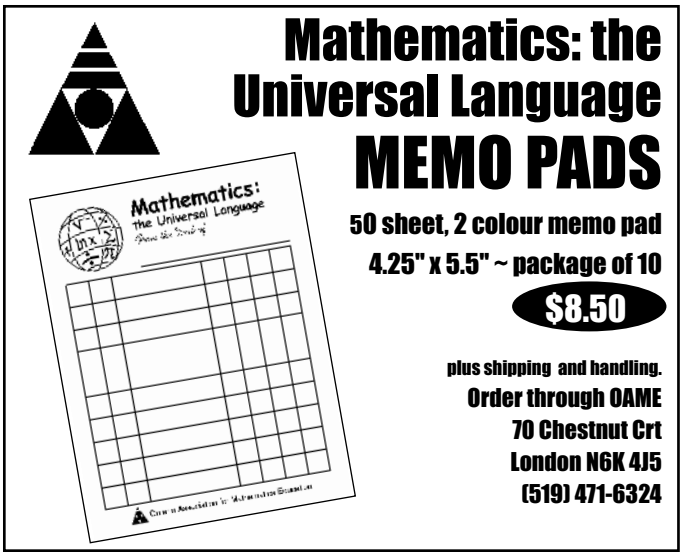
As I listened, I was taken back in time to my days at the Computers in Education department at the Scarborough Board. There, I ran a *Learning Partners* program in which teachers attended workshops on Logo with a student partner from their classroom. My philosophy at the time was that teachers were so busy in the classroom that they could not attend to 30 students and supervise the small group using the one or two computers that would be at the back of the classroom, but that one student, who learned the commands and about the activities could help other students and trouble-shoot if necessary. The fact that children were not intimidated by the technology and were more natural risk-takers also helped the teachers to see the technology in a different light. The program was a rich experience for a large number of teachers and students.

We could do the same at mathematics workshops. By bringing selected children to workshops and doing activities with them or observing small groups of children from different classrooms work together using manipulatives or trying new approaches, teachers would learn what to expect when they implement the ideas in the classroom. They would know how children might interpret or misunderstand instructions. They would have a better sense of how to introduce the task, what questions to ask and how to de-brief. Moreover, they would have an extra pair of eyes and hands in the classroom that had experience with the materials and the approach. And most importantly, these special children would have a remarkable set of experiences on which to look back in order to build their own pedagogical principles when they become educators themselves.

Also at the NCTM conference, I attended several sessions by Deborah Ball. In every session, after a brief introduction, Deborah turned the stage over to classroom teachers or graduate students. They told the story of how they had worked on projects with Deborah and collaboratively made decisions about materials, approaches and lesson design. They explained that Deborah always taught the lesson first, in an elementary classroom or a university lecture room, and they observed her. Later they de-briefed the lesson, revised it and then they taught it themselves. They explained that the conference presentation had been prepared the same way.

There are numerous coordinators, consultants and administrators who know of great things happening in classrooms in their region. We could replicate some of Deborah Ball's approach by encouraging the teachers who work daily to implement the complex initiatives like the Early Math Strategy to have their voices heard. Instead of a coordinator or teacher leader presenting about the initiative, why not have a coordinator and a classroom teacher present together as partners in the process? The collaboration would remove the onus of responsibility from the teacher, who already has huge demands in the classroom, but would add a credibility that far exceeds much of what is seen in current workshops. Rather than saying, "I saw a classroom in which the teacher did x and y," and then leave it to the audience's imagination to visualize the situation, the instructional leader could say, "I saw a classroom in which the teacher did x and y," and then turn to the teacher so that her voice could be heard. This validation and valuing of everyday practice could have an extraordinarily positive impact on the quality of workshops, and would open the door to mentoring new leaders by giving outstanding teachers a gentle introduction to the world of professional development.

We are in a good position in Ontario's faculties of education at this time in that there are a number of institutions which offer additional qualifications (A.Q.) courses in elementary mathematics. The Part III



specialist program at most universitities adopts a leadership position and at least part of the course is devoted to introduce candidates to complex issues such as teacher beliefs and the change process and their role in implementation of standards-based curricula. To this end, candidates produce extraordinary projects that illuminate the value of technological integration, parental involvement or school infrastructure models. In general, these powerpoint presentations, workshops or on-line submissions may be seen only by the course director and a few classmates.

As teachers we know that by expanding the audience–for example, having students write letters to their M.P. or local newspaper editor–the quality of the work is enhanced. Why could we not have the assignments for the A.Q. course at the specialist level to be a presentation at a regional OAME conference? Individuals or teams could work with the instructor (who should already be an experienced presenter and teacher leader) to develop, practice and then present a workshop, with authentic audience feedback considered as part of the grade. This would give focus and purpose to the course assignment, expand the teachers' network and give new leaders a chance to present the product of their hard work and commitment in a supportive venue to a group of interested participants hungry for new ideas.

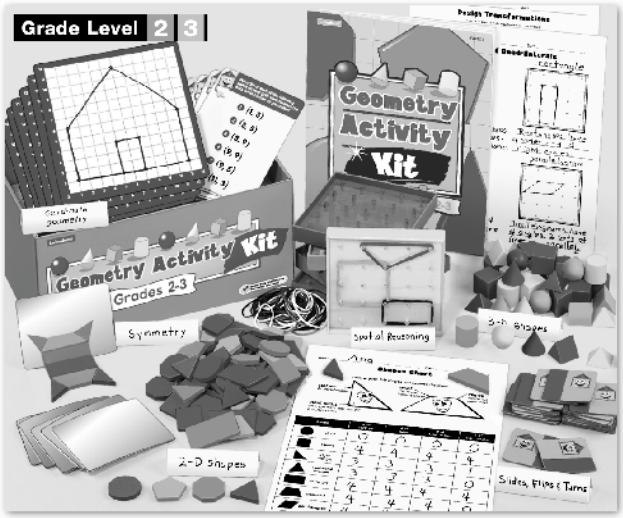
Lastly, many full-time teachers work very hard to juggle the demands of job and family to pursue post-graduate degrees at the M.Ed., Ed.D. and Ph.D. level. Often the results of four to eight years of work sits on a shelf in the form of a bound thesis, read by the student, her family, her supervisor and thesis committee and few others. Perhaps an article was prepared for an academic journal that is likely inaccessible to much of the profession.

If supervisors were to advise the OAME *Gazette* editor of the title and topic of the thesis and provide a brief description of it, interested folks could go to various university websites to access the published thesis, contact the author or take action on the new research questions that were raised by the study. This could be enormously beneficial in bridging the theory-practice chasm and serve to emphasize the outstanding quality of work that is done by our peers, largely for personal reasons.

Author Aung San Suu Kyi said "We will surely get to our destination if we join hands." And what better place to join hands than in passing the torch. ▲

The FUN way to teach Geometry...

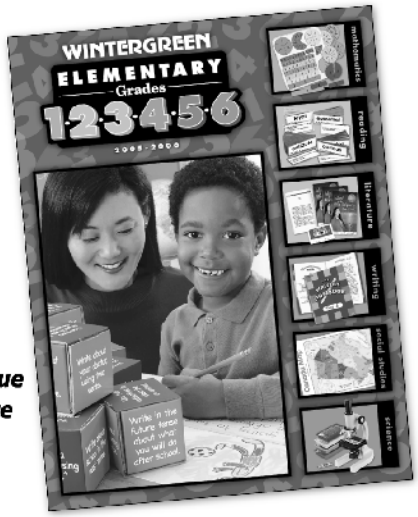
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▲ Friday Special

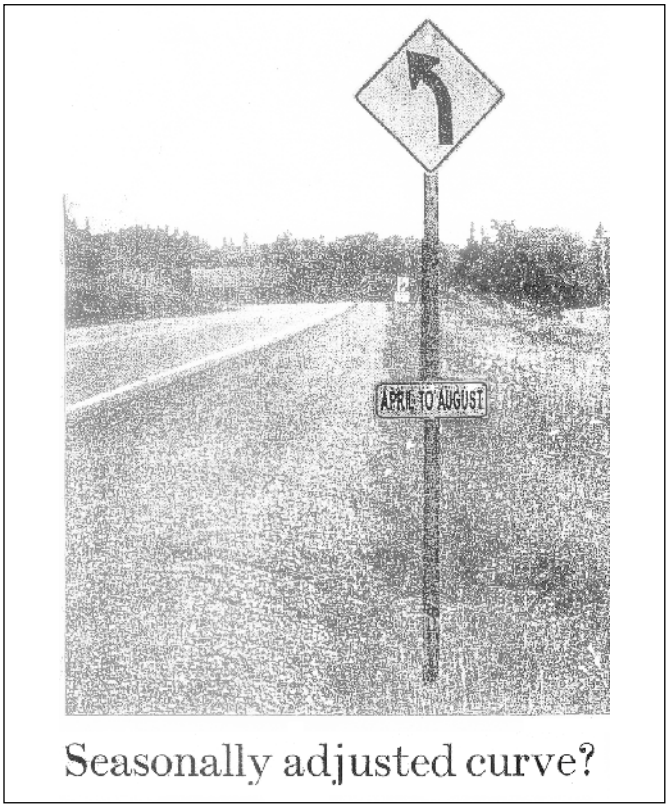
JACK WEINER



Fridays at the University of Guelph, five minutes before the end of class, I say, "Pens down, books closed, it's "Friday Special" time!" Then I show on screen an article or cartoon or letter or…something that has to do with math (well, usually), the "real world"(well, most often), and has absolutely nothing to do with class, assignments, or tests (always!) It is math for fun. Often, it is some flagrant example of how the media abuse math. I hope you use some of these. Make them "Monday Morning" specials or "We need a break!" specials. If one falls flat, blame me. If it works, you take the credit.

Well, I am writing this column on March 31. Spring is in the air, we have had a few days with temps in the teens, and the trails where my canine pal Denver and I run each day are a muddy mess.

Which brings me to this neat "springish" picture printed in the Toronto Star a few years ago.



I guess the road somehow straightens itself out from September to March. Not.

Show this to your class and ask for an explanation.

I suspect that at least one of your students will think outside of the box and realize the solution is not what we see, but what is missing. Some miscreant stole the sign which originally appeared above the "April to August". The purloined piece: "Turtle Crossing"!

This kind of thinking is actually not rare in mathematics. How often do we ask students to prove or find a counter-example to a stated assertion. For example:

If two corresponding sides of two triangles and one angle of each triangle are equal, then the two triangles are congruent.

The assertion is false and it is not hard to find two non-congruent triangles that satisfy the hypothesis. What's missing? If we strengthen the hypothesis to say, *"and the contained angles are equal",* then the assertion is true.

I occasionally ask my students to prove an unprovable result by providing an insufficient hypothesis. It is a neat, albeit somewhat sadistic way of driving home what a "hypothesis" really is.

Best wishes, Jack ▲

Ontario Association for Mathematics Education
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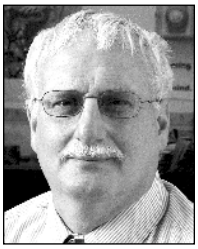
This 168-page document is available at the following rates: $16.00 per copy; Bulk price: $336.00/box (28 copies $12 each). (OAME members $12.00 for first copy, state membership number.) Shipping and handling costs extra.

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▲ OAME/NCTM June 2005 Report



JOHN KERSLEY

NCTM's theme for this year is algebra and is entitled, "Developing Algebraic Thinking: a Journey from Preschool to High School". Go to www.nctm.org/focus for details. Recently Cathy Seeley, NCTM President, discussed the teaching of algebra courses/ high school courses before the start of high school. She questioned whether or not it is worthwhile. On the pro side is the opportunity for students to finish their high school math courses sooner and take AP calculus or AP statistics. On the con side is the findings that students who take these courses early do not end up necessarily studying more mathematics, resulting in many students not taking any mathematics courses for a year or more before going to university. Ms. Seeley raises two points: to ensure students develop skills and thinking to comprise a rich mathematics program in these pre high school grades and to seriously consider what lies ahead for students at the end of their high school career. Her conclusion is that students should take such courses if they are highly motivated, they intend to study mathematics further than the standard four years, and they have been taught the essentials of proportionality. This report is published in a recent issue of the *NCTM News Bulletin*. Is the above something to consider as we, in Ontario, are undergoing a review of our mathematics program?

Mission Mathematics II Series

The *Mission Mathematics* series has been developed by NASA and NCTM to link the science of aeronautics with NCTM's Standards. The original series was first published in 1997. This series is a revision. The publications are: "Prekindergarten-Grade 2", "Grades 3–5", "Grades 6–8" and "Grades 9–12". In all publications, there are a wide range of activities from making models, exploring mathematics ideas associated with aeronautics, collecting data and linking with other mathematical topics to promote understanding of reasoning, patterns, communication and problem solving strategies.

These publications can be reviewed at the NCTM resource website: **www.nctm.org/catalog**. One can also narrow a search by visiting **www.nctm.org/elementary**, **www.nctm.org/middle** and/or **www.nctm.org/high**. Contact me for the best prices and avoid the full exchange rate if ordering online and using credit/debit card payment option.

Membership Information and Benefits www.nctm.org

Membership benefits include information on the NCTM Standards, events, conferences, publications, journal articles, five years of article archives, products for lessons and the classroom, and job postings. In addition there is a members only site, **www.nctm.org/members** which contains further resources. Membership dues contribute to the development of resources and materials, the many various conferences and the delivery of NCTM services. Contact me for a current Canadian individual membership form. The Canadian price is $90 which includes a choice of one journal, plus $22.50 for postage to Canada. Discounts are available for 2 and 3 year memberships. If you apply online with a credit/debit card, you will pay the full exchange rate.

NCTM Conferences www.nctm.org/meetings

Upcoming regional conferences are: Hartford, "Discover the Connections: Instruction and Assessment", October 6-8; Birmingham, "The Role of Assessment: More than Testing!", October 20 – 22; and Denver, "Mathematics at Its Peak" November 10 -12. Great discounts on advance registration rates are available for NCTM members. Next years annual meeting will be held in St. Louis, MO April 26 -29, 2006

Interesting Websites for You to Visit as Suggested by NCTM

- **www.hawaii.edu/crdg** click on "reports and samples", provides educational programs pre school to grade 12
- **www.earthmath.kennesaw.edu** click on "Related Projects" or topics on the left side, offers many and wide variety of free classroom materials and ideas.
- **www2.bc.edu/~caseyb/oview.html** introducing a series of books linking literacy and mathematics, pre-K to grade 2. s

▲ 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, websites of interest to teachers of mathematics will be shared. As the end of a busy school year draws to a close, let's take a look at the more humourous side of mathematics. Math can be funny? Most definitely!

Mathematics Anecdotes - http://www.anecdotage.com/browse.php?term=Mathematics

A wide variety of historical and local stories about mathematicians and mathematics. Did you know that the great mathematician Paul Erdos never had a home of his own? He just travelled from friend to friend, sharing his brilliance in return for lodging and company. His lifelong motto: "Another roof, another proof!"

Parenting: Math Games and Puzzles: K-6 http://childparenting.about.com/cs/mathgamesonline/?terms=math

Lots of links to math games and puzzles for younger children. All sites vetted by parent and teacher groups. Try the link to Count On!

Math Jokes: A Wide Variety of Mathematical Humour http://www.math.utah.edu/~cherk/mathjokes.html

Wacky definitions, puns, folklore, limericks and more….

Sample: "One evening Rene Descartes went to relax at a local tavern. The tender approached and said, 'Ah, good evening Monsieur Descartes! Shall I serve you the usual drink?'. Descartes replied, 'I think not', and promptly vanished."

Some great math cartoon archives

- Simon Singh's Mathematics Cartoons - http://www.simonsingh.com/Mathematics_Cartoons.html
- Carolina's World-class Support for Science and Math http://www.carolina.com/math/cartoons/mcarch.asp
- Charlotte's Math Cartoons - http://www.charlottemathtutor.com/htmlfile/cartoons.html ▲

▲ Photo Math ~ A New Way of Picturing Math

RON LANCASTER
INDEPENDENT MATHEMATICS CONSULTANT



Ron Lancaster is a Lecturer in Mathematics Education at the Ontario Institute for Studies in Education at the University of Toronto. He is also an independent mathematics consultant and works with teachers, students and educational organizations in North America, Asia and Israel.

"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.

Photo Math Contest with Prizes for Students and Teachers!

Entering this contest is easy! Write a mathematics question related to one of the following photos, provide an answer to your question, then submit your work to the author of this column. Copies of the game SET (www.setgame.com) will be awarded to five people selected at random who submit a rich and interesting question. You may enter more than once. The deadline for submissions is June 30, 2005. Good luck!

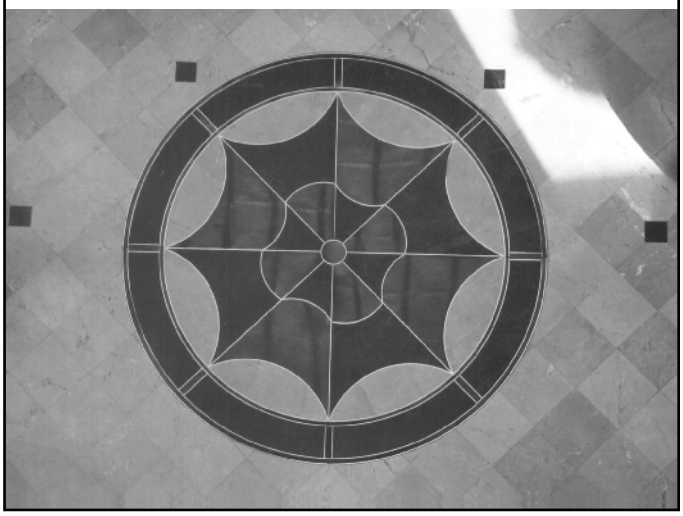
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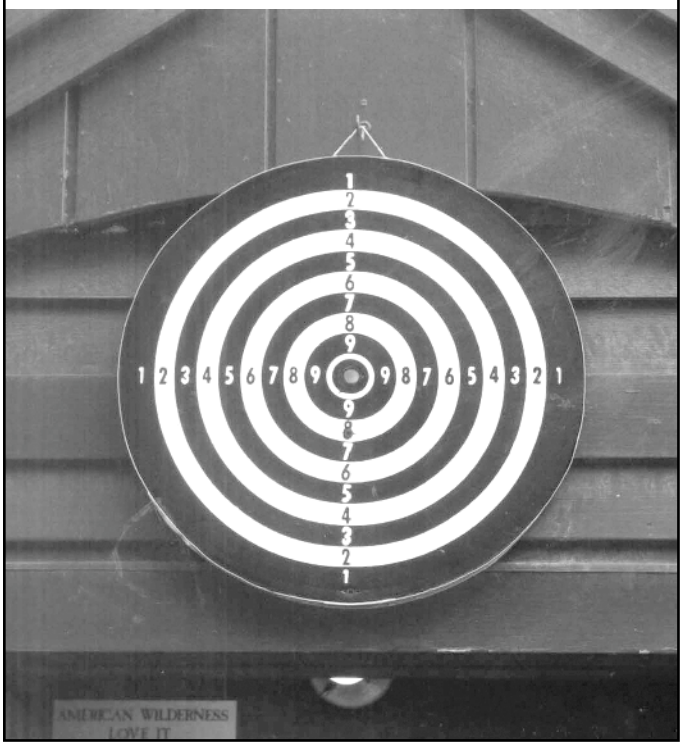
Photograph 1
Metulla, Israel



Photograph 2
Nashville, Tennessee



Photograph 3
Peterborough, New Hampshire



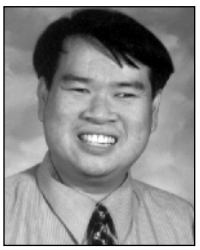
Photograph 4
Yellowknife, Northwest Territories



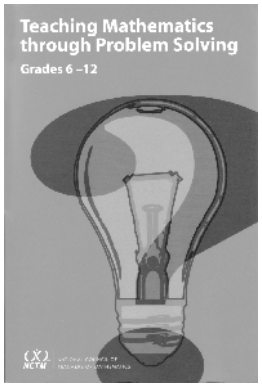
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▲ Book Review: *Teaching Mathematics through Problem Solving: Grades 6-12*

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.



Teaching Mathematics through Problem Solving: Grades 6-12, ©2003, is a 270 page book published by the National Council of Teachers of Mathematics (NCTM). Edited by Harold Schoen and Randall Charles, this volume contains 16 Chapters divided into four sections: Issues and perspectives; Tasks and tools for teaching and learning; In the classroom; and Research. Each Chapter is approximately 12 pages and can be read in any order. Included are stories from classroom teachers who have blended theory and research into practice. The book also contains an extensive bibliography.

With the revised K-12 Ontario mathematics curriculum scheduled for implementation beginning September 2006, this resource is timely for educators to reflect on their practices. With public accountability at the forefront of education, it is important that teachers are aware of why the mathematics education reform advocates a shift from traditional teacher-directed lessons where the aim is acquisition of skills and procedures, to conceptual understanding where students are actively engaged in their learning, with teacher as facilitator. This book focuses on teaching mathematics **through** problem solving, rather than the teaching of problem solving.

In Chapter 16, Mary Kay Stein, Jo Boaler, and Edward Silver provide a synopsis of research that has been conducted with teaching mathematics through problem solving. Of particular concern with using a problems-based approach is whether students' computational skills would be weakened. No significant differences were found from the research conducted by Boaler et al., 2002; Riordan and Noyce, 2001; Schoenfeld, 2002; and Thompson and Senk, 2001. The work of Lane and Silver in 1999 found that "despite historical trends showing that the achievement gap between racial groups tends to grow wider during the middle grades, this outcome did not occur in schools in which teachers used innovative approaches to mathematics instruction. In fact, the achievement gap grew no wider in most schools and was reduced in some" (p. 250). Equity issues were also addressed in Boaler's 1997 work, with no achievement differences to gender and socioeconomic status when mathematics was taught through problem solving.

In Chapter 9, Douglas Grouws describes the important, yet complex, role that teachers play in teaching mathematics through problem solving. Chapters in the book are devoted to assisting teachers in how to select tasks that are problematic with the mathematics embedded, so students will want to be engaged in them; the role of the teacher before, during, and after the task; how to help students pose problems; use of technology; assessment issues; how to establish and maintain a classroom environment conducive to discussions; strategies to work with students of varying levels of ability and students from low socioeconomic status; suggestions on how a teacher can move from a traditional to a problems-based environment.

I highly recommend this new NCTM publication! This book provides teachers with a strong rationale to teach using a problems-based approach, as well as strategies to make that happen. I believe that the editors have done an excellent job to ensure the Chapters are well-written and can be read quickly by busy and overworked mathematics educators.

Teaching Mathematics through Problem Solving: Grades 6-12 is available for purchase by contacting OAME'S NCTM-representative, John Kersley, jkersley@sympatico.ca. For elementary teachers, an accompanying companion, *Teaching Mathematics Through Problem Solving: Prekindergarten – Grade 6*, edited by Frank Lester and Randall Charles, has also been published by the NCTM. ▲

▲ Quadratic Creativity

LORRI PURNIS



I am a graduate of the Teaching Option program at the University of Waterloo (1996). I have been teaching since 1997; a year in North Carolina and after that, in Sault Ste. Marie ON at Sir James Dunn C &VS. I love living and teaching in the North. The winters are brutal, but the students are fabulous!

The quadratic formula…how to get students to remember it? My grade 10 teacher used to make us chant it and I will admit, I never once forgot it. I have used the chanting method, but I thought it might be fun to have the students express their creative thoughts by making up a song to try and remember the formula. The first time I tried this activity, the students created some very simple songs sung to tunes like "Mary Had a Little Lamb", and "Old MacDonald Had a Farm", and "Twinkle Twinkle Little Star". I thought these were pretty good and you could hear the kids humming their various tunes during the tests and quizzes. Last year, I asked my grade 11 class to do the same thing and the projects that were turned in were far above and beyond my expectations. Some of the songs are clearly not practical for remembering the formula as they are long and developed, however, I thought they were fabulous none the less and when I was asked to share a few of them I was more than willing.

Song Number One: Sung to the tune of *"One Tin Soldier"* and written by James Campbell.

Listen children to a formula
That was written long ago
'Bout some x-intercepts
And the math textbook below.

In the math book was this formula
That only the teacher knows
And all the math students swore
They'd have it for their very own

CHORUS (although I don't condone the cheating part)

So go ahead and hate fractions
Go ahead and cheat on a test
Do it in the name of Purnis
You can justify it in the end
There won't be any Purnis 'x' marks
Come the marking day
On the heartbreaking day after...
Mrs. Purnis marks away

Now the secret of the formula
First you take negative b
Then negative or positive root
of b^2 minus 4ac

Now most students think this is it
But revealed by Ms. May
the most important part is missing
Divide it all by 2a

CHORUS

Now the students cried with anger
"Get your pencils! Wrack your brains!"
And they tied up the math teacher
They got the math book for their pains

Now they stood beside the textbook
The cover was yellow and red
They turned the pages, looked at all them
"Purnis rocks," was all it said.

CHORUS

Song Number Two: Sung to the tune of *"Oh Canada"* and written by Mark Schildroth.

Listen to this
x equals negative b
Plus or minus
The root of b^2 minus 4ac

All of this is put
Over top 2a
And that's your formula

So remember this
So you can do stuff
With parabolas

Quadratic equation
Oh can't you see
Listen to this
x equals negative b
Listen to this
x equals negative b....

Song Number Three: Sung to the tune of *"Y.M.C.A"* and written by Ian Flaxey.

Young kids, there's no need to feel down
I said young kids, pick yourself off the ground
I said young kids, 'cause you're in a new class
There's no need that you quit so fast.

Young kids, there's a way to solve this
I said you can, use a good formula
You can use it, and I'm sure you'll find x
You can solve things, it's quadratics.

CHORUS

It's fun to do some hard M. A. T. H
It's fun to do some hard M. A. T. H
It has everything that can boggle your mind
If it's x that you have to find
It's fun to do Purnis' M. A. T. H
It's fun to do Purnis' M. A. T. H
You can become a genius just like Mrs. Purnis
You will get to love quadratics

Young kids, are you listening to me
I said, you got a negative b
I said, then it's plus or minus
Then the square root sign is next

No man, it doesn't end there
I said, there is the value of b squared
And just write down negative 4ac
Divide all by 2a and see

CHORUS

One of my students turned in a sad little quadratic song and felt, in order to redeem himself, he should turn in another math song. I thought it was fabulous so I am including it too.

Crazy Little Thing Called Math (sung to the turn of *"Crazy Little Thing Called Love"*) and written by Jeff Jonuasitis.

This thing, called math
I just can't handle it!
This thing called math
It's got some hard questions I'm telling you
I can't solve 'em
Crazy little thing called math.

This thing, called math
It's tough, keeps me up all night
This thing, called math
Ask BOB for the answers 'cause he's always right ***(Note: BOB is what Mrs. Purnis calls the Back Of the Book)*
But I'm stupid
Crazy little thing called math

CHORUS

There's goes my average
It's dropping really fast
Try not to panic
But I already got a fever, I'll be in a coma soon

This thing, called math
I've got to learn so much
This thing, called math
You've got functions and relations, algebra and stuff
I have to learn it
Crazy little thing called math

This thing, called math
It really hurts my brain
This thing, called math
Hurts all over and gives me pain
This is torture
Crazy little thing called math

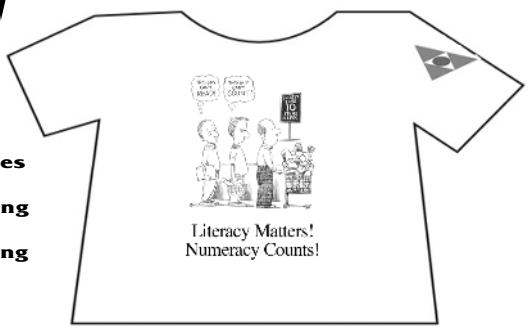
Repeat Verse 1

Crazy little thing called math (repeat a lot) ▲

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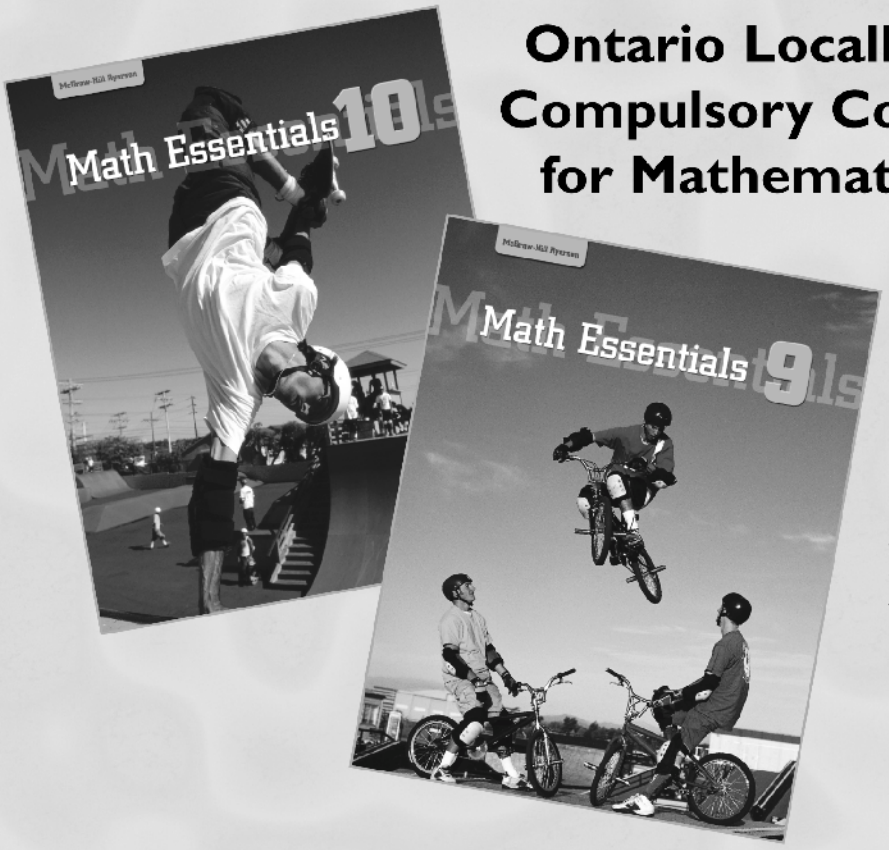
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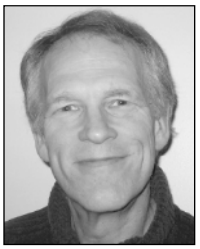
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▲ A Summer's Dalliance

STEVE SPARLING



Steve Sparling lives in Campbell River, BC where he teaches mathematics at the Adult and Continuing Education Centre. As professional development chair of the BC Adult Educators specialist association he believes that playing with highlighters, Valpolicella and writing articles are all important parts of professional development.

In order to pacify us for having a 'school growth plan' meeting on the last day of school in June, Vicki, our administrator, gave us some nifty three cornered highlighters and told us to use them any way we wished as part of the growth planning process. Most put them away, the English teacher used hers to create a tri-colour doodle and I began to idly rearrange the caps. I managed to come up with six unique arrangements when I snapped out of my reverie: why six when I know that there are (3-1)!=2 possible circular permutations. Ah! Three of those arrangements are rotations and they are all different otherwise our school logo would turn and a reflection in the horizontal axis yields a different arrangement because Vicki forgot to put the logo on both sides. It had been decades since the mysteries of Galois theory had been revealed to me.



Abstract Algebra

When the others broke for coffee I went to the white board to see if I could remember what a finite group was. I took the upright position to be 1 and the first rotation to be r so the second rotation would be r followed by r, or r^2. Clearly r^3 was equal to 1, the starting point. I remember now! It's a cyclic group with three members. But what about the other three? After reflecting on this I reflected the triangle in each of its altitudes: the vertical axis, through yellow, was p, the axis through the green was p_1 and the axis through the red was p_2. I suspected that p_1 and p_2 were redundant so with some experimenting I arrived at[1]:

$rp = p_1$

$r^2p = p_2$

I wrote the above on the whiteboard along with $pr^2 = rp$ and $pr = r^2p$. Not only can I generate p_1 and p_2 from r and p, but the system is not commutative. I surprised myself by remembering the term non-Abelian, named for the mathematician Niels Abel who, at age 19, showed that there was no general formula for quintic polynomials. By the time everyone got back from coffee I had erased the board.

My finite non-Abelian group is complete (and closed) with elements 1, r, r^2, p, rp and pr. To be a group it must have a unit, 1, and each element must have an inverse:

$r(r^2) = (r^2)r = 1$

$p(p) = 1$

$rp(rp) = rp(pr^2) = rppr^2 = 1$

The operations are summarised in the Cayley[2] table below where the top row is the first operation and the left column is the second operation:

	1	**r**	**r^2**	**p**	**rp**	**r^2p**
1	1	r	r^2	p	rp	r^2p
r	r	r^2	1	rp	r^2p	p
r^2	r^2	1	r	r^2p	p	rp
p	p	r^2p	rp	1	r^2	r
rp	rp	p	r^2p	r	1	r^2
r^2p	r^2p	rp	p	r^2	r	1

Dihedral and Cyclic Groups

The triangle is an example of a dihedral group of order 6, written D_3. Dihedral groups figure prominently in nature, art and corporate logos. A square is D_4 and a starfish is D_5. In fact any n sided regular figure is D_n and has order 2n. According to my son's Abstract Algebra

[1] *Following the convention of working from right to left so pr means rotate first then reflect in the vertical axis.*

[2] *Cayley first introduced such tables in 1854.*

text ammonia is "a pyramidal molecule with symmetry group D_3" (Gallian 2002, p 35) and the HIV virus is D_{28}.

Logo designers love cyclic groups. The set of rotations of my highlighter is a cyclic group denoted R_{120} with three rotations of 120º and the *Chrysler* symbol is R_{72}. Another cyclic group is the set $Z_3 = \{0, 1, 2\}$ which is a group under addition mod 3:[3]

X	0	1	2
0	0	1	2
1	1	2	0
2	2	0	1

Actually, it can be shown that Z_n is a group under addition if and only if n is a prime number.

Making it Complex

The corners of my highlighter, when yellow points east, can represent the three cube roots of unity. Making use of DeMoivre's formula to transform a complex number from a+bi form to polar form:

$$a + bi = r(\cos\theta + i\sin\theta)$$

$$\sqrt[n]{(a+bi)} = \sqrt[n]{r}\left(\cos\frac{\theta}{n} + i\sin\frac{\theta}{n}\right)$$

To find the cube roots of unity:

$$1 = 1(\cos 0^\circ + i\sin 0^\circ) = 1(\cos 360^\circ + i\sin 360^\circ) = 1(\cos 720^\circ + i\sin 720^\circ)$$

$$\sqrt[3]{1} = \sqrt[3]{1}\left(\cos\frac{0^\circ}{3} + i\sin\frac{0^\circ}{3}\right) = \sqrt[3]{1}\left(\cos\frac{360^\circ}{3} + i\sin\frac{360^\circ}{3}\right)$$

$$= \sqrt[3]{1}\left(\cos\frac{720^\circ}{3} + i\sin\frac{720^\circ}{3}\right) = 1(\cos 0^\circ + i\sin 0^\circ)$$

$$= 1(\cos 120^\circ + i\sin 120^\circ) = 1(\cos 240^\circ + i\sin 240^\circ)$$

The above can easily be converted back from polar form:

$$\sqrt[3]{1} = 1$$

$$\sqrt[3]{1} = w = \frac{-1+\sqrt{3}\,i}{2}$$

$$\sqrt[3]{1} = w^2 = \frac{-1-\sqrt{3}\,i}{2}$$

The second and third cube roots of unity are written w and w^2 because the third is, indeed, the square of the second and $w^3 = 1$ making this a cyclic group.

The above is even easier using Euler's formula:

$$r(\cos\theta + i\sin\theta) = re^{i\theta}$$

$$1 = e^{i(0^\circ+360^\circ n)}$$

$$\sqrt[3]{1} = \left(e^{i(0^\circ+360^\circ n)}\right)^{\frac{1}{3}}$$

$$= e^{i(0^\circ+120^\circ n)}$$

I created a model of the above by drawing a complex plane, placing the centre of the highlighter directly above the origin and pointing the yellow corner along the positive real axis in the three o'clock direction. By defining the distance from the centre to the tip of the yellow corner as one, the corners of the highlighter all lie on the unit circle and, as a bonus, green is directly above w and red above w^2. As I idly rotated the highlighter counter clockwise with the yellow passing from the three o'clock position through ninety degrees to the twelve o'clock position I realized that, while being rotated, the highlighter defined a number of cube roots. After rotating 30˚ counter clockwise to the two o'clock position the corners were above the three cube roots of i. A further 30˚ to the one o'clock position reveals the three cube roots of –1. Not only does the twelve o'clock position mark out the cube roots of –i, but the marker can mark out the cube roots of any complex number on the unit circle! All this brings back the day, thirty years ago, when Dr. Glass spent the whole class time using complex analysis to show us why a violin string makes a different tone when struck than when plucked.

Enter Permutations

Before Cayley stepped outside of the permutable box in 1850, groups of permutations were the vogue. A permutation is a function from a set to itself that is 1-to-1 and onto. S_3 is the permutation of three things:

$$\varepsilon = \begin{Bmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \end{Bmatrix}, \alpha = \begin{Bmatrix} 1 & 2 & 3 \\ 2 & 3 & 1 \end{Bmatrix}, \alpha^2 = \begin{Bmatrix} 1 & 2 & 3 \\ 3 & 1 & 2 \end{Bmatrix}$$

$$\beta = \begin{Bmatrix} 1 & 2 & 3 \\ 1 & 3 & 2 \end{Bmatrix}, \alpha\beta = \begin{Bmatrix} 1 & 2 & 3 \\ 2 & 1 & 3 \end{Bmatrix}, \alpha^2\beta = \begin{Bmatrix} 1 & 2 & 3 \\ 3 & 2 & 1 \end{Bmatrix}$$

A quick look at this and it is obvious that S_3 is isomorphic to D_3 including my highlighter. Two groups are isomorphic if you can map from one to the other and preserve all operations. Isomorphisms help us to go from one group to another and prove some surprising results. The order of a permutation S_n is, not surprisingly, n! so the isomorphism stops at D_3. D_4, the transformations of a square, is isomorphic to one of the many subgroups of S_4.

[3] *Note that 2+2 = 4 = 1 mod 3 because there is a remainder of 1 when 4 is divided by 3.*

The da Vinci Code

Leonardo da Vinci, in his study of art and geometry, discovered some fundamental findings regarding symmetry groups. Three hundred years later mineralogist Augustine Bravais, while studying the structure of crystals, extended da Vinci's work to include three dimensional isomorphisms. Building on da Vinci's ideas on mathematics in art, algebraists studying symmetry have shown there are exactly 7 possible frieze patterns–those patterns around the top of walls or on the valences for curtains. These are delightfully illustrated as footpatterns "step, hop, jump, slide, spinhop, spinjump and spinslide" on **http://michaelshepperd.tripod.com/resources/groups.html**. Escher aficionados are invited to visit **http://www.clarku.edu/~djoyce/wallpaper/** where the 17 planar symmetry groups are portrayed as the 17 wallpaper patterns (if I had enough highlighters I would try them). Here we have one of the many areas where the line between art and mathematics becomes blurred.

Applications

Group theory has been used to encode and decode digital signatures. The RSA public key encryption scheme makes use of some of the group theory properties involving mod arithmetic, primes and lcm. The breakthrough in recognizing the shape of DNA came when Crick recognized it as a symmetry group. Group theory and its close cousin, ring theory, were instrumental in Wiles' proof of Fermat's famous last theorem. Some of the ancient problems in geometry have been clarified through abstract algebra: squaring the circle, trisecting the angle, the transcendence of π to name a few.

Conclusion

After a gruelling morning of formulating a growth plan, the staff retreated to a local riparian pub for lunch. While the clerical staff, seated on my right, were finding punctuation and grammatical errors in the menu, Vicki and I sipped our Valpolicella and discussed Hemmingway's errant personal life. The beginning of summer—a great time for teachers to muse. While writing this I can hear the television blaring as my wife and daughter watch *The Lord of the Rings*. Shall I tell them who the lord of the rings really is?

Reference

Gallian, Joseph A. (2002). *Contemporary Abstract Algebra.* Houghton Mifflin Company. New York. ▲

▲ Union Gas Awards

BY: DAVE AND SUE HESSEY, EXECUTIVE DIRECTORS, STEWART CRAVEN, PAST-PRESIDENT, AND JUDY DUSSIAUME, AWARDS CHAIR, OAME

In October 2004, directors of each of the seventy-two school boards in Ontario were invited by the Ontario Association for Mathematics Education 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 York University on May 12 at the *Nexus* banquet at Black Creek Pioneer Village. 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 has sponsored these special awards for the last three 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, last year at OAME 2004.

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 enhance 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 2005 "Ontario Mathematics Educators of the Year":

1. The Union Gas Award for Teaching Excellence in Mathematics (elementary), awarded to **Felicity Laudisa, Toronto DSB**
2. The Union Gas Award for Teaching Excellence in Mathematics (secondary) awarded to **Ron Gaudreau, Ottawa-Carleton DSB**
3. The Union Gas Award for Outstanding Leadership in Mathematics Education awarded to **Anna Jupp, Toronto DSB**

OAME would like to congratulate all the teacher-leaders who have been nominated over the past three years for this special award, sponsored by Union Gas. They are all deserving of recognition as outstanding mathematics teachers and/or leaders.

Special congratulations to the following Ontario educators who were nominated by their boards in 2005.

ELEMENTARY NOMINEES	
Bruce-Grey CDSB	Tim Broughton
Hamilton-Wentworth DSB	Rick Kaszas
Ottawa-Carleton DSB	Heather Lawson
Toronto DSB	Felicity Laudisa
Waterloo Region DSB	Mary Forbes Christine MacTavish
SECONDARY NOMINEES	
Halton DSB	Amy Lin
Ottawa-Carleton DSB	Ron Gaudreau
Superior-Greenstone DSB	Karen Saarimaki
Toronto DSB	Dr Kathir Brabaharan
LEADERSHIP NOMINEE	
CSDEC du Sud-Ouest	Paul Lachance
Ottawa-Carleton DSB	Ron Gaudreau
Toronto DSB	Anna Jupp
Waterloo Region DSB	Keith Baumann

▲

▲ Making Effective Use of Our Time: A Tracking Sheet for Daily Classroom Assessment of Student Learning

JAMIE PYPER



Jamie Pyper is a former department head of mathematics, currently seconded from the Thames Valley District School Board to the Esso Centre for Mathematics Education (www.edu.uwo.ca/essocentre) and the Faculty of Education, UWO. Jamie is a J/I and I/S mathematics education instructor, and the coordinator and practicum advisor for the concurrent mathematics and education program at UWO.

> *"Stiggins (1988) observed that classroom teachers are assessing at least 25 percent of every instructional day, but the criteria and data are usually stored in the teacher's head" (Sperling, p. 73). Sperling suggests that these criteria and observations be put on paper for everyone, especially students to see (p. 74).*

In an average semester, I have contact with about 90 students every day. What I value is continuous, consistent, clear, non-verbal communication between my students and myself, concerning general classroom expectations for effective learning, behaviour, and participation in the learning activities of the course. I have learned that repetitive verbal communication, or nagging, does not guarantee students will perform according to these expectations. Nagging tends to be unproductive and exhausting as I repeatedly implore my students to remember how to behave in the classroom: to be on time; to have all their equipment with them; to have homework done; to try to learn something; and that everything they do in class has an impact on their achievement – even if their actions are not "for marks"!

Consequently, I developed a Tracking Sheet (see Figure 1) to use in class. It has become an integral part of my classroom practice. Each student has a personal Tracking Sheet, and together, we write on it. The visual display of classroom expectations, course expectations, and standards, reduces the amount of time I talk about these issues. Students frequently and immediately judge

STUDENT: _____ DATE: _____

GOAL: _____

MONDAY	Things done today…					Punctuality ☐
						Equipment ☐
						Homework ☐
						Class notes ☐
	Teacher's Signature:	WI/TW	Organization	Initiative	Work Habits	
TUESDAY	Things done today…					Punctuality ☐
						Equipment ☐
						Homework ☐
						Class notes ☐
	Teacher's Signature:	WI/TW	Organization	Initiative	Work Habits	
WEDNESDAY	Things done today…					Punctuality ☐
						Equipment ☐
						Homework ☐
						Class notes ☐
	Teacher's Signature:	WI/TW	Organization	Initiative	Work Habits	
THURSDAY	Things done today…					Punctuality ☐
						Equipment ☐
						Homework ☐
						Class notes ☐
	Teacher's Signature:	WI/TW	Organization	Initiative	Work Habits	
FRIDAY	Things done today…					Punctuality ☐
						Equipment ☐
						Homework ☐
						Class notes ☐
	Teacher's Signature:	WI/TW	Organization	Initiative	Work Habits	

Figure 1

their performance against the criteria (punctuality, equipment, homework, class notes, class work) listed on the page, and see any differences between their assessment and mine. This process of assessing classroom behaviours is a very collaborative effort and I can attest to Sperling's observation that "… teachers using collaborative assessment have documented extraordinary improvement with nearly all students" (p. 73).

A Connection with the NCTM Standards

In my classroom, I see a shift in emphasis from passive student attention to rules and routine problem solving, toward active student participation. As well, I see an increased sophistication of student communication about his or her learning and a reflective practice of self-assessment. For me, the NCTM Standards (2000) clearly supports this shift with what it says in its grade level sections and its Assessment Principle. Metaphorically, I think of mathematics learning and teaching as a pond, a 'math' pond, and the Standards as a set of stones thrown into the middle of the pond. The stones change the pond by adding to it, and creating ripples in the surface, and making the water move against the shore. Rather than standing on the shore and observing the ripples of the pond the Standards ask me to interact differently with the pond of mathematics learning and teaching. I am to be in the pond and collaborate in the learning and teaching of mathematics, to experience the ripples too.

The NCTM Standards' stones are *problem solving* (monitoring and reflecting), *communication*, *connections* (building to produce a coherent whole), and *representations* (organizing, recording and communicating). Interpreting the Assessment Principle with this metaphor, I, the teacher, experience the resulting ripples through an assessment process that is enhancing student learning through consistency and frequency of feedback. The Assessment Principle states that assessment should become "… a routine part of the ongoing classroom activity rather than an interruption" (NCTM Standards, 2000, p. 23). It should build a picture of individual student progress toward the goals of instruction based on identifying valuable student insights rather than concentrating on errors or misconceptions (p. 24). To accomplish this I really do need to be in the pond with my students as an *active participant* rather than standing on the shore as a passive observer.

So, How Does it Work in Class…?

I photocopy the Tracking Sheet on both sides of a piece of paper in order to get a two-week "picture" of student activity. I usually use green paper to differentiate it from regular handouts, and so it has the nickname – "the green sheet". At the beginning of the class period, students find their "green sheet" in an in/out tray on a table or counter in the room. (This tray is usually close to the door as this puts the Tracking Sheet in the students' line of sight coming in and going out of the room. It is harder to forget about the sheet this way!) Students sit down at their desks, place their Tracking Sheet on a corner of their desk and complete the punctuality, equipment and homework sections. Throughout the class, as I move about the room, I am able to immediately write a comment on the students' pages for any achievement or behaviour that should be noted.

I save a few minutes at the end of each class period so that students can make sure their Tracking Sheet is complete. As the class ends, I stand by the door to ensure no one forgets to leave the Tracking Sheet in the tray. Once everyone understands the process, it is rarely necessary for me to give reminders to leave the Tracking Sheet in the class (my students successfully continue this tracking sheet process even on those days when a supply teacher is with them). At the end of the day, I review the class sets of Tracking Sheets and sign each sheet. This review takes about five minutes of my time for each class of Tracking Sheets.

What Does this Tracking Sheet Do?

From the basic administrative function of attendance and punctuality to the collection and assessment of learning skills and course content achievement, the Tracking Sheet provides daily opportunities for positive, corrective, and informative feedback to students, and in the longer term to parents or guardians. Students and teacher together provide concrete anecdotal information regarding participation in activities and learning that occur within the class period. It has proven to help foster a sense of reflective practice and enhance students' personal growth.

For example, homework is one criterion for which I frequently add my agreement or suggestion to the students' evaluation. There is a single-row homework rubric on the wall so that everyone knows the criteria for each level of achievement. In a situation when a student copies from a friend and records a 4 for homework each day but achieves a 2 out of 15 on a Friday quiz of the weeks' homework questions, conversation resulting from this Tracking Sheet data can provide diagnostic opportunities and a chance to talk with the student

STUDENT: _____ DATE: November 8

GOAL: to bring a ruler to class

	Things done today...			
MONDAY	copyed stuff off the board	Punctuality		4
		Equipment	ruler	3
		Homework		4
		Class notes		3
	Teacher's Signature: JP	Classwork	Work in a group to get help.	4
TUESDAY	Things done today... continued on the paper we did yesterday	Punctuality		4
		Equipment	ruler	3
		Homework	not much was done on the activity	4
		Class notes	over night!	4
	Teacher's Signature: JP	Classwork	?	
WEDNESDAY	Things done today... copied stuff off The board	Punctuality		4
		Equipment	ruler	3
		Homework		4
		Class notes		4
	Teacher's Signature: JP	Classwork	good participation.	4
THURSDAY	Things done today... copied stuff off the board	Punctuality		4
		Equipment	ruler	3
		Homework	at home	0
		Class notes		4
	Teacher's Signature: JP	Classwork		4
FRIDAY	Things done today... 2 couple of note on Multiplying	Punctuality	examples	3
		Equipment	ruler	3
		Homework	forgot to do it	0
		Class notes	2 polynomial by monomial	3
	Teacher's Signature: JP	Classwork	good participation, good effort	23

Figure 2

and/or his or her parent(s) about the importance of homework practice.

With this Tracking Sheet, I experience an emerging classroom environment also described by Sperling where "students can take responsibility to evaluate their own work… compare their self-assessment with the teacher's assessment, set goals for future work, and initiate corrective action to improve their own work" (p. 75).

Tracking Sheet Examples

Figure 1 is the latest version, which includes the OSS Learning Skills of Works Independently/Teamwork, Organization, Initiative, and Work habits. Figures 2 and 3 are examples of an earlier Tracking Sheet in use, and Figure 4 shows my attempt, using the earlier version, at having students write the Learning Skill for the day on the page. These pages are mechanically reproduced to make it easier to read what was handwritten.

Figure 2 provides an example of a student with a behaviour identification in combination with a cognitive learning disability, who is in a grade nine academic class. I am employing specific, long-term interventions with this student. The week shown is during a period of time when my primary focus is his participation in class and with the learning activities. On Monday, I also describe this focus for the week to the entire class and ask the students to write a goal at the top of their Tracking Sheet (notice that this student's goal for participation is to bring a ruler to class). At the end of Monday's class, I talked with the student about his participation during the period, i.e., how it could be greater than just having a ruler to use, and of the work that needed to be done for the current topic. He said he understood the day's work and would have it ready to participate more fully in class the next day. I reinforced my comments by writing in the "Classwork" section for Monday and entering a 2 over his 4 (rather than writing a 1) indicating a positive starting place. On Tuesday, there was little evidence of progress on the activity started the day before, and with little participation during the class period, the student avoided self-assessing his classwork on the Tracking Sheet. We talked again in class, and then on Wednesday and Thursday, he worked harder in class. By Friday, I thought he had improved and done very well, and so recorded a level 3 at the end of class when the student and I were able to talk and reflect on his performance throughout the week, and look ahead to the next week.

When it is not possible to speak with a student during or after a class period, the Tracking Sheet provides an opportunity for written communication. Figure 3 offers two such examples. The student in the bottom example had attempted to participate more on Thursday than she had in prior days, but was still a little hesitant to initiate a response. I wanted her to know that I noticed her engagement in the topic, and hopefully provide encouragement for future participation. The top example illustrates other communication some students may offer more regularly and comfortably in writing rather than verbally.

Short-term Options

I have used this Tracking Sheet in grade 11 and 12 (and previously in OAC) classes for up to four weeks, but usually I use it for the whole course with grade 9 and 10 students. While any classroom process has its benefits, there are times when this Tracking Sheet does not work very well. There are some students (irrespective of their level of ability) who actively resist the Tracking Sheet. In these instances I usually get two to four weeks of use with the Tracking Sheet to set the stage, identify my classroom expectations and collect some assessment data. Then I stop using it in class. As with any classroom learning or management strategy that is not as effective as I had hoped, another strategy is implemented.

Changing the Classroom Learning Environment

For me, classroom management, assessment, instruction, and learning activities are interrelated parts of the educational experience. To improve on one part requires awareness and possibly re-alignment of the other parts "since all aspects of a system are interlocking, [and] all parts must change in accordance with the new paradigm" (Costa, p. 50).

I have used various forms of this Tracking Sheet for years, through two other secondary school mathematics curriculums. Over time, my teaching style has changed, as have my classroom assessment strategies. This Tracking Sheet is a re-alignment of assessment practices to respond to the changing environment and culture of mathematics learning. Stigler & Hiebert (1999) confirm there is a school culture, and that cultural changes evolve over time. The latest curriculum reform has had a greater influence on the culture of my math classroom. It feels like there is so much more to keep track of, and to report, with respect to my students' learning. Even if I can keep all the information in my head, no-one else can see it, so, like Sperling, I am putting it down on paper and making my students collaborators in learning.

STUDENT: _____ **DATE:** November 15

GOAL: To participate more in group discussions

MONDAY	**Things done today...** - discussed homework in groups	**Punctuality**	
	- homework check (by teacher)	**Equipment**	
	- Quiz *What happens on quizzes? You do so well on tests... can you identify what happens to you?*	**Homework** - from Thursday (Absent): 4/4 - from Friday's class : 3/4	4
	- factoring note and work	**Class notes**	4
	Teacher's Signature: JP	**Classwork**	3
TUESDAY	**Things done today...** Homework discussion	**Punctuality**	
	Quiz retake - I find that I do better on tests when I have more time to do them. I got almost perfect the second time.	**Equipment**	
	Give back exams.	**Homework**	4
	Class work time	**Class notes** I can't concentrate when someone's telling me I have 30 seconds to finish.	n/a
	Teacher's Signature: JP	**Classwork**	3
WE	**Things done today...**	**Punctuality**	

Above sample is a sample from a grade 9 Academic student.

Below is a sample from a grade 9 Applied student

THURSDAY	**Things done today...** *Wrote down question*	**Punctuality**	✓
	Took up homework	**Equipment**	✓
		Homework	4
		Class notes *good*	3
	Teacher's Signature: JP	**Classwork** *I could see that you were ready to answer*	23
FRIDAY	**Things done today...** *Took up homework*	**Punctuality** *& I went on to other things before you could volunteer*	✓
	questions	**Equipment**	✓
		Homework	4
		Class notes	3
	Teacher's Signature: JP	**Classwork**	3

Figure 3

STUDENT: _____ **DATE:** November 1

GOAL: To do something about my headaches, I think I need glasses in class

MONDAY	**Things done today...** We reviewed work. And looked how slope connets with the stuff we're doing now	**Punctuality**	✓
		Equipment	✓
		Homework	4
		Class notes	4
	Teacher's Signature: JP	**Classwork** ✶ Initiative ✶	3
TUESDAY	**Things done today...** We had a work time, Got what we would do for Midterms. Mid-term review.	**Punctuality**	✓
		Equipment	✓
		Homework	4
		Class notes	4
	Teacher's Signature: JP	**Classwork** ✶ work habits ✶	4
WEDNESDAY	**Things done today...** I was at take your kids to work day. The office has the note.	**Punctuality**	
		Equipment	
		Homework Absent	
		Class notes	
	Teacher's Signature:	**Classwork**	
THURSDAY	**Things done today...** I fixed this sheet. We looked at distributive properties.	**Punctuality**	✓
		Equipment	✓
		Homework	4
		Class notes	4
	Teacher's Signature: JP	**Classwork** ✶ work habits ✶	4
FRIDAY	**Things done today...** Today, before class I got my table of contents up to date. We looked at poly Nomials.	**Punctuality**	✓
		Equipment	✓
		Homework	4
		Class notes	4
	Teacher's Signature: JP	**Classwork** ✶ Organization ✶	4

Figure 4

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▲ USING TECHNOLOGY IN THE JUNIOR GRADES

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Dr. Margaret Sinclair is an Assistant Professor in the Faculty of Education at York University. She brings to this work almost twenty years of experience as an elementary and secondary classroom teacher and a secondary administrator. Her research focuses on the use of technology in elementary and secondary school mathematics, and on the use and design of mathematics learning objects. Dr. Sinclair recently served as a member of the Ontario Ministry of Education's Expert Panel on Mathematics in the Junior Division.

What's all the hype about using technology in math? Does it make a difference? Should we bother in the junior grades? Is it worth the effort?

Tim Granger thinks it's worth it (Granger, 2000). His fifth grade students used TesselMania! ("TesselMania! Deluxe," 1997) to produce computer-generated tessellations then ironed their creations onto t-shirts. He noted, "As it prompted their exploration into patterns, symmetry, and spatial reasoning, the project opened students' eyes to the beauty of mathematics" (p. 13). Robert Berry III and Joyce Wiggins (Berry III & Wiggins, 2001), who carried out an angle measurement unit with a group of grade 6's, also think it's worth it. Their students used home-made protractors to measure the interior angles of three-, four-, five- and six-sided polygons, then worked with *The Geometer's Sketchpad* on three activities involving measuring and estimating angles. Berry III and Wiggins noted that the students "increased their repertoire of benchmark angles" (p. 156), which helped them make reasonable estimates of angle size. Both these projects illustrate what research has shown – that the appropriate and integrated use of technology can produce measurable gains in learning (Jones, 2002; Ruthven, 1999).

Technology is already important to our junior students - many use it on a daily basis. They surf the internet to find information, upload, download and edit digital photos and graphics, use word processing software to prepare assignments, and talk to one another via email and chat.

Junior students could also use technology to enhance their mathematical experiences.

Many people think that using technology in mathematics means pressing a button to calculate an answer, or clicking a formula to instantly produce a graph. They see it as a tool to be used once you know the math. In fact, working mathematicians use technology regularly to investigate and to think. Computer tools have become as fundamental to their work and the work of other scientists as the protractor was to the work of the ancient geometers. Mathematicians know that tools (ranging from paper and pencil up to calculators and computers) actually transform the way we think about mathematics. For instance, our ability to use visual thinking is enhanced by the use of technological tools such as dynamic geometry software (Jones & Bills, 1998).

The introduction of technology has changed our priorities about what students need to learn. It is no longer necessary for them to do extensive calculations by hand, but it is very important for them to have a deep understanding of number and shape. The nature of technology is also changing our ideas about how we teach mathematics. For example, it provides new opportunities for hands-on exploration. We can use technology to physically "play" with ideas – both numerical and geometrical.

We know that play motivates and engages people. Children (and adults) willingly spend hours learning new skills or practicing old ones when they are deeply involved in a game or sport. This isn't surprising to researchers. They point out that games are a way of telling stories, and stories are fundamental to both understanding and learning (Reiber, Smith, & Noah, 1998). Play also creates a risk-free environment. Students given opportunities for free-play with science materials show increased curiosity and a willingness to consider different options (Stone & Glascott, 1997). And play is strongly linked to self-directed discovery. When playing with physical objects or with interactive applets students can access new levels of knowledge in mathematics (Sinclair, 2004; van Hiele, 1999). Perhaps this is a good place to start with junior students.

Technology and the Junior Grades

In grades 4 to 6, technology activities that emphasize play and discovery can be integrated into the mathematics curriculum to support the development of student understanding. Students can use calculators to play with number patterns, investigate geometric patterns with *The Geometer's Sketchpad*, create their own displays of data with spreadsheets, or explore visual relationships using online applets.

But do these opportunities offer more than paper and pencil activities? Is there 'value added'?

A clear advantage of technology is that it can provide a multiplicity of examples. Thus students have the opportunity to analyse and compare many more graphs or tables or shapes than they can with traditional tools. Using technology, students can also examine the "behaviour" of mathematical objects. As they drag a *Sketchpad* triangle and watch its perimeter change, students see not just one example but a whole range of cases; as they alter a number in a spreadsheet column and watch their graph update, they see a relationship between cause and effect. Students can use this information to make conjectures about the changes and to develop explanations.

Perhaps most importantly, technology can provide support for visual thinking, which is often neglected in favour of numeric or symbolic work; a visual image helps many students build stronger connections among mathematical representations.

Appropriate Use of Technology

Many teachers and parents are concerned that if technology were freely available, students would use it without thinking and would fail to learn mathematical ideas, but research studies have shown that unrestricted access to calculators does not adversely affect student performance in mathematics. Ellington notes, "Results [of a meta study of 54 studies] revealed that students' operational skills and problem-solving skills improved when calculators were an integral part of testing and instruction" (2003, p. 433). In addition, computer activities have been shown to have beneficial effects, e.g., on low SES students (Page, 2002), on the strengthening of spatial visualization skills (Smith, 2001), and on the development of understanding in algebra (Abramovich & Nabors, 1997), in geometry (Laborde, 2000), and in probability (Pijls, Dekker, & Van Hout-Wolters, 2003). The key is to examine how technology is used in the classroom – what role it plays. Clements and Sarama note:

> *Having students use technology does not necessarily guarantee that they will be able to transfer the knowledge gained to another medium. Teachers must provide opportunities for students to link actions carried out in one environment to those in another. In fact, "research shows that computer activities yield the best*

results when coupled with suitable off-computer activities" (Clements & Sarama, 2002, p. 342).

When students just accept calculator results without thinking, technology is the *master*. No one supports this role for technology. On the other hand, technology is a *servant* when it is used to carry out calculations that are tedious or difficult, and a *partner* when it helps students to formulate questions and investigate hypotheses. These are important uses of technology in everyday life and in the mathematics classroom. Finally, technology is an *extension of self* when students use it in a natural and appropriate way (Goos, Galbraith, Renshaw, & Geiger, 2003). In this last role, technology is as central to the work of the students as pencil and paper; calculators and a variety of mathematics software are available when and if students decide they need to use them.

Teachers can help students learn when it is appropriate to use a calculator or a computer, and when it is not:

1. By including questions, activities, and investigations that use technology to support realistic problem solving. For instance, problems can include very large or even "messy" numbers such as 75.689 if students have access to calculators.
2. By having calculators, spreadsheets, and dynamic geometry software readily available so that students can move towards using these tools in a natural way. For example, students working on bar graphs could choose to use a computer, or construct the same graph by hand. Students working on tessellations could construct a design with cardboard shapes, or with *The Geometer's Sketchpad*.
3. By restricting access to technology when the main aim is to help students hone mental computational skills.

With regard to classroom organization, teachers who have used technology successfully have found that it is not always necessary (nor even advisable) for students to work individually with a computer or calculator. To foster collaboration, and encourage students to discus mathematical ideas, many teachers have students work in pairs. Other teachers prefer to have 2 or 3 computers in the classroom; they find this arrangement more flexible, because groups, pairs, or individuals can use a computer as needed. Alternatively, teachers can use an LCD projector in addition to lab-based or classroom-based computer work. With an LCD projector a teacher can display an interactive object to spark an investigation, or present student work to focus discussion at the closing of a lesson.

But which technological tools are appropriate for use in the junior program? Calculators are important, and students should have access to a variety of software programs for exploring numeric and geometric relationships. In addition, online mathematical objects (applets) can be used. Some specific suggestions are as follows:

1. Calculators – Junior students should use scientific calculators, preferably with two-line display (e.g., TI-15). The advantage of the two-line display is that the teacher can see the expression entered and the computed value, and students can look for patterns in the expressions and answers (St. John & Lapp, 2000).
2. Computer software – Some of the most useful programs for the junior grades are:
   - Spreadsheets
   - *The Geometer's Sketchpad ("The Geometer's Sketchpad Version 4, Dynamic Geometry Software for Exploring Mathematics," 2001)*
   - Tabs+, version 3 ("Tabs+," 2000).
   - Squeak (available at: http://www.squeakland.org/index.html)
   - Tinkerplots – ("Tinkerplots: Dynamic Data Exploration," 2004)
3. Applets – There are a number of online collections of mathematical applets.
   - Alive Maths, created by Nathalie Sinclair, offers both English and French pages at http://tapor1.mcmaster.ca/~sgs/maths/.
   - Brock University houses a collection of mathematics learning objects at http://www.brocku.ca/mathematics/resources/learningtools/learningobjects/.
   - MathFrog, http://cemc.uwaterloo.ca/mathfrog/index.shtml, at the University of Waterloo, offers "fun resources and online games". Each applet or module has additional teaching and learning materials related to the Ontario mathematics curriculum for grades 4,5, and 6 in both English and French
   - The Library of Virtual Manipulatives, http://matti.usu.edu/nlvm/nav/, provides online versions of familiar manipulatives such as geoboards and base ten blocks.

Two Examples for the Junior Grades

Although often neglected, the spreadsheet's flexibility and ease of use makes it a perfect choice for the creative junior teacher. Research has consistently shown the benefits of including spreadsheets in mathematics programs (cf., Abramovich & Nabors, 1997; Sutherland & Rojano, 1993). For example, Sutherland and Rojano concluded from their research with two groups of 10 -11 year olds that spreadsheets were very beneficial in helping students develop an understanding of simple algebraic expressions. Enhanced graphical capabilities of spreadsheets now allow students to explore links between numeric information, formulas, and visual images.

Building an interactive recorder. The example shown in Figure 1 illustrates a spreadsheet chart showing height, armspan and wrist measurements of a group of students. An empty chart can be set up ahead of time as follows: Using Excel (Microsoft Excel 2000), create a column with the students' names, and three more columns named "Height", "Armspan", and "Wrist". Using the Chart Wizard, create a bar graph beside the table. Now, each time a student measurement is typed into the table, a bar will 'magically' appear in the chart.

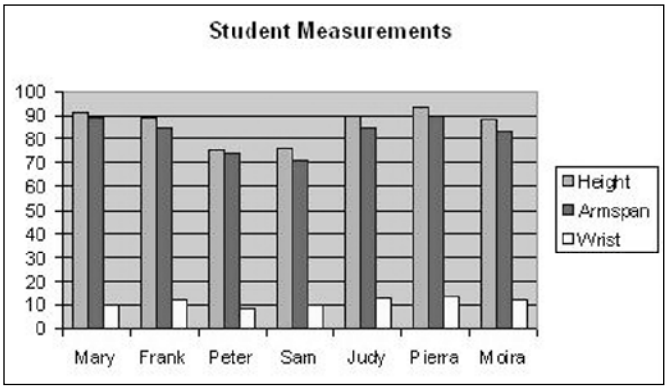


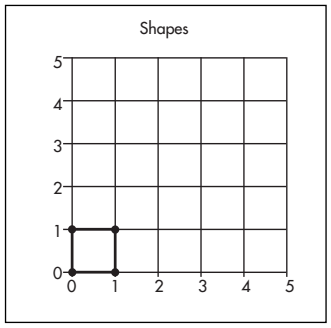
Figure 1: Graphing heights, armspan and wrist measurements of students

This simple recording device can be set up at a station along with tape measures and instructions; throughout the day students can enter their measurements directly into the table. Once all measurements have been recorded the students can analyse and compare the results.

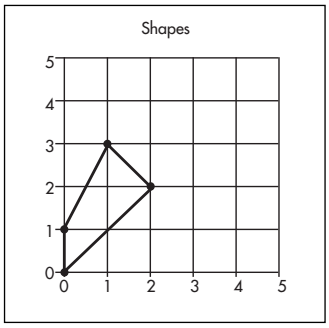
Similar "interactive recorders" can be developed (by teachers or students) for other class projects or activities.

Creating 'shape plotters'. Figure 2 shows another application of spreadsheets that is appropriate for junior students.

After listing ordered pairs in a table, use the Chart Wizard to create an XY (scatter) plot with data points connected by lines. Note that in order to make the figure close, the first point must be repeated at the bottom of the table. Students can use these prepared plotters to create crazy shapes by altering the numbers in the table. With very little preparation, they can also create their own 'shape plotters'.



x	y
0	0
0	1
1	1
0	1
0	0



x	y
0	0
2	2
1	3
0	1
0	0

Figure 2: Plotting points to create a shape with Microsoft Excel.

The spreadsheet is just one of many technological options for the elementary mathematics classroom. Graphics calculators, virtual manipulative applets, and geometry packages can also enrich the program and provide opportunities for students to explore mathematical ideas. However, spreadsheets are powerful, versatile, and easy to learn — and since they are readily available both in and out of school students can work with them outside of the classroom.

Conclusion

So what are the answers? Why should we use technology with junior students?

Some reasons are pragmatic. Technology is used by mathematicians in their work. Research shows that it can help students build connections between numeric, symbolic, and graphical representations of mathematical concepts. It can provide a multiplicity of examples, support the development of visual thinking, and help students work with real-life problems. Numerous activities that engage junior students in exploring

mathematical ideas are available on the web and in resource books.

But none of these reasons are as compelling as that put forth by Andrea diSessa at a recent conference at the University of Western Ontario. diSessa noted that to be fully proficient in the new technology-based literacies that are emerging, our students must become both 'readers' and 'writers'. Calculators, spreadsheets and dynamic software programs are particularly suited to helping students develop both skills. With these tools students can learn to read numeric results with understanding, look for patterns in tables and graphs, and analyse the relationships between geometric shapes; but they can also use calculators, spreadsheets and dynamic software to create – they can become 'writers' in their new technological world.

It's worth the effort.

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▲ Calendar Math

ART JORGENSEN

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JOURNAL OF THE MATHEMATICS COUNCIL
OF THE ALBERTA TEACHERS' ASSOCIATION
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Deciphering codes is an excellent exercise in mathematical reasoning, sound thinking and solid logic. Almost any code will provide this practice. Here is a simple one that can be adopted and reused as student abilities change or increase.

Use the table below to solve the following mathematical exercises:

2	9	4
7	5	3
6	1	8

1. $\square + \square =$
2. $\square \times \square =$
3. $\square \div \square =$
4. $\square - \square =$
5. $\square \times \square =$
6. $(\square^{\square} + \square) \div \square =$
7. $\square^{\square} =$
8. $\square + \square =$
9. $\square \times (\square - \square) =$
10. $(\square + \square) \times \square =$
11. $\square \div \square + (\square - \square) =$
12. $\square \times \square - (\square \times \square) =$
13. $\square \times \square \div (\square + \square) =$
14. $(\square^{\square} - \square) \times \square =$
15. $\square^{\square} \times \square^{\square} =$
16. $\frac{\square}{\square} + \frac{\square}{\square} =$
17. $\frac{\square}{\square} - \frac{\square}{\square} =$
18. $\square + \square - \square =$
19. $\frac{\square}{\square} \times \frac{\square}{\square} =$
20. $\frac{\square}{\square} \div \frac{\square}{\square} =$
21. $\square^{\square} \times \square =$
22. $(\square + \square) \div (\square + \square) =$
23. $\frac{\square}{\square} + \frac{\square}{\square} - \frac{\square}{\square} =$
24. $(\square + \square) \times (\square + \square) =$
25. $\square \times \frac{\square}{\square} - \frac{\square}{\square} =$
26. $\square^{\square} - \square^{\square} =$
27. $\frac{\square + \square}{\square} =$
28. $(\square + \square) - (\square + \square) =$
29. $\square\square \div \square =$
30. $_ + \square = \square$
31. $\square\square - \square\square =$

Answers

1. 8	9. 16	17. $^{1}/_{6}$	24. 176
2. 4	10. 24	18. 6	25. 2
3. $^{9}/_{7}$ or $1^{2}/_{7}$	11. 9	19. $^{35}/_{48}$	26. 8
4. 3	12. 25	20. $^{3}/_{4}$	27. 7
5. 10	13. 8	21. 72	28. 10
6. 10	14. 1,899	22. $^{8}/_{11}$	29. 7
7. 81	15. 675	23. $^{13}/_{30}$	30. 5
8. 14	16. $^{41}/_{63}$		31. 24

▲ Distinguishing Sample Space Situations

BONNIE H. LITWILLER AND DAVID R. DUNCAN
PROFESSORS OF MATHEMATICS
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Bonnie Litwiller and David Duncan teach mathematics and mathematics education courses at the University of Northern Iowa. They have published over 850 articles in journals for mathematics teachers and have spoken at numerous professional meetings. Each has served as President of the Iowa Council of Teachers of Mathematics and Dr. Litwiller has served on the boards of NCTM, SSMA and AMTE.

Subtle distinctions are sometimes necessary in determining probability events. Let us contrast these two problems:

Problem I

Molly flips two coins, a penny and a nickel. She tells Melissa that the penny was a head. Molly then asks Melissa "What is the probability that both coins are heads?"

Since no information has been given about the nickel, Melissa reasons that there is a 50% chance (a probability of ½) that the nickel shows a head; consequently the probability is ½ that both coins were heads.

Problem II

Molly flips two fair coins, a penny and a nickel. She tells Melissa that at least one coin is a head. Molly then asks Melissa "What is the probability that both coins are heads?"

Melissa reasons that there were initially four equally likely outcomes as a result of flipping the two coins. Expressed as ordered pairs in the form (penny, nickel), they are (h,h), (h,t), (t,h), (t,t). The information that Molly provides rules out only (t,t). Since (h,h), (h,t), (t,h) are still equally likely, Melissa concludes that the probability of two heads is now ⅓.

Note that in Problem I, the information provided by Molly enabled Melissa to eliminate the possibilities of (t,h) and (t,t). The remaining possibilities of (h,t) and (h,h) were equally likely, thus leading to the conclusion that ½ was the probability of two heads. The two problems are seemingly similar, but the answers are quite different.

Other examples can be constructed to illustrate the distinction between these two problems.

Example 1

Melissa is looking at the end of a water pipe which is controlled by two independent faucets. If either one or both of these faucets is turned on, water will run out of the pipe. (An example of these would be a typical bath tub faucet system with separate hot and cold water controls.) Molly covers both faucets with her hands, while Melissa is looking at the end of the pipe.

A. Assume that Melissa sees Molly turn on the first faucet, but is unable to see the second faucet. This situation is similar to Problem I. Melissa concludes that the probability is _ that both faucets are turned on.

B. Assume Melissa is unable to see either faucet, but observes that water comes out of one end of the pipe. She then knows that at least one faucet has been turned on. This situation is similar to Problem II. Melissa concludes that the probability that both faucets are turned on is 1/3.

Example 2

Molly and Melissa are watching a college basketball game on television. As time runs out with the score tied, Ed attempts a shot, but is fouled by Greg. With regulation time expired, Ed who normally makes 50% of his free throws, steps to the free throw line to attempt two shots. If Ed makes either one or both of his free throws, his team will win the game.

A. Molly and Melissa watch Ed make the first free throw. The picture tube of the television set then goes out and they do not see the second shot. On the basis of what they did see, Molly and Melissa conclude the probability that Ed made both free throws (by making the second shot) is ½.

B. The picture tube of the television set goes out as Ed stepped to the line to attempt his first free throw. Later Molly and Melissa hear on the radio that Ed's team won without going into overtime, but they do not hear the score. They conclude that Ed made at least one of the free throws and further reason that the probability that he made both free throws is ⅓.

Teachers and their students are invited to compose further examples which require this type of analysis. ▲

▲ 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 read the *Directors' Dialogue* and answer a question about the material and you could be a winner!

This edition of Directors' Dialogue *highlights events at the Friday and Saturday, February 4 and 5 2005 OAME Board of Directors' meeting at the Holiday Inn Select, Toronto Airport.*

The Board Meeting was called to order Friday evening at 8:05 pm. President Gord Cooke welcomed all board members. He thanked Sue and Dave Hessey, OAME Executive Directors, for all their support in his year as President.

Other Highlights include:

- **Chapter Reps Meeting** was held Friday evening 6:30 - 7:50 pm. Greg Clarke welcomed those in attendance. He gave them a great run through of the OAME website. The minutes of our board meetings will soon be published in the 'members only' section of the **www.oame.on.ca** website. Most chapters have their own websites up and running and chapters can now have on-line registration for their mini-conferences. There is also a 'ch rep' link in the members only section where the reps can update chapter information and get a list of their members.

  The chapter numbers were reported at this time. These included: WOMA 103 members; QSLMA 43; SAME 30; SWOAME 25; TEAMS 62; T4MA 115; CHAMP 71; COMA 241; GOLDEN 58; GVMA 165; ISOMA 41; MAC^2 48; NOMA 35; NWOAME 129; PRMA 101. Three chapters have increased their membership substantially in the last year. They are NWOAME, COMA and PRMA. Each was awarded a t-shirt to use at their next mini-conference as a door prize.

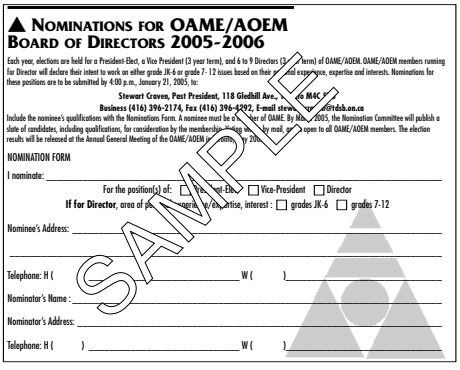
  OMO 2005 spokesperson was Heather Boychuk. She is very happy with how things are progressing. The major sponsor is Union Gas and the committee is working hard to rustle up more sponsorship. A schedule of events was enclosed in each chapter reps package.

- **Equity:** John Ferguson spoke on the change of format for Equity at this year's OAME Annual conference. There will be an Equity Lunch held on Friday with Andrew Alan as guest speaker.

- **Written Reports:** Several written reports were submitted. These include *SQC Meetings* from Bev Farahani and Pat Margerm, *The Kindergarten Program Technical Analysis Team* from Laurie Moher and the *Report From the Expert Panel on Grades 4 - 6 Mathematics* from Irene McEvoy. (You can read these reports in full by logging onto the OAME website: members only.)

- **SQC:** Anthony Azzopardi came from the Ministry of Education to speak about the grade 9 and 10 (Academic and Applied) revisions to the curriculum. He spoke about the feedback process as well as the review teams that were in place. He talked about the implementation time lines. The MoE anticipates a release of the 9/10 revisions at the end of February and the 1 - 8 by the end of March. Board training would be April/May so that training in boards would be June/early fall.Then he answered questions from the Directors relating to the new curriculum. A question that arose more than once was the inservicing of teachers, the how and when questions. Anthony took lots of notes to take back to the ministry with him. Anthony stayed for lunch with the Directors and answered more informal questions, then left for

OAME BOARD NOMINATION FORM
Now Available on Line!


▲ Nominations for OAME/AOEM
Board of Directors 2005-2006

Each year, elections are held for a President-Elect, a Vice President (3 year term), and 6 to 9 Directors (3 year term) of OAME/AOEM. OAME/AOEM members running for Director will declare their intent to work on either grade JK-6 or grade 7-12 issues based on their personal experience, expertise and interests. Nominations for these positions are to be submitted by 4:00 p.m., January 21, 2005, to:

Stewart Craven, Past President, 118 Glenhill Ave., [illegible] M4C [illegible]
Business (416) 396-2174, Fax (416) 396-5292, E-mail steve[illegible]@rdsb.on.ca

Include the nominee's qualifications with the Nominations Form. A nominee must be a member of OAME. By Mar[illegible] 2005, the Nomination Committee will publish a slate of candidates, including qualifications, for consideration by the membership. Voting will be by mail, and is open to all OAME/AOEM members. The election results will be released at the Annual General Meeting of the OAME/AOEM [illegible] May 2005.

NOMINATION FORM

I nominate: _____

For the position(s) of: ☐ Vice-President ☐ Director

If for Director, area of p[illegible] expertise, interest : ☐ grades JK-6 ☐ grades 7-12

Nominee's Address: _____

Telephone: H ( ) _____ W ( ) _____

Nominator's Name : _____

Nominator's Address: _____

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SAMPLE

www.oame.on.ca/boardnom.pdf

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FALL CONFERENCE AT THE UNIVERSITY OF WATERLOO – THURSDAY, OCTOBER 20, 16:00 – 21:00

another commitment.

- **Farewells:** Gord Cooke recognized the contribution to OAME of the following retiring board members: Judy Duissaime, Stewart Craven and Irene McEvoy.

Chapter Reports

CHAMP–Rep: Lynda Fernyhough:

The chapter is focussing on finding ways to appeal to more elementary school teachers and a broader range of high school teachers. They held a very successful high school math contest, as well as a Nov 18th 2004 fall conference, and are gearing up for the elementary school contest coming up April 4, 5.

COMA–Rep: Joanne Anas

COMA has been working hard to help with the implementation of Literacy initiatives in their area They are looking for ways to put the money they earned from their conferences back into their math community. They are busy preparing their grade 7 and 8 students for OMO in Sudbury in June of this year.

GOLDEN–Laura Tonin:The team is working to get their Spring conference, set for April 27th at Brock University up and running. Their theme this year is "Mathematics: Just do it!"

GVMA–Rep: Barb Vukets: barb_vukets@wrdsb.on.ca

GVMA was pleased that they were able to close the books on OAME 2004. They also held a very successful 2004 fall conference for 160 people. They have already started plans for their 2005 fall conference.

ISOMA–Rep: Chris Kirkpatrick:

The ISOMA team was very happy with their 2004 fall conference. They felt excited that Independent Schools teachers had an opportunity to come together and share technology workshops, make acquaintances and discuss issues unique to the Independent Schools.

MAC²–Rep: Andrew Morrison:

MAC^2 is very excited about the initial planning stages for OAME 2007! They have been busy at the local level as well. They are running a Junior Math Challenge this year, and have begun volunteering in schools to help students prepare for this problem solving opportunity. Their team is working on their April 21st 2005 mini-conference. As well they are preparing three teams to attend OMO 2005.

NOMA–Rep: Sue Melville:

NOMA's team has been working diligently to get the June 4th and 5th 2005 Union Gas Ontario Mathematics Olympics underway. They are hosting the event at Laurentian University and Science North in Sudbury. Venues have been booked and sponsorship requests have been sent out.

▲ Upcoming Events

For further information on OAME Chapter Conferences contact the Chapter Representative and for NCTM conferences, contact John Kersely, OAME/NCTM Rep.

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

Chapters now have websites that are linked to the OAME website: see these for full information on upcoming events.

OAME Chapter Conferences and Events

October 13 2005	Philip Pocock CHS Mississauga	CHAMP
October 27 2005	St Augustine CHS	Y4MA
November 17,18 2005	MathFest Travelodge Airlane Hotel Thunder Bay	NWOAME

OAME Annual Conference:

May 11 - 13 2006	Fanshawe College "Everyone Counts"	hosted by WOMA

NCTM Annual Conference

April 26 - 29 2006	St Louis MO

NWOAME–Rep: Maribeth Williams:

NWOAME's executive had to reschedule Math Fest 2005 from February 2005 to November 17 & 18 2005 at the Travelodge Airlane Hotel in Thunder Bay. Flyers advertising this conference wil be in schools early June. Keynote speaker is Anthony Azzopardi. Plans for their regional OMO 2005 events are underway.

PRMA–Rep: Sandra Jean Price:

This years' focus is to increase membership in outlying regions of our chapter. We are hosting "Would Alex have Passed with a different Teacher" in April 2005 in Peterborough. The chapter is thrilled to have Don Fraser as their keynote speaker. He is a legend in the mathematical community. The chapter is trying something a wee bit different this year: they are hosting their annual general meeting in conjunction with a chapter social (in hope of raising attendance).

QSLMA–Rep: Robert Sherk:

QSLMA has been working to keep in touch with its membership. They use e-mail newsletters and have been working on developing a website. They have been supporting and encouraging members to attend annual Leadership and provincial conferences.

SAME–Rep: Sumintra Koowar

SAME is preparing their students for OMO 2005 in June. They are also considering hosting OMO in 2006.

SWOAME–Rep: David Petro:

SWOAME continues to work on membership. They are planning some exciting upcoming conferences that should bring out more teachers to their functions.

TEAMS–Rep: Pat Margerm:

With the plans for the 2005 Annual OAME conference well underway TEAMS looks to fine tune their on-line registration as well as their website. They have a great team in place and this should be one of OAME's finest annual conferences. Their program booklet was streamlined to help encourage members to look on-line for full conference details.

WOMA–Rep: John Ferguson:

WOMA is hosting OAME 2006 "Everyone Counts" May 11 - 13. They are very excited about the venture and have been working hard to put the plans in place. They continue to work on a logo, book facilities, book keynote speakers and are job shadowing OAME 2005. This spring they will be hosting "MatheMagics" on April 14th at Fanshawe College.

Y4MA–Rep: Rosey Mastrofrancesco:

No spring conference is planned for Y4MA. They are taking a well deserved break before gearing up for another fall conference. Plans are underway to send teams to OMO 2005 in June.

"Which chapter is considering hosting OMO 2006?"

Yours in Mathematical fun,

Jacqueline ▲

The Geometer's Sketchpad Version 4

April, 2005

To access Ministry-licensed online training for The Geometer's Sketchpad go to:

http://www.atomiclearning.com/sketchpad

Ontario teachers and students in publicly funded educational institutions, contact your OESS representative for the sketchpad tutorials password.

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