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▲ Editorial



MARILYN HURRELL, EDITOR
E-MAIL: mhurrell@tbaytel.net

First, let me introduce myself. I have been a Mathematics Specialist teacher with the Lakehead District School Board in Thunder Bay for 32 years, retiring in 1999. In 1989 I became the founding Chair of NWOAME (North Western Ontario Association for Mathematics Education) and joined the Board of OAME. I have been re-elected as a Director for the past 9 years, and have written the *Directors' Dialogue* for four years. Hence I move from the last page to the front!

Louis Lim and I have talked over the past year as he made up his mind to retire and I decided to fill my retirement years with a new project. The Editorship of the *Ontario Mathematics Gazette* seemed perfect, as I am familiar with OAME and with the editing process, and I can work out of my house as I care for a disabled partner. Louis has been my great friend and mentor throughout this transition process and I thank him for his mentorship.

You will note from the Table of Contents that I inherited a wonderful Team, which continues through this edition of the *Ontario Mathematics Gazette*. I am very appreciative of their support of me. I welcome back Associate Editors **John Egsgard** and **Todd Romiens**, Columnists **Lynda Colgan**, **Fred Ferneyhough**, **Chris Suurtamm**, **Ron Lancaster**, **Frances Schatz**, *Abacus* Editor, **Dean Murray**, Advertising Manager and **Doug Evans**, Webmaster. I welcome **Jacqueline Hill** who has taken over the *Directors' Dialogue*.

Other columns will be included over the year, including an update on the OAME Vision Project in the December *Gazette*.

The *Gazette* is recognized by the mathematics education community as an outstanding journal, and "the place to be". This is proven by the number of articles which arrive from all over Canada and the US. I encourage any reader who has a "Good Idea" to write it up and submit it for review and possible publication in the *Gazette*. I did this when I was teaching Finite Math and had an article describing my annual MFN "Casino" published, much to my delight.

I am seeking reviews of books you have read, a video, a web site, a manipulative you have used. Submit this by e-mail along with a brief writeup of what grade

level this is appropriate for and how you have used it.

The fact that you are reading a September issue of the *Gazette* proves that Louis and Penny Clemens, graphics designer, have guided me well. An assurance to all current reviewers; you are still on my list. I continue to seek other reviewers and if you are interested, send me an e-mail stating area of expertise and mailing address. Also, I welcome e-mails letting me know how you feel about the subject matter in this issue of the *Ontario Mathematics Gazette*, please e-mail me your comments and questions. Be sure to include some information about your background.

As I am no longer in a classroom, but I do a fair amount of tutoring, I look at the articles and columns in this, my first edition, with some wistfulness. What a wealth of opportunities are out there for math teachers just entering the profession, or those who are experienced and have the opportunity to tackle new courses, new tools and challenges! ▲

Marilyn Hurrell

▲ Letter to the Editor

Dear Editor,

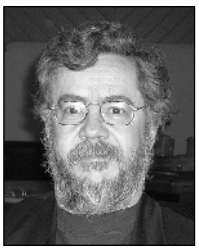
First, I want to commend Dr. Lynda Colgan's excellent, timely, and vivid articles on connecting mathematics education to research in both the March and June 2003 issue of the *Ontario Mathematics Gazette*. I believe she is performing an invaluable service for practicing teachers by pointing them to accessible research that they can apply to reflections on their own classroom efforts.

I wish to make a correction to the article *"Hey, It's Elementary...: Research on the Beach..."*, which appeared in the June 2003 issue. In Dr. Colgan's review of three articles, she refers to tthe Nelson-Thompson Publishing report, which was mistakenly attributed to Jeanette Mackenzie.

Of course, that is understandable since Ms Mackenzie was in charge of the project and the name of the author, Dr. Roslyn Doctorow, was not included in the first issuing of the report. In the new print versions of the report, the correct authorship is now indicated. It's gratifying to see that Dr. Colgan included Dr. Doctorow's research in her article.

Gord Doctorow
Gord.Doctorow@tel.tdsb.on.ca ▲

▲ President's Message



STEWART CRAVEN

Recently, I have had the privilege of participating in a variety of mathematics groups where learning, thinking, and even socializing with the exceptional educators involved has been nothing less than exhilarating. Whether it has been in formal or informal meetings with my department, at workshops with teachers in our schools, at the OAME Annual Conference at Durham College, the GSP4 Summit in Kingston, the Canadian School Mathematics Forum in Montreal, or the Canadian Mathematics Education Study Group at Acadia University, I have witnessed my colleagues' vitality, passion, and concern about mathematics. Conversations have ranged from a curriculum that is too "packed", to how best to use *Geometer's Sketchpad* in middle school, to the trials and triumphs of implementing the new Ontario curriculum.

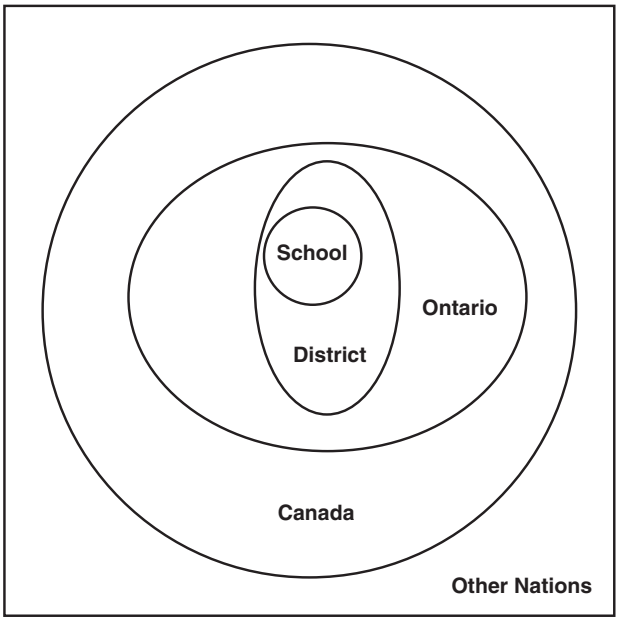
We all belong to several communities of learners. Let me start with your school level where you likely belong to several "communities of learners". One such group may comprise your colleagues who teach mathematics, another, perhaps a middle school mathematics team or a high school mathematics department. These are the people who eagerly share ideas and resources with you, discuss assessment and evaluation issues with you, support you in times of need, and laugh with you when it is time to relax.

At the board level, there are numerous communities in which you might become involved. For example, you could become involved in a Head's Council, you might get together with other teachers to discuss teaching and learning as part of a study group or book club, or you might plan and participate in a math camp. You might think that this last example is a bit unusual. However, there is a weekend math camp with a fourteen-year history where forty students experience mathematics in ways they never thought possible along with fifteen to twenty teachers. Here, both teachers and students experience the thrill of exploring, thinking about, and discussing mathematical ideas shoulder to shoulder. If one wanted to find the perfect example of a "community

of learners," this would be it.

At the provincial level, there are also many opportunities to join groups. Each year, EQAO and PISA look for developers and markers who will work closely together and who will inevitably come away enriched by their experience. Another group that brings teachers and university professors together to discuss wide-ranging issues is the Field's Education Forum. And, of course, there is the OAME, the amazing community of teachers and educators from every corner of the province. That is you and I. Through Chapter organizations and the provincial body, many thousands of mathematics educators gather to discuss issues, develop resources, and learn together. We are indeed a powerful community of teachers and learners.

As I was taking part in a debriefing session held at the University of Quebec (Montreal) on Victoria Day, a group of about twenty teachers and members of faculties of education and university mathematics departments were gathered around the discussion table. In our midst was an aboriginal mathematics professor from Western Canada. We were talking about the teaching and learning of mathematics in a general sense, unaware that our views were very much a product of our ethnocultural background. At a critical moment, Ed very quietly spoke up, saying, in effect, "Our philosophy does not distinguish teaching from learning. We believe that from the time you are born until you die, all people are both teachers and learners." ▲



▲ 2003 OAME Award Recipients



Mike Morin's contribution to education over the past eight years has benefited students internationally. His experience ranges from teaching ESL in Taiwan and Spanish in Guatemala to teaching mathematics in Colombia (South America), Ottawa, and most recently, York Region, where he teaches at Middlefield Collegiate Institute. His innovative teaching strategies include many hands-on, interactive investigations and inquiries that students find exceptionally fun and interesting. Highly respected by his students and colleagues, Mr. Morin has been described by the Department Head at Middlefield Collegiate as *"… always open to innovative techniques and new ways of teaching material that would otherwise seem very dry."* Mike Morin is this year's recipient of the **Award for Exceptional and Creative Teaching in Secondary Mathematics**.



In addition to being a mathematics educator, **Ron Sauer** has a wealth of experience working "behind the scenes". As a member of OAME/AOEM for the past thirty years, Mr. Sauer has been a director and councillor of OAME, an executive member for the Grand Valley Mathematics Chapter, Program Chair for the 1995 OAME Annual Conference, and coordinator of publishers' displays for two OAME Leadership Conferences. In addition, he has been an active member of OMCA since 1984 and has been a member of countless committees and writing teams. Ron Sauer is this year's recipient of the **OAME/AOEM Life Membership Award**.



Frank Schatz is neither an educator nor a professional mathematician, yet his involvement in the mathematics education community is said to be so proficient that he is able to *"…recite the NCTM resource by price and number!"* Frank Schatz has shared his knowledge and advice, assisting NCTM-OAME with respect to its annual conferences and the *Ontario Mathematics Gazette/Abacus* publications. In recognition of his significant contribution to the mathematics education community, Mr. Schatz is this year's recipient of the Award for **Outstanding Contribution to OAME/AOEM and Mathematics Education in Ontario**.

The Mathematics Department of Centre Dufferin District High School combines collegiality with joint excellence. For the past seven years, these eleven dedicated teachers have given up their lunch times to run tutorial programs in mathematics and science, have developed detailed guides for new curriculum courses, organized math contest preparation, led the EQAO assessment, and co-authored new textbooks. The department has also initiated a lease-to-own program to encourage all students to use technology, not just in class, but also at home. These teachers have attended workshops in the district, in the province, and in various parts of North America and are involved in extracurricular activities such as the talent show, lip synch, Christmas music nights, student council, and coaching the basketball and curling teams. These eleven teachers have become leaders, not only in their school, but district and province-wide. The Mathematics Department of Centre Dufferin District High School is this year's winner of the **Kenneth D. Fryer Award**.



Back row, left to right: Rob Scott, Rob Thackeray, Janet Kranz, Pauline Lloyd, Amy Phillips, Gord Plumridge, Fran McLaren Front, seated, Mike deLaat, Kevin Spry Missing: Leah Pressey, Chris Sales.



Merilyn Fox has been described as *"an extraordinary ambassador of mathematics education."* Her intelligence, creativity, kindness, open-mindedness, and sense of humor make her students and colleagues feel *"special and important."* An active member of S.A.M.E. and O.A.M.E., Merilyn Fox has enthusiastically piloted and supported many projects from running the Math Club and Math League to working many, many hours with the Scarborough team to prepare for the Ontario Mathematics Olympics. Over the years, Merilyn has developed hundreds of rich learning tasks while maintaining a presentation style that has been consistently fresh and engaging. To teachers and administrators alike, Ms. Fox has established herself as a dynamic and passionate educator who always gives 110%. As one of her colleagues states, *"For Merliyn, every moment is a 'teachable moment'; that is why so many people have learned so much from her over the years."* Merilyn Fox is this year's winner of the OAME award for **Exceptional and Creative Teaching in Elementary Mathematics**.



Connie Quadrini has been described as *"a leader who articulates a clear school vision, [and who] motivates and empowers other teachers to meet high performance expectations."* Connie is an enthusiastic educator who has found her niche in the mathematics classroom. At St. Augustine Catholic High School, Connie received a grant from the *SchoolNet GrassRoots Program* to implement information and communications technologies (ICT) as a complement to constructivist student activities throughout all grade levels and streams/destination. At the York Catholic School Board, Connie was actively involved in the Grade 9 EQAO testing, co-led the Grade 9 Mathematics Writing Team, and presented workshops for grade 10 Academic math. Connie's emphasis on technology, hands-on student investigations, and real-life mathematics, along with her strong commitment to a progressive vision for mathematics education, makes her an ideal role model. Connie Quadrini is the winner of the **Union Gas Award for Outstanding Leadership in Mathematics Education**.



Susan Guzzo's enthusiasm, commitment, and faith in the idea that every student can do better, coupled with her innovative lessons, projects, and leadership in various math-oriented extra curricular activities became the driving force behind Ridgemont H.S. EQAO results. It has been quoted that Susan would always go the extra kilometre for her students, and in recognition of Susan's leadership, she has been selected as the winner of **The Union Gas Award for Teaching Excellence in Mathematics (Secondary Division)**.



Blanche Thomas not only *"loves math",* but her continuous renewal in the way she teaches mathematics has also created a love of math in her students. The only teacher in the Renfrew County District School Board with a Math Specialist qualification, Blanche Thomas is an exemplary leader. By incorporating ideas from many workshops, conferences, books, and professional publications, she implements problem-solving strategies into her lessons and shares these strategies with her colleagues through her workshops on problem solving in the junior division. Blanche Thomas is the 2003 winner of **The Union Gas Award for Teaching Excellence in Mathematics (Elementary Division)**.▲

▲ Welcome to the Statistics Canada Data Fair

BY CHRIS SUURTAMM
TOM STEINKE AND JOEL YAN

Question: What do you get when you bring the teachers and students of the Grade 12 Data Management Course (MDM4U) together with Statistics Canada staff to celebrate exemplary student projects?

Answer: The wildly successful Statistics Canada Data Fair, held in Ottawa in the lobby of the Jean Talon building at Statistics Canada on June 4th .



A student from St. Puis X shares her project with several Statistics Canada employees and a teacher.

The Data Fair, where students set up displays of their culminating projects, gave students, teachers and Statistics Canada staff from the Ottawa Region the opportunity to see the range and quality of student projects from the MDM4U course. The Data Fair highlighted 26 student projects from 9 high schools and three school boards in the region. The projects were strong evidence that the challenging vision of the curriculum is coming to life in the MDM4U course. Students really are:

- Posing significant problems which require large data sets;
- Using the tools of the course to analyze their data;
- Producing and presenting their findings; and
- Constructively critiquing the work of their peers.

The many teachers who were in attendance all received a CD containing the PowerPoint presentations for most of the student projects. The CD also contained support materials for teachers from Statistics Canada. The students were the recipients of remarkable attention, interest and enthusiasm from the throngs of Statistics staff who stopped to engage the students in conversations about their projects. Here are some comments:

"Wow, Joel. Some of those research papers are as good as those the analysts in Statistics Canada have published! I spoke with . . . and he says that depending on the length of papers, we may be able to publish some of the students' projects that are relevant to education."

Shelley Harris, Analyst, Statistics Canada

"It was so great to make the connection between those that set up the data and the students who are using it."

Student Participant



A teacher and Statistics Canada employee watch a presentation from a student from Sir Robert Borden.

The students all received the *Canada: A Portrait* book and the *Canada Yearbook* CD as well as a Certificate of Appreciation. Probably the greatest benefit for students was the opportunity to talk about their work and see the work of other students. Students recognized that their projects have value both in and outside of the classroom.

"It was very fun and interesting to see what students at other schools were doing and researching. Not many projects were the same. I had a great time. It was an excellent experience."

Student Participant

Most of the student projects used Statistics Canada data. In particular, data was drawn from:

- E-STAT
- The National Longitudinal Survey of Children and Youth (NLSCY) microdata from the Ontario Fathom CD (called OntarioYouths.ftm)

In the fall of 2003, students may have access to additional data sets such as:

- 1991 Census Microdata set
- Census at Schools data



St Matthews students share their projects with data fair judge, David Zimmer, and several Statistics Canada employees and a teacher from Perth.

The projects were judged by a panel of educators and

Statistics Canada staff. Students with the top 7 projects received prizes donated by Statistics Canada, Spectrum Educational and Texas Instruments. The judging of so many excellent student projects in such a short period of time was extremely challenging.



Statistics Canada employees stopping to speak with students from Brookfield High School.

"Next year, we plan to focus on celebrating the quality and diversity of student projects rather than ranking the projects. They were all great!"

Joel Yan, Statistics Canada

The model of a Data Fair to celebrate and share the MDM4U student projects can be used at several different levels: school, board, region, or province. In the 2003 – 2004 school year, Statistics Canada will build on the success of this initial experience by:

- Providing ideas for projects on the Learning Resources web site of Statistics Canada
- Planning earlier (September)
- Holding the event in early February
- Involving more boards, schools, teachers and students
- Building in learning opportunities for teachers and students
- Creating partnerships with mathematics educators:
  - OAME
  - OAME Chapters
  - OMCA
  - Fields Institute

"Many thanks for a great day – my students were really impressed and felt that their research was being well considered. All in all, a huge success."

Heather Rayner, Teacher,
St. Matthew High School

Watch for an upcoming regular column in the *Gazette* that will provide further support to teachers from Statistics Canada. Please send any suggestion for this column to Joel at joel.yan@statcan.ca, 1-800-465-1222. ▲

▲ From Number to Variable: Transition to Algebraic Factoring

CORNELIUS DE GROOT



Dr. Cornelius (Kees) de Groot is an assistant professor of elementary education at SUNY New Paltz in New York State. His interests are related to learning transitions in mathematics and performance assessment. Dr. de Groot is director of the NYS K-8 Math Mentor Network and is the editor for Secondary Math Exemplars.

The middle grades are an important transitional period toward more formal approaches in mathematics in high school. Hirsch and Lappan (1989) identify three important dimensions in which this transition must occur: (1) from number to variable, (2) from specifics to generalizations, and (3) from description to proof. In this article, I will focus on the first dimension of transition, from number to variable, as well as the second dimension, from specifics to generalizations. I will view a transition toward algebraic factoring in two ways: a) as the study of patterns and relationships and b) as generalized arithmetic (see Fernandez and Anhalt, 2001). I propose a method that employs students' number sense and their knowledge of patterns with whole numbers and integers. While this method is intended for middle grades, it can be used with high school students, who do not have a grasp on algebraic factoring, even though they have been taught how to factor before. It is not the intention of this article to provide a shortcut to algebraic factoring. Rather, this method aims at a conceptional level of understanding factoring.

Prerequisite Knowledge

I will begin by providing an inventory of skills and knowledge that should be in place for the method to

work successfully. Students need to be able to factor negative integers and positive integers, using the rules for multiplying integers. For example, 17 factors as 1 x 17 and –1 x –17, while –17 factors as –1 x 17 and 1 x –17. Students must have well-developed ideas about patterns and relationships, a) within a sequence of numbers, and b) between two sequences of numbers. Within a sequence, students should be able to recognize common differences and they should be able to extend a pattern with this knowledge. They should also be able to recognize that all elements in a sequence may have a common factor, or a greatest common factor. Between sequences, patterns focus on the relationship of a sequence to the natural numbers and later the set of integers. This means that they should be able to generate the nth term of a sequence. Students need to be able to substitute a value for a variable in (linear and quadratic) algebraic expressions and calculate the expression value. Last, students need to be able to factor numbers and be able to choose a factor pair such that a pattern will develop. This is explained in the next section.

Factoring Using Patterns

Students begin this method by calculating the values of the expression for a sequence of chosen (integer) values of the variable in a table. It is important that the chosen values of the variable are in a pattern such as consecutive whole numbers or integers. In the beginning the teacher should choose the values such that he/she does not end up with negative integer expression values. Negative integer values should follow after students become sufficiently familiar with the method. We will begin by investigating the expression: 5x + 10. Let x = 1, 2, 3, 4, and 5 (see Table 1). Next explain to the students that they will factor each expression value in two columns, First Factor and Second Factor. In the case of linear expressions the first factor will be a constant. Students should recognize that in Table 1, all expression values have 5 as their greatest common factor. From this they should determine the second factors.

Table 1

x	5x+10	First Factor	Second Factor	pattern
1	15	5	3	5(1+2)
2	20	5	4	5(2+2)
3	25	5	5	5(3+2)
4	30	5	6	5(4+2)
5	35	5	7	5(5+2)
⋮	⋮	⋮	⋮	⋮
n	5n+10	5	n+2	5(n+2)

Now it is time to develop a relationship between the x-values column and the column of second factors. I have found it helpful when students cover up everything between these columns and look for the pattern across. This establishes a one-to-one correspondence of the variable x with the associated collections of first and second factors. Then they can generalize the factorization as 5x + 10 = 5(x + 2), as can be seen in the column labelled "pattern". I have used n as the general value substituted for x in all the examples I present in this article. After sufficient experiences, students can begin to investigate quadratic expressions and apply the same method. We will begin with quadratic binomials and then proceed to trinomials.

Factoring Quadratic Expressions

Table 2 demonstrates the method for the quadratic binomial. Students will not be able to find a greatest common factor in this set of expression values. Their job now is to choose factor pairs for each expression such that the factors in each column form a *pattern*.

Table 2

x	$x^2 + 2x$	First Factor	Second Factor	pattern
1	3	1	3	1(1+2)
2	8	2	4	2(2+2)
3	15	3	5	3(3+2)
4	24	4	6	4(4+2)
5	35	5	7	5(5+2)
⋮	⋮	⋮	⋮	⋮
n	$n^2 + 2n$	n	n+2	n(n+2)

In the table, start with products that factor in one or two ways only, such as primes, and then do the remaining factorizations so these fit a pattern. For example, 3 = 1 x 3; 15 = 3 x 5; and 35 = 5 x 7. Another agreement, which is not always possible to follow, is that the smallest of the factors goes in the First Factor column. Have students articulate the pattern in words and then in symbolic form. For example, "the first factor column is a one-more pattern starting at 1 and the second factor column is a one-more pattern starting at 3."

This method works well for binomials with common factors in each term as we saw in the first example. The next example, $5x^2 + 10x$, is a combination of examples 1 and 2.

Table 3a						
x	$5x^2 + 10x$	First Factor	Second Factor	First Factor	Second Factor	pattern
1	15	5	3	1	3	5(1)(1+2)
2	40	5	8	2	4	5(2)(2+2)
3	75	5	15	3	5	5(3)(3+2)
4	120	5	24	4	6	5(4)(4+2)
5	175	5	35	5	7	5(5)(5+2)
⋮	⋮	⋮	⋮	⋮	⋮	⋮
n	$5n^2 + 10n$	5		n	n+2	5n(n+2)

Most students will connect this quadratic binomial with the previous linear and quadratic examples and realize that all expression values will have a greatest common factor of 5. This will result in the initial First and Second Factor columns. Stimulate students to try to continue factoring the Second Factor column into two new columns (like example 2) until a *pattern develops*. After some experiences some students may start to see that algebraically a common factor can vary in a pattern, such as demonstrated in Table 3b.

Table 3b				
x	$5x^2 + 10x$	First Factor	Second Factor	pattern
1	15	5	3	5(1)(1+2)
2	40	10	4	5(2)(2+2)
3	75	15	5	5(3)(3+2)
4	120	20	6	5(4)(4+2)
5	175	25	7	5(5)(5+2)
⋮	⋮	⋮	⋮	⋮
n	$5n^2 + 10n$	5n	n+2	5n(n+2)

In Table 4, the process is applied to the expression $x^2 - 49$, a difference of squares. This will introduce factoring over the integers. It may not be easy to determine which factor pairs to use, since some numbers in the expression column can be factored in several ways. It may be helpful to point out to students to decide first how 33 and 45 can be factored. Next, choose the best place for the negative sign, again emphasizing the need for a pattern that leads to a generalization. You may need to extend the table beyond x = 5 for some students who have difficulty seeing the relationship between the x-values and the First Factor values. Notice, however, that this problem is an excellent opportunity to involve students' knowledge of adding and subtracting integers, which is supported here by looking for patterns. It is important that when students complete the factor columns via discovery of patterns, they should check that the factors obtained multiply correctly to the corresponding expression value. This may invalidate an inferred pattern or confirm it.

Table 4				
x	$x^2 - 49$	First factor	Second Factor	pattern
1	-48	-6	8	(1–7)(1+7)
2	-45	-5	9	(2–7)(2+7)
3	-40	-4	10	(3–7)(3+7)
4	-33	-3	11	(4–7)(4+7)
5	-24	-2	12	(5–7)(5+7)
⋮	⋮	⋮	⋮	⋮
n	$n^2 - 49$	n – 7	n + 7	(n–7)(n+7)

From Specifics to Generalization

After some practice, it is important to discuss with the students that the algebraic factorization gives information about how a specific set of products generated by an expression can always be decomposed in two or more factors in a patterned manner. The idea of generalization is what is powerful here and often not understood by students. It reveals the structure of algebra very clearly and makes a conceptual link between factoring with numbers and the patterned factoring in algebra.

Factoring Trinomials

The proposed process also works well for trinomials (see Tables 5 and 6), even with the coefficient for x^2 being greater than 1 or negative (see Table 7). The example in Table 5 is interesting, because there appears to be a common factor of two. In fact, all expression values are even.

Table 5				
x	$x^2 + 5x + 6$	First Factor	Second Factor	pattern
1	12	3	4	(1+2)(1+3)
2	20	4	5	(2+2)(2+3)
3	30	5	6	(3+2)(3+3)
4	42	6	7	(4+2)(4+3)
5	56	7	8	(5+2)(5+3)
⋮	⋮	⋮	⋮	⋮
n	$n^2 + 5n + 6$	n+2	n+3	(n+2)(n+3)

This can be proved by looking at the algebraic factors: if x is even, then x + 2 is even and x + 3 is odd, thus their product is even. If x is odd, then x + 2 is odd and x + 3 is even, therefore the product is also even. As you can see in the factor columns, the common factor 2 is not consistently in the same column, and therefore it

should not be factored out here. It will remove the pattern in both columns. To avoid this you may want to start with an expression such as $x^2 + 4x + 3$. This methods also works very well for perfect squares such as $x^2 + 4x + 4$ and $x^2 – 6x + 9$.

The example in Table 6 again allows for students to consider factors of negative products and patterns with integers. You can start a discussion with students about how they could avoid the occurrence of negative products by choosing the values of x carefully, in this case starting at x = 3.

Table 6

x	$x^2 – 2x – 3$	First Factor	Second Factor	pattern
1	-4	2	-2	(1+1)(1-3)
2	-3	3	-1	(2+1)(2-3)
3	0	4	0	(3+1)(3-3)
4	5	5	1	(4+1)(4-3)
5	12	6	2	(5+1)(5-3)
⋮	⋮	⋮	⋮	⋮
n	$n^2 – 2n – 3$	n+1	n-3	(n+1)(n-3)

In Table 7, you can observe that the first two expression values have straightforward factorizations and may establish the pattern. All first factors increase by one, starting at 2, and all second factors are consecutive odd numbers, starting at 5.

Table 7

x	$2x^2 + 5x + 3$	First Factor	Second Factor	pattern
1	10	2	5	(1+1)(2x1+3)
2	21	3	7	(2+1)(2x2+3)
3	36	4	9	(3+1)(2x3+3)
4	55	5	11	(4+1)(2x4+3)
5	78	6	13	(5+1)(2x5+3)
⋮	⋮	⋮	⋮	⋮
n	$2n^2 + 5n + 3$	n+1	2n+3	(n+1)(2n+3)

Therefore, the factorization of the expression is (x + 1)(2x + 3), as can be noted in the pattern column. But this may not be obvious for all students. This may require some of the additional strategies described in the next section. This method works for any quadratic expression, but as you can see from the last example, it requires increasing sophistication with patterns when factors are of forms other than x + a.

Connecting with the Function Concept

Up to this point the method proposed has tried to link with students' number sense and their understanding of patterns within and between sequences of numbers. For more complex situations you may want to use the area model, often demonstrated with Algebra tiles (see, for example, http://www.ucs.mun.ca/~mathed/t/rc/alg/tiles/tiles1.html). However, I propose to look at these situations from a graphical/function point of view. If we view the quadratic expression as a function, then it can be thought of as the product of two linear functions. This approach is readily available to middle grades students by using graphing calculators or spreadsheet programs.

To take the function view, it is necessary for students to have knowledge of linear functions, and the ideas of slope and y-intercept. They should be able to graph linear functions. This can be done on a graphing calculator, entering the table values and using line of best fit, or a spreadsheet, entering the table values and using a trend line capability, to make the connection with graphical representation. This means that students can try to fit a linear equation with each column of factors and the column of chosen x-values. If students include 0 in their choices for x, the y-intercept will roll out for free and after determining the slope the factors are then of the form mx + b. If you do not include 0 for x, as done above, you can use the point-slope formula when two points are known. I will first illustrate this with the example in Table 7 and then I will give an example where we can get to the slope, y-intercept form more directly.

For the first factor, I can choose two points of the form (x, first factor), (1,2) and (2,3). Using the point-slope formula will yield y = x + 1. Therefore, (x + 1) represents the general first factor. Using (1,5) and (2,7) for the second factor will yield y = 2x + 3. Therefore, (2x + 3) represents the general second factor. One of the things that need to be emphasized is that the same general factor must come

Table 8

x	$6x^2 + x – 2$	First Factor	Second Factor	Pattern
-3	49	-7	-7	(2x-3-1)(3x-3+2)
-2	20	-5	-4	(2x-2-1)(3x-2+2)
-1	3	-3	-1	(2x-1-1)(3x-1+2)
0	-2	-1	2	(2x0-1)(3x0+2)
1	5	1	5	(2x1-1)(3x1+2)
2	24	3	8	(2x2-1)(3x2+2)
⋮	⋮	⋮	⋮	⋮
n	$6n^2 + n – 2$	2n-1	3n+2	(2n-1)(3n+2)

from any choice of two points. If students get several different general factors for arbitrary choices of pairs of points, they must conclude that there is no general factorization possible for that quadratic expression.

Table 8 is an example where I chose 0 as one of the x-values and where patterns are maybe more difficult to discern.

For the first factor you can see that the y-intercept is -1 and the slope is 2, making (2x – 1) the first factor, and that similarly the second factor is (3x + 2). This appears to be easier. However you may not be able to avoid having to deal with negative factors. I found that spreadsheets and graphing calculators that allowed for curve fitting generated these expressions very easily as well. As stated earlier, the tabular format forms a good transition to using this technology.

Showing that Factoring Cannot be Done

Students can also decide that an expression *can not* be factored by means of this technique. Let the expression be $x^2 + x + 1$. Then the table looks as follows:

Table 9

x	$x^2 + x + 1$	first factor	second factor
1	3	1	3
2	7	1	7
3	13	1	13
4	21	1 or 3	21 or 7
5	31	1	31

Only one of the values in the second column can be factored other than using primes. Therefore, there is no general factorization possible of this trinomial. This method does not distinguish between non-factorable expressions whose correspondng equation has irrational roots, for example $x^2 + x = -1$, and those that have complex roots, such as the above example.

Conclusions

You can continue to experiment further with this method before you take it to your class. For example, this method extends to simplifying rational expressions. You are encouraged to try this method for yourself and determine whether it is a useful strategy in your classroom. It worked well for me when I did this with remedial high school students, who had not learned how to factor after two years of formal instruction. Experiment with choosing x-values such that negative product values show up. Does this method work with expressions of degree other than 2? How could you employ a spreadsheet or a graphing calculator with this method?

I have found that students' development in learning algebra hits a symbolic wall. When I returned to my students' number sense and their sense of pattern, they could discover how each algebraic expression generates a special set of numbers that can be factored in a patterned way. This provided meaning to their learning of algebra. It was not until after the algebra was meaningful to my students that they were open to using other ways of investigating these problems. I helped my students derive meaning by connecting with what they knew well.

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Fernandez, M, and Anhalt, C, (2001). Transition toward algebra. *Mathematics Teaching in the Middle, 7*(4), 236-241.

Hirsh, R, and Lappan, G, (1989). Transition to high school mathematics. *Mathematics Teacher, 82*, 614-618. ▲

▲ Upcoming Events

For further information, please contact the Chapter Representative (see last page of the *Gazette*) for OAME conferences, and Frances Schatz, OAME's NCTM Representative, for NCTM conferences.

OAME Conferences

(all Chapter Conferences are held after school)

October 16, 2003	Markham	Y[4]MA Chapter Conference
October 17 – 18, 2003	Sudbury	NOMA Chapter Conference
October 23, 2003	Orillia	MAC[2] Chapter Conference
November 5, 2003	*location yet to be determined*	ISOMA Chapter Conference
November 8, 2003	Ottawa	COMA Chapter Conference
November 13, 2003	Kitchener	GVMA Chapter Conference
Early November *(exact date yet to be determined)*	Kingston	QSLMA Chapter Conference
Early February *(exact date yet to be determined)*	Thunder Bay	NWOAME Chapter Conference
April 28 – May 1, 2004	University of Waterloo	31st Annual OAME Conference

NCTM Conferences

November 20 – 22, 2003	Edmonton, Alberta	Canadian Regional Conference
April 21 – 24, 2004	Philadelphia, Pennsylvania	82nd Annual Meeting

Other

October 3 – 4, 2003	Brampton	Texas Instruments Regional Conference

OAME 2004

▲ Book Review: *Jayden's Rescue*

REVIEWED BY LAURIE MOHER

Laurie Moher is an Educational Services Advisor with the Kawartha Pine Ridge DSB. She is on the Board of Directors for OAME. She was a member of the Early Math Strategy Expert Panel.

Dedicated to the late Bob Wilsher, former Chair of the Kawartha Pine Ridge DSB. It was through his keen observance that this book came to my attention.



A math-phobic's nightmare or a mathematician's dream come true? Technically both. In *Jayden's Rescue*, Vladimir Tumanov's first novel, the main character Alex is a mathphobic. Alex's teacher, Ms. Lund is a stereotypical math teacher who begins every Monday morning with a math test. Her justification for this strategy is, "You need to wake up your brain cells at the start of a week!" For Alex, these tests are a source of anxiety. His brain "seizes up" from the start of the test until he hears the words, "Turn in your papers, please." The highest grade he was ever able to achieve on these tests was a 'C' and that was a rare achievement. The solution to Alex's math difficulties came "out of nowhere" and landed at his feet, in the form of a magical pencil. Life was good. From that day on it was nothing but 'A's for Alex on his Monday morning tests. However, his success was short lived. The pencil soon disappeared leaving in its place a mysterious book entitled, *Jayden's Rescue*. In this book, Jayden was a young, beautiful queen who ruled a prosperous kingdom called Idyllia. Jayden was also a well respected scholar and teacher. And, although she had a love of all subject areas, her favourite subject was mathematics. In fact, "no one could explain the trickiest geometry theorems or most complicated algebra equations better than she did." The trouble began in Idyllia when Jayden spurned the marriage request of the evil King Rechner of Lugubria. As Alex began to read the story, he quickly discovered Rechner had kidnapped Jayden. She was being held captive in a castle with 400 rooms and needed his help. For although Jayden was capable of solving the mathematical problems in the book, she was prevented from doing so by Rechner. Alex realized that without solving the problems Jayden was stuck in the room where she was being held and could not move towards freedom. Alex wanted to help Jayden but had no desire to attempt the problems. He simply did not believe he could do the math without the help of the magical pencil. Alex did solve this first problem but with 400 rooms and 400 more problems, he knew he would have to enlist the help of his two friends, Sam and Vanessa. Together the three friends solve puzzle after puzzle and move Jayden safely through the castle. In the end they are successful in rescuing Jayden and Alex learns that he really is a mathematician.

This book is geared towards students in Grades 4 to 6. The mathematical problems in the book involve the strands of measurement, patterning and algebra, and number sense and numeration. Here is one of the problems the friends were faced with:

King Rechner once a castle built. He used his magic powers.
And on the castle's mighty wall he put twelve silver towers.
Each one is taller than the last, each one beyond compare.
A lofty problem's built for you, so solve it, if you dare.
The smallest tower's twenty metres; tower two, five more.
The third one's height is thirty-five, and then comes tower four.
It is a huge one: fifty-five. So tell me, if you please:
What is the height of number twelve? The answer is a breeze. (p.43)

Shortly after the problems are presented, solutions are offered, with the thinking clearly illustrated. Although the problems themselves have only one correct answer,

students could use a variety of ways to arrive at the answers. The only caution with this book is that some of the problems that are presented involve mathematics that goes beyond the Grades 4-6 level (e.g., some of the patterning and algebra toward the end of the book).

The characters in this book model good mathematics strategies. They reread questions, pull out important pieces of information, discuss ideas, and write solutions. They use different problem solving strategies to solve the problems (e.g., choose an operation, make a chart). The appropriate use of a calculator is modelled.

Aside from the mathematics, this is an interesting book to examine with students. The story of Jayden (story within the story) can be analyzed in terms of the elements of fairy tales and for the themes that run throughout this story. There are also sub-themes that run throughout the story of Alex and his friends; solving social problems with each other, teachers, and with parents. There is an emphasis on acceptable ways to solve social/ethical problems or challenges.

Jayden's Rescue was published in 2002 and is available from Scholastic Canada Ltd., ISBN 0-439-98864-0. The price is $5.99.

When I read this book, I immediately began to envision a variety of ways this book could be used in a primary or junior classroom.

- Read the book and have students solve the problems in groups as the story progresses. The language in the book is better geared to independent reading at the 4/5 level but to have students solve the problems without first seeing the solutions, it would need to be read aloud.
- Use the book in the same way for grade 2/3 students, but substitute different problems for the ones in the book.
- Substitute some problems with multiple solutions for the problems in the book. Accept any solutions that are correct and can be justified.
- Have students use the adventure idea as a springboard and have them create their own math stories.
- Send one or two problems home each week to be solved with a family member.
- Read the book as part of a Reading Buddies or Math Buddies program and have partners solve the problems together. ▲

▲ OAME/NCTM September 2003 Report

FRANCES SCHATZ



Elementary School web site is http://www.nctm.org/elementary/.

Middle School web site is http://www.nctm.org/middle/. How Much of Yourself Do You See in a Small Mirror? Explores angles, reflections, lines of sight, triangles, and more at http://www.figurethis.org/challenges/c09/challenge.htm.

High School web site is http://www.nctm.org/high/. This site presents a weekly problem and highlight of the month with past problems and solutions.

Leadership Messages

Highlights from *Students, Families, Communities, and Mathematics Teachers* by Johnny Lott, NCTM President (NCTM *News Bulletin*, April 2003).

"An often quoted proverb suggests that it takes a community to raise a child. As a mathematics educator, I am convinced that a teacher is needed to educate a child mathematically. We expect to see children learn when they are in a classroom with an appropriate curriculum, a highly qualified teacher, support materials and technology along with a supportive school administration. But it takes a community and a family for real success.

We have long known that family members are a child's first teachers. It is also frequently true that once a child has entered school, the child becomes more dependent on the school. In school we frequently reteach concepts as if they had never been learned at all. Students do not come to us as blank slates and we educators might be more effective if we capitalized on the education that families and communities provided in preschool learning.

We are running a huge risk of making learning much more difficult for the student, especially if we introduce an alternative algorithm to what the family member has taught the child for computing. We have to allow the student to use either or both to avoid conflict situations and take advantage of the 'outside of school learning'. I recommend a family math night built around having students demonstrate their learning. Use community resources such as business people or bankers to explain how daily tasks use mathematics. Let's not miss opportunities for the real learning of mathematics.

A perfect example of why students, families, communities and mathematics educators need to work together appeared in the development of www.figurethis.org. Classroom teachers and mathematics educators wrote the challenges but students and families helped the writers by asking many questions and making the language understood by people outside of school. There is a fine line between correct mathematical language for the classroom and that used in the community and home."

GVMA

2003 MET Winners

There are no winners from Ontario. NCTM encourages Ontario mathematics educators to apply for the various awards available. For more information please visit http://www.nctm.org/about/met.

New Resources

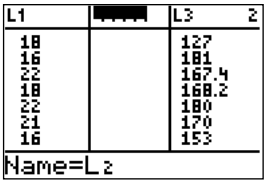
- *Navigating Through Data Analysis in Grades 6-8*
- *Computer Algebra Systems in Secondary School Mathematics Education*
- *Learning and Teaching Measurement: 2003 Yearbook*
- *Share and Compare: A Teacher's Story*
- Many other titles from the catalog

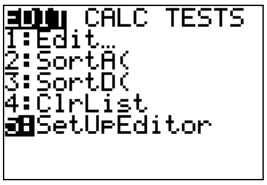
For prices and availability please contact this writer.

Membership Information

For an up-to-date membership application form specifically for Canada please contact this writer. ▲

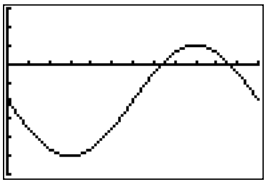


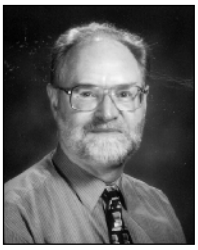




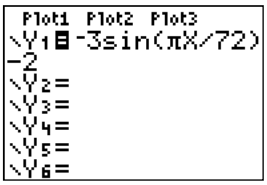
Technology Corner: Tips and Tricks with the TI-83 Plus

FRED FERNEYHOUGH



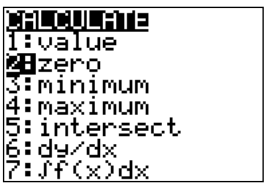


Fred Ferneyhough is Head of Mathematics at Harold M. Braithwaite SS in Brampton and is a technology consultant for the McGraw-Hill Ryerson texts in Ontario. He is an avid user of, and advocate for, the use of technology in the mathematics classroom.

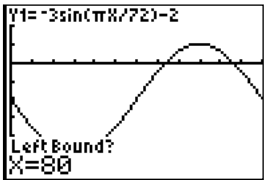


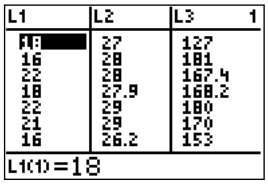
The TI-83 Plus has many features that most users are not aware of that can be useful. Let's look at two of them.

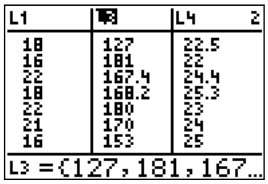
What Happened to My List?

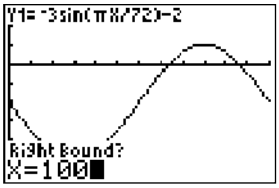


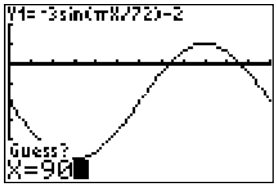
First is a problem that arises with every grade nine student in the province, or at least, all of mine. The lists represent the data from the profile activity, "Is There A Relationship Here?" Each list represents the measure of a



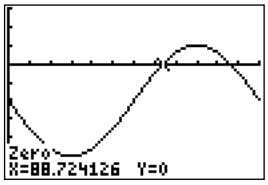




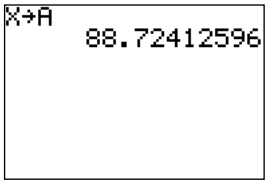


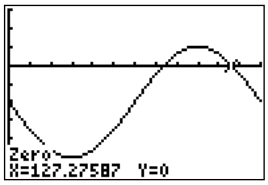


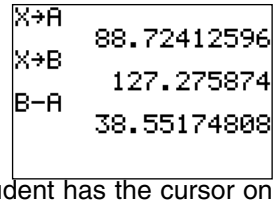
different physical feature and students attempt to find a relationship between these features.



You might be halfway through your demonstration that the data in list two is related to the data in list five when a student tells you that he/she doesn't have list two. Of course, you must drop everything and tend to this problem immediately if you want to get anything done. When you check the calculator, you see that the student is telling you the truth – list two is gone. The first time that this happened to me, I had no idea what to do.







Fortunately, I have friends who put up with my constant questions about these types of matters. This occurs when the student has the cursor on the list name header and presses the DEL key. To correct it, place the cursor on the header for L3 and press 2nd

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The total horizontal distance was given to be 144 m. Part of the exercise was for students to develop the appropriate trignometric equation to represent the height vs. horizontal distance. This equation is shown to the right. Later, they were told to adjust the equation to represent the height vs. time if the cycle took 8 seconds to complete.

After talking about the assumptions in the problems, a portion of the activity asked how far the dolphin leaped horizontally. To do this, we can either solve the trignometric equation or present a graphical solution by using the ZERO feature. Press 2nd and TRACE to access the menu. The next set of screens show the values that were used to find the first zero of the function.



Most students will use the cursor keys to move to the left bound, right bound and the guess, but you can also enter values that you think are useful.

Another feature that is not well known is the ability to retain the x and y coordinates in the home screen. In this case, the value of the x coordinate has been stored in variable A.

In the same way, the second root can be found and stored in variable B. The distance between the two roots represents the distance that the dolphin travelled horizontally during its leap. Obviously, this dolphin was moving very quickly!

There are many other features that the average user never sees. Over the summer, a large number of instructional packages for calculator activities were developed for each of the courses in our curriculum. These are available in PDF format on the web sites for Harold M. Brathwaite SS and the program department of the Peel District School Board. ▲

▲ A Pair of Insurance Problems: Policies, Premiums and Profits

DAVID R. DUNCAN

Circumstances	Piece lost/stolen	Piece not lost/stolen
X (Company profit)	-$99 750	$250
P(X)	0.002	0.998

AND BONNIE H. LITWILLER
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CEDAR FALLS, IOWA 50614-0506

Teachers are always searching for real world activities to exemplify mathematical concepts. A good source for such activities concerns insurance policies and premiums.

Suppose that an insurance company insures a $100 000 piece of jewelry against loss or theft. If the piece is lost or stolen, it will pay its full value of $100 000. The company calculates that the probability of loss or theft during a given year is 0.2%. Two similar sounding problems can be considered:

1. If the company charges a premium of $250 for the year for such a policy (excluding administrative costs), what is its expected profit for the year for insuring each piece of jewelry?

Circumstances	Piece lost/stolen	Piece not lost/stolen
X (Company profit)	-$100 000	C
P(X)	0.002	0.998

2. If the company wishes to make an expected profit of $250 for the year for insuring each piece of jewelry (excluding administrative costs), what premium should it charge for the year?

Discussion:

To many students, these two problems sound alike. In each case, the wording is similar and in each case $250 is mentioned. However, in problem 1, a careful analysis reveals that the premium of $250 is given and the profit must be calculated, while in problem 2, the profit of $250 is given and the premium must be calculated.

To solve each of these problems, the concept of "expected value" must be employed. To calculate the expected value of a variable, one must multiply each of its values by the probability that it occurs, and then add these products together. Symbolically: Expected Value of X = E(X) = $\sum X \bullet P(X)$. The two solutions follow:

Solution 1:

Two possible things might happen during the year covered by this policy on a given piece of jewelry. The piece might be lost or stolen. In this case, the insurance company collects a premium of $250 and pays out $100 000. The net profit is $250 – $100 000 = –$99 750. The probability of this occurring is 0.002 – 0.998.

Use a chart to organize the reasoning. The circumstance and the resulting Expected Value, E(X), are summarized below:

$$E(X) = -\$99\,750(0.002) + \$250(0.998)$$
$$= -\$199.50 + \$249.50$$
$$= \$50$$

How can the expected profit of $50 per customer be explained? Suppose that the company has 1 000 customers for this policy. Each customer pays a $250 premium for a total income of $250 000. According to the calculations, two of the 1 000 customers can be expected to have their piece of jewelry lost or stolen, requiring a total payout of $200 000. The company's net profit (excluding administrative costs) is then $250 000 – $200 000 = $50 000 or $50 per customer.

Solution 2:

In this situation E(X) is given to be $250, but the premium is unknown. Let C be the premium charged for each customer. Then

$$E(X) = -\$100\,000(0.002) + C(0.998)$$
$$\$250 = -\$100\,000(0.002) + C(0.998)$$
$$\$250 = -\$200 + C(0.998)$$
$$\$450 = C(0.998)$$
$$C = \$450$$

Note that an equation must be solved to determine the premium, and that the chart helped to organize the reasoning process. Your students should explain how this premium would lead to the desired expected profit per customer.

▲ 2003 OAME/ Union Gas Ontario Mathematics Olympics

JUNE 13 AND 14, 2003
SUBMITTED BY TOM GRIFFITHS, CHAIR WOMA

OMO 2003 was a great success with one hundred and four students on twenty six teams representing eleven Chapters of OAME.

Members of WOMA, the host Chapter, put together a great contest. The students enjoyed the challenges of the Mad Hatter Math Challenge, Western Regional Mathematics League (MML) with the addition of a Mental Arithmetic test.

The students were successful in the competition, with papers from the Power Contest, three from the Team Contest and one perfect Individual Paper.

We were pleased to have Chapter teams from as far away as Thunder Bay and Windsor participate in this competition. The top three teams were two from ISOMA with scores of 357 and 327 and a team from WOMA with a score of 319.

My recommendations for any Chapter bidding to hold an OMO competition have been submitted to the Executive of OAME and can be found by contacting the Executive Directors. I wish the organizers of OMO 2004, hosted by PRMA a most successful event. (Editor's note: We in NWOAME hosted OMO 2001, a "Northern Odyssey", and had a very gratifying experience. I encourage every Chapter to host this event.) ▲

Challenges:

1. Change the monetary and probability conditions on the two problems and solve each of them.
2. Note that this "casualty" problem is similar to a term life insurance policy. Find mortality data for people of a certain age and use this information to determine the interaction between the premium charged and the profit to be earned.
3. Find other situations in which probability and money interact in real life settings. ▲

▲ Assessment Corner: Using Assessment to Promote Learning

CHRIS SUURTAMM
E-MAIL: suurtammc@uottawa.ca



Chris Suurtamm is an Assistant Professor of Mathematics Education at the University of Ottawa. She is an experienced mathematics teacher who is committed to helping teachers with the implementation of the new curriculum and assessment practices.

This article begins with a discussion of changes in instructional and assessment practices in mathematics classes and then proceeds to offer some suggestions for using assessment to focus on growth in student learning. As teachers and researchers learn more about how students learn mathematics, they begin to see the student as more than an information retainer. Problem solving in mathematics classrooms is moving away from the following of a structured path with routine algorithms to an opportunity for students to construct, describe, model, manipulate, and predict. Mathematics classrooms take on a different appearance and mathematics teachers and students take on a very active role.

Several studies (Lehman, 1995; Suurtamm, 2000) suggest that as teachers change their instructional practices to a more problems-based approach, they notice the necessity to change their assessment strategies to match the different learning that students are doing. Stenmark (1991) suggests:

> *As the forms of mathematics teaching become more diverse – including open-ended investigations, cooperative group activity, and emphasis on thinking and communication – so too must the form of assessment change* (p. 3).

In many cases, this new view of assessment requires a shift in thinking that encompasses new understandings about the nature of mathematics, mathematics instruction and mathematics learning. New assessment

techniques also assume a shift in underlying assumptions about the nature and purpose of assessment, learning and teaching.

Like good instruction, good assessment allows students to grapple with discovery in mathematics and also to reflect on their grappling. Assessment focuses on both the process and products of problem solving and often includes students' own descriptions of their exploration.

Linking Assessment and Instruction

An assessment plan that is well aligned with the mathematics curriculum and instruction is built around tasks that are similar to the tasks that form instruction. In fact, moving from instructional activities to assessment activities should be seamless and one tends to look like the other. In linking assessment and instruction, assessment should not appear as a separate event but should be well connected to what students do in classrooms every day. It is important to maintain consistency between instruction and assessment environments. If students have a variety of tools available for instruction, these tools should be available for assessment. If students engage in instructional tasks in a variety of forms and groupings, then these should also be part of the forms and groupings for assessment. Assessment that is aligned with curriculum and instruction is the most purposeful type of assessment. As teachers deepen their understanding of assessment, they will find that almost any setting can be an opportunity for assessment.

When designing an assessment task, it is first necessary to determine what is being assessed which in turn helps to determine the assessment criteria and qualities of good work. Teachers need to understand the goals of instruction and then to determine what, why and how assessment tools will address these goals. Assessment should contain a variety of methods for assessing key cognitive components and should include structured interviews, group problem solving, creative projects, portfolio evaluations.

How do we use assessment to promote student learning?

Assessment should provide teachers with descriptions that help to determine what students can do and what they are struggling with. Yet, in many cases the immediate focus in assessment seems to be on determining how to level student work. Other steps need to take place prior to leveling if teachers are to use student work to promote learning. When I work with my teacher candidates, the first step I have them take is to examine student work and to use the student response to tell them something about the student's learning. I ask them to focus on what a particular piece of student work is saying about what the student knows and can do, and what the student is struggling with. After distributing samples of a task and two students' work, I ask teacher candidates to focus on: "What is the student doing well?" and "What is the student struggling with?" I also ask, "What evidence do you have of this?" to help them pinpoint what they see in student work. The following template is used:

	Level 1 Slightly	Level 2 Somewhat	Level 3 Adequately	Level 4 Extensively
• Explains mathematical processes, methods of solution, and concepts clearly to others				
• Connects graphs and equations and supports the choice of a model				
• Demonstrates the correct use of mathematical language, symbols, visuals, and conventions				
• Makes effective use of graphing technology				
• Discussion is coherent and logical				

Student:	
What is the student doing well?	How do you know?
What is the student struggling with?	How do you know?
Next steps:	

Teacher candidates then work in pairs discussing the students' work and completing the template. Particular things that they might fill in are "uses geometric terms properly" or "is having trouble seeing the pattern". Often, teachers' criteria are quite general – for instance using words like "logical". With some prompting and digging beneath the general descriptor, teachers can identify the specific characteristics of the work to further describe what "logical" means in this situation. Perhaps the student picked the correct information to use, used a suitable representation to clarify the problem's meaning or possibly presented a series of sequential steps. As a whole group we discuss the particular characteristics that the pairs recognized when looking at student work and find that we are all discussing similar characteristics. This

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discussion and examination of students' work helps us move forward in several directions. One way to proceed is to discuss possible next steps for the individual students. Clearly, the discussion of what the student is struggling with helps to determine ways to address the difficulties. However, the features of the work that the student does well also provide information that suggest future direction. Often students focus on what they cannot do rather than celebrate and continue what they are doing well and their quality work needs to be reinforced to continue. Hence, next steps should not only include suggestions for improvement, but should reinforce the strength of their work. Particular evidence of strength may also suggest the student's preparedness to move on to a new concept or to pursue the concept in greater depth.

Examining student work and discussing what they can tell us also helps to determine the criteria that we would use to judge quality work when students engage in this task. Determining these criteria can help us to construct an assessment tool for the task. (Normally an assessment tool should be developed as the task is created, but we are using this exercise to learn about the design of such tools.)

Another method that can be used to help to determine the characteristics of quality work, or to examine what student work tells you about student learning is to use a class set of student work. Teachers can be asked to work in groups to sort the student work into three stacks: strong, medium, and weak performances. Teachers then describe the differences between the stacks. The reasons that they give for placing work in a given stack reveal the criteria that they used to sort. This would be a good time to examine such criteria and to see if they focus on the important learning inherent in the task. For instance, do the criteria focus on learning meaningful mathematics or is the focus on neatness? The criteria should represent what is valued in the mathematics class and should align with the curriculum. Determining criteria is important and should also be shared with students so that students become experts at identifying quality.

Once clear criteria for a task are established, teachers might use these criteria to help them build a "check-bric", a combination of a rubric and a checklist, to assess student work. This check-bric draws attention to the left-hand side of a rubric. It clearly describes the criteria that will be used for assessment. For me, this is the most important part of a rubric and it is crucial for teachers to spend time determining these criteria. A "check-bric" helps students to focus on the important components and expectations of the task and does not appear overwhelming. A "check-bric" can be used as it is or the descriptors for levels can be further developed and the "check-bric" could become a full rubric. A sample of a "check-bric" for a particular task that included student presentations is given.

Establishing clear criteria for quality work is important and helps to provide a framework for both instruction and assessment. These criteria also help to make connections between outcomes of student work on tasks and "next steps" for whole class and individual instruction.

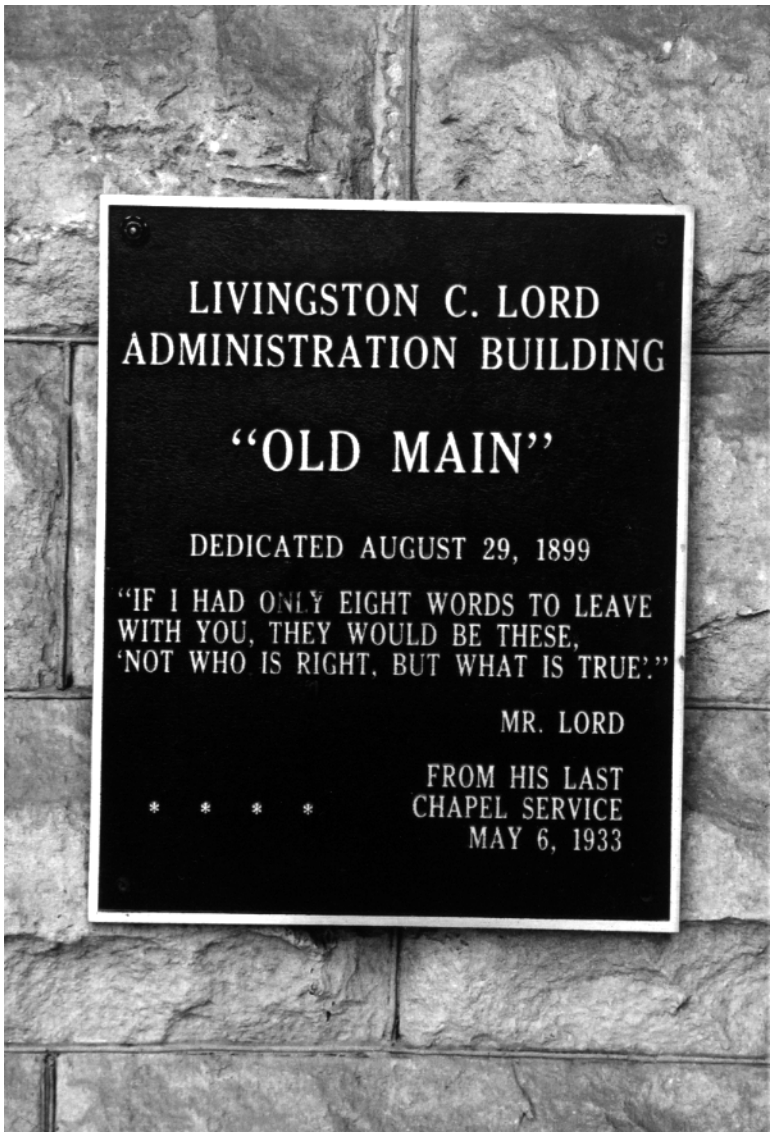
References:

Lehman, M.F. (1995). *Assessing Mathematics Performance Assessment: A Continuing Process.* National Center for Research on Teacher Learning.

Stenmark, J.K. (1991). *Mathematics Assessment: Myths, Models, Good Questions, and Practical Suggestions.* Reston, VA: NCTM.

Suurtamm, C. (2000). Teachers Make It Authentic: Supporting New Assessment Practices. *Research In Ontario Secondary Schools, 6* (1). http://www.oise.utoronto.ca/field-centres/vol6no1.htm. ▲

Photograph #1



The plaque shown in the photograph appears in front of the Old Main building on the campus of Eastern Illinois University. The building is the oldest one on campus and it is a main building which explains the name!

(a) Without doing much in the way of any calculations, estimate the number of days between the day on which the building was dedicated and the day that Mr. Lord gave his last chapel service. Then calculate the number of days and see how close you were with your estimate.

(b) On what day of the week did the dedication occur? On what day of the week did Mr. Lord give his last service?

(c) What are the chances that the two dates mentioned on the plaque landed on the same day of the week? Were they the same?

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Photograph #2



The seal shown in the photograph appears on a gate that leads into the campus of the Eastern Illinois University.

(a) Without doing any measurements or calculations, determine by estimation which of the following statements are true.

(i) The area of the annulus is less than the area of the small circle.

(ii) The area of the annulus is less than one tenth of the area of the small circle.

(iii) The area of the annulus is less than the area of the large circle.

(iv) The area of the small circle is more than two thirds of the area of the large circle.

(b) Measure the radii of the circles shown in the photograph and then do some calculations to determine which of the statements in part (a) are true. Then check your answers and consult your teacher for a mark.

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Photograph #3



The gate shown in the photograph leads into the campus of Eastern Illinois University.

The curve formed by the upper edge of the gate appears to be part of a sine graph. Develop a strategy that could be used to determine if this is true. If so, it this a sign of something?

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▲ Nominations for OAME/AOEM Board of Directors 2004-2005

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. Nominations for these positions are to be submitted by 4:00 p.m., January 23, 2004, to:

Margaret Warren, Past President

Include the nominee's qualifications with the Nominations Form. A nominee must be a member of OAME. By March 2004, 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 in Waterloo, April 2004.

NOMINATION FORM

I nominate: _____

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

Nominee's Address: _____

_____

Telephone: H ( ) _____ W ( )_____

Nominator's Name : _____

Nominator's Address: _____

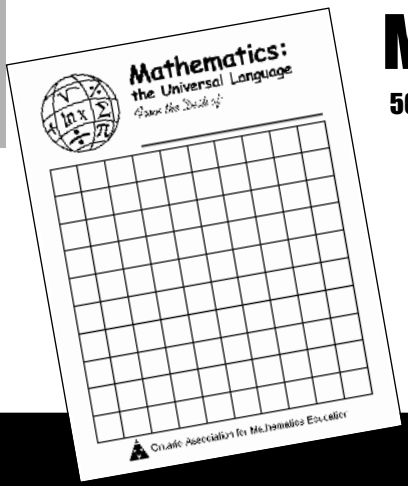
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▲ Photo Math – A New Way of Picturing Math

RON LANCASTER



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

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

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

Introductory comments for the September 2003 Column

The following photographs were taken on the campus of Eastern Illinois University (EIU) in Charleston, Illinois. I was on the campus during the month of October 2002 to conduct workshops for pre-service teachers. Charleston itself was quite small and everyone seemed to know that I was from out of town. The campus of EIU was beautiful and there were several buildings that were well over 100 years old. For a virtual tour of the university campus via a number of *QuickTime* movies, go to the web site http://www.eiu.edu/text/vt1.html

▲ A Math Scavenger Hunt! Why Not?

TODD ROMIENS
ASSOCIATE PROFESSOR UNIVERSITY OF WINDSOR
FACULTY OF EDUCATION

For two years I have been running a "Math Scavenger Hunt" in grades 7 and 8 classes of the local school boards. The purpose of the hunt is to get them engaged in a cooperative effort to collect information and solve problems that connect to the math curriculum, as well as having some recreational value.

Consider the number 19.
Find the sum of the squares of its digits.
$1 + 9 = 1 + 81 = 82$
Find the sum of the squares of these digits
$8 + 2 = 64 + 4 = 68$
Continue $6 + 8 = 36 + 64 = 100$
Now $1^2 + 0^2 + 0^2 = 1$

Since the sum is now 1, 19 is considered a HAPPY NUMBER.
Find all the positive whole numbers that are HAPPY NUMBERS less that 25. Explain why the number are either HAPPY or not.

3
$3^2 = 9$
$9^2 = 81$
$8^2 + 1^2 = 64 + 1 = 65$
$6^2 + 5^2 = 36 + 25 = 61$
$6^2 + 1^2 = 36 + 1 = 37$
$3^2 + 7^2 = 9 + 49 = 58$
$5^2 + 8^2 = 25 + 64 = 89$
$8^2 + 9^2 = 64 + 81 = 145$
$1^2 + 4^2 + 5^2 = 1 + 16 + 25 = 42$
$4^2 + 2^2 = 16 + 4 = 20$
$2^2 + 0^2 = 4 + 0 = 4$
$4^2 = 16$
$1^2 + 6^2 = 1 + 36 = 37$
Cycle repeats
3 is not a HAPPY NUMBER

4
$4^2 = 16$
$1^2 + 6^2 = 1 + 36 = 37$
$3^2 + 7^2 = 9 + 49 = 58$
$5^2 + 8^2 = 25 + 64 = 89$
$8^2 + 9^2 = 64 + 81 = 145$
$1^2 + 4^2 + 5^2 = 1 + 16 + 25 = 42$
$4^2 + 2^2 = 16 + 4 = 20$
$2^2 + 0^2 = 4 + 0 = 4$
$4^2 = 16$
Cycle repeats
4 is not a HAPPY NUMBER

7
$7^2 = 49$
$4^2 + 9^2 = 16 + 81 = 97$
$9^2 + 7^2 = 81 + 49 = 130$
$1^2 + 3^2 + 0^2 = 1 + 9 + 0 = 10$
$1^2 + 0^2 = 1 + 0 = 1$
7 is a HAPPY NUMBER

8
$8^2 = 64$
$6^2 + 4^2 = 36 + 16 = 52$
$5^2 + 2^2 = 25 + 4 = 29$
$2^2 + 9^2 = 4 + 81 = 85$
$8^2 + 5^2 = 64 + 25 = 89$
$8^2 + 9^2 = 64 + 81 = 145$
$1^2 + 4^2 + 5^2 = 1 + 16 + 25 = 42$
$4^2 + 2^2 = 16 + 4 = 20$
$2^2 + 0^2 = 4 + 0 = 4$
$4^2 = 16$
$1^2 + 6^2 = 1 + 36 = 37$
$3^2 + 7^2 = 9 + 49 = 58$
$8^2 + 5^2 = 64 + 25 = 89$
Cycle repeats
8 is not a HAPPY NUMBER

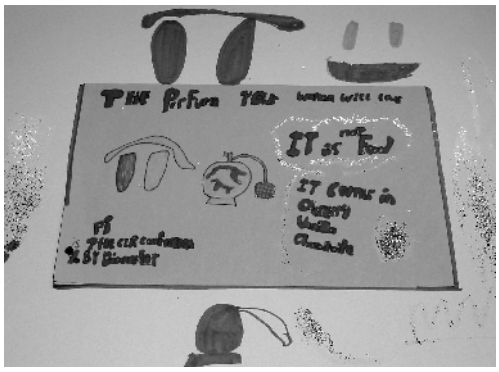
In each of the two years, over 40 classes have entered the competition. There is no charge to enter and prizes are given to the top 3 entries. The prizes are as follows:

- **First Place** - a plaque and T shirts with school logo and names
- **Second Place** - a plaque and pizza party for the class
- **Third Place** - a plaque and $100.00 to spend on classroom materials.

The challenge for me is to make up questions that can be done cooperatively, are challenging and don't rely heavily on Internet sources, as well as to continue to provide a variety of questions that are creative and interesting to do.

Pi day is fast approaching. It's March 14 (03 14) and is officially celebrated at 1:59 a.m.
The "Smell Good" perfume company has developed a new unisex fragrance called π. The company executives need an ad campaign that will embody the true meaning of Pi, its historical background and capture the attention of their target audience (Ages 14-15). It's your job to create this ad.

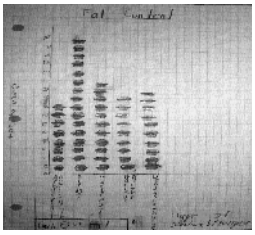
Billboards & Signs



The time of year to hold the hunt as well as how much time to give classes to do it is a difficult issue. Teachers are always busy, and for some teachers this hunt can be seen as an "add on". For others, they try to incorporate the questions into their current place in the curriculum. The first year I tried to coordinate the end of the hunt with Education Week, usually celebrated the first week in May. This year I held it earlier, ending at the March break. Based on feedback from teachers, there is no ideal time. Those that feel the benefits are there, will do it when it is held.

Over the two years, there have been 20 questions to investigate. I am including a few of them here, with student samples and connections to the curriculum.

McDonald's Quarter Pounder
Harvey's Hamburger
Wendy's Hamburger
Do not include fries or a drink. You could put toppings on the burgers.



Harvey's Hamburger	18g
Wendy's Hamburger	19g
Arby's Roast Beef Sandwich	16g
McDonald's Big Mac	31g
McDonald's Quarter Pounder	21g

Based on the information you now know, which of the above would you recommend eating and why?

We would recommend eating a Harvey's Hamburger or an Arby's Roast Beef Sandwich.
Both can be considered healthy sandwiches compared to the other three. If you are on a fat reduced diet, we recommend the Arby's Roast Beef Sandwich. Both of these items are very close in fat and carbohydrate content.

Question 1

a) What is the sum of the 4 prime, 2 digit numbers that can be made from the digits 1,2,3,4,5,6,7,9? Show all of the possible ways this sum can be made. There is a way of reasoning what the sum must be without determining the primes. What is it?

b) Consider the number 19. Find the sum of the squares of its digits.

$1^2 + 9^2 = 1 + 81 = 82$

Leonardo de Pisa was a mathematician in the 13th century. Write an essay about his life and times. What sequence of numbers is he famous for? Where did it first appear?
What problem generated it? Find out at least 5 interesting things about this sequence and why you find them interesting.

Fibonnacci
By: Rachel Lalonde

He was said to be the greatest European mathematician of the Middle Ages, born in Pisa, Italy, in about 1175 AD. His name was Leonardo of Pisa, or Leonardo Pisano in Italian, or Fibonacci, short for Filius Bonacci. Leonardo's farther, Guglielmo Bonacci was a kind of customs officer in the North African town of Bugia, where wax candles were exported to France. Leonardo grew up in North Africa, and was educated by the Moors (Arabs and Berbers). He later traveled to extensively around the Mediterranean coast. He met many merchants and learned their arithmetic. he also realized the advantages of the Hindu-Arabic system and others.

The original problem that Fibonacci developed in 1202 was how fast rabbits breed in ideal circumstances. Each number in the sequence is how many newborn rabbit pairs there were after the month was over. Female rabbits are able to reproduce after a month from being born.
0, 1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, 987, and more...

In the first month, when the first female rabbit was born, it couldn't reproduce so there were no pairs. In the second month, the rabbit was old enough to reproduce, so it found a mate. In the third month, they had two offspring, one female and one male. Now there were two pairs of rabbits. Also in the third month, the original pair mated again, and the newborns were too young to mate. in the fourth month, the original pair had two more offspring, one male and one female. The pair born previously to the original pair mated and had offspring the next month. This cycle keeps continuing through the sequence. To reach the next number in the sequence, add the number of pairs previous to the number to reach the next number in the sequence.

Example: 0 + 1 = 1, 1 + 1 = 2, 2 + 1 = 3, 3 + 2 = 5, and so on...

Problems that the theory makes are that the brothers and sisters mate, which leads to disease. Also, it states that the rabbits never die, which is unrealistic since there is disease, being hunted by other animals, death at birth, famine, and natural causes. Another problem is that each new pair of offspring is a female and a male, which is extremely rare. Also, rabbits having only two children are very rare, since they often have large litters or a number greater than two. One thing that is very peculiar, is that the first rabbit has no parents. What is odd is how Fibonacci chose rabbits instead of an animal that is easier to observe, like sheep.

He was famous for the sequence of numbers know as Fibonacci Numbers
0, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, 233, 377, 610, ...
It first appeared in Henry E. Dudeney's book of puzzles.
The problem that generated the numbers was,
"How rabbits breed in ideal circumstances."

Interesting facts:
1) The relationship between Fibonacci numbers and the Golden Number.
2) How Fibonacci numbers are the number of petals on many plants.
3) How all the parts of our hands come in Fibonacci numbers.
5) Spirals of a pine cone form Fibonacci spirals.
All of these facts were truly amazing once we learn about Fibonacci numbers.

Find the sum of the squares of these digits.

$8^2 + 2^2 = 64 + 4 = 68$

Continue $6^2 + 8^2 = 36 + 64 = 100$

Now $1^2 + 0^2 + 0^2 = 1$

Since the sum is now 1, 19 is considered a HAPPY NUMBER. Find all positive, whole numbers less than or equal to 25 that are HAPPY. Explain why they are HAPPY or not.

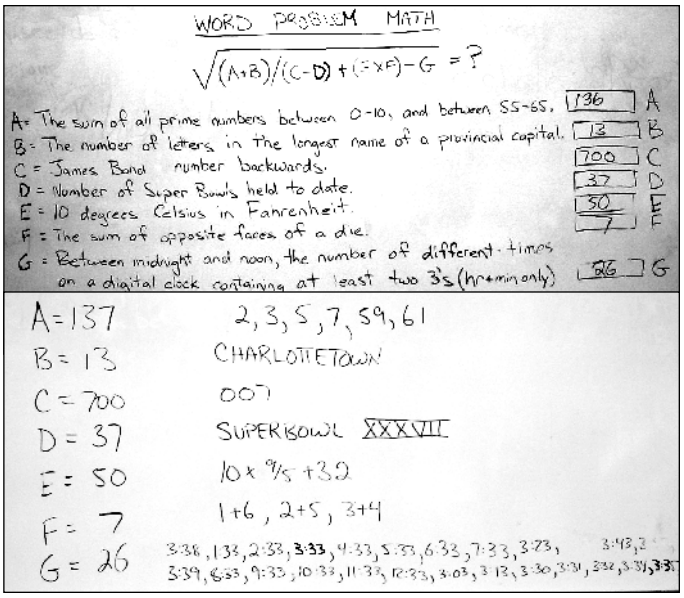
Curriculum Expectations

Grade 7/8: Number sense. Explain the process used and any conclusions reached in problem solving and investigations.

Question 2

Pi day is March 14 (03 14) and is officially celebrated at 1:59 in the morning. The "SMELL GOOD" perfume company has developed a new unisex fragrance called "∏". The company executives need an ad campaign that will embody the true meaning of Pi, its historical background and capture the attention of their target audience (ages 13 - 25). It's your job to create this ad.

Curriculum Expectations



This is a cross curricular question - language arts and math grade 7/8: Communicate ideas and information for a variety of purposes.

Question 3

Draw a graph to compare the fat content of each of the following sandwiches:

- Arby's Roast Beef Sandwich
- Big Mac
- Quarter Pounder
- Harvey's Hamburger
- Wendy's Hamburger

Do not include a drink or fries. Based on the information you find, which would you recommend and why?

Curriculum Expectations

Grade 7/8: Collect, organize and analyze data. Describe information found on graphs.

Question 4

Leonardo de Pisa was a mathematician in the 13th century. Write an essay about his life and times. What sequence of numbers is he famous for? Where did these numbers first appear? What problem generated them? Find 5 interesting patterns from this sequence.

Curriculum Expectations

It is expected that students will use the Internet to find out information about Leonardo. Using the search engine *Google*, look for "Fibonacci".

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:

- demonstrations 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, and
- 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 may not be specifically mentioned above.

The Nomination Cover Page

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

Incomplete or inaccurate information may cause a 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, and excellent 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 a member of OAME/AOEM.

AWARD FOR EXCEPTIONAL AND CREATIVE TEACHING IN ELEMENTARY MATHEMATICS

The award is to be given annually to recognize an elementary teacher who has demonstrated excellence in mathematics education, as well as contributing to the overall development of students beyond classroom activities.

AWARD FOR EXCEPTIONAL AND CREATIVE TEACHING IN SECONDARY MATHEMATICS

The award is presented annually to recognize an exceptional and creative secondary school mathematics teacher who enhances the teaching of mathematics in Ontario.

AWARD NOMINATION COVER PAGE

INTENDED AWARD *(please check one)*

- ❑ **Life Membership**
- ❑ **Kenneth D. Fryer**
- ❑ **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**

Nominee's Information:

_____

Name of Nominee (Principal and Department Head for K.D. Fryer Award)

_____

_____

School, Organization, or Business Address

Telephone Number ( ) _____

Fax Number ( ) _____

Home Address _____

_____

Home Phone ( ) _____

Nominator's Information:

_____

Name of Nominator

_____

_____

School, Organization, or Business Address

Telephone Number ( ) _____

Fax Number ( ) _____

Home Address _____

_____

Home Phone ( ) _____

SEND TO: Judy Dussiaume

Also it is hoped that they will take a closer look at the Fibonacci Sequence and the mathematics related to it.

Question 5

If a = the sum of all primes between 0–10 and 55–65;

b = number of letters in the longest name of a provincial capital;

c = James Bond's number backwards;

d = number of Super Bowls to date;

e = 10 degrees Celsius in Fahrenheiht;

f = the sum of the opposite faces of a die;

g = between midnight and noon, the number of different readings containing at least two 3's (hours and minutes only) that will appear on the face of a digital clock.

Evlauate $\sqrt{(a+b)/(c-d)+(exf)-g}$ to 2 decimal places.

Ontario Association for Mathematics Education PUBLICATIONS

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

- ▲ Eleven field-tested Assessment Activities
- ▲ Exemplars of student work illustrate Levels of Performance
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- ▲ Extensive hints to assist in using the materials

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Curriculum Expectations

Grade 8: Evaluate simple algebraic expressions (this is a little beyond the expectation, but students had no difficulty with it).

Other questions included making scale models of their school and yard, focusing on the 100th day of school, writing about a local celebrity and making connections with geography.

There were a variety of approaches to the solutions of the problems. Some classes put their answers in booklet form, others constructed solutions out of cardboard, playdoh or bristol board. Classes also used video tape or cd's to show their work. Many submissions were very creative and professionally done.

Because the calibre of work was so high in most cases, judging the entries was difficult. Once I had narrowed the entries to the top 10, I asked 3 colleagues to rank their top 3. From this, the first, second and third entries were determined.

The categories that I used to assess the entries were:

PRESENTATION - what did it look like? Was it neat and orderly? How much work was put into it?

CREATIVITY - did the class do something unexpected in their presentation? - did they go above normal expectations?

ACCURACY - were there errors? Were they major errors? Were all questions complete?

EXPLANATIONS - were solutions explained completely? Was all information required included?

Of course, because of the number of different approaches and solutions, some subjectivity entered into the judging process, but usually a few rose to the top to make the selection of prize winners easier.

Follow up to the event included a questionnaire that was sent to each school. Since this is an annual event it is important to get feedback from as many schools as possible so that you can continue to make the hunt better and more adaptable to the needs of the teachers. Some comments from teachers were:

"Wow, did our students learn a lot by doing the hunt, many turned onto math", and "thank you for providing the hunt, I look forward to it each year."

In conclusion, this has become an annual event for teachers in our area. The response to it has been terrific. If anyone would like the other questions I have used, please feel free to contact me at toddr@uwindsor.ca. In the meantime, GOOD HUNTING. ▲

▲ Hey It's Elementary: Important Things



LYNDA COLGAN
E-MAIL: colganl@educ.queensu.ca

Lynda Colgan has been at the Faculty of Education at Queen's for four years, teaching in the B.Ed., M.Ed., and Ph.D. programs. Her primary focus is the classroom and her research is aimed at improving the mathematics learning experience of the child by supporting teachers and parents.

"There are teachers who have taught for 27 years. And there are teachers who have taught one year, twenty-seven times." Originator Unknown

The quote above is indelibly etched into my brain. I heard it early in my career and vowed never to become the kind of teacher described in the second sentence.

In spite of my best intentions, the quote recently came back to haunt me. I was at an end-of-school-year barbeque with a small group of new B.Ed. graduates and faculty, when a guest of one of the honorees (a former B.Ed. graduate himself from several years back) said, "Hey, Lynda. Did you know my kid sister is going to be in your class this September? I told her you'd make her do that little math book thing in the first class just like we did five years ago and just like this year's class did."

I cringed. The word is "out". It's true. I teach the same lesson every year for the first class with my incoming teacher candidates. But I promise I am not becoming one of those teachers who turns to her filing cabinet in search of the "Day X" lesson.

In fact, I believe that because I do teach the same lesson at the start of each school year, my course is better suited to my students. Since this reason seems to conflict sharply with the opening quotation, I feel obliged to explain …

As an experienced classroom teacher, I operated from the assumption that I would start with what my students knew and build upon that knowledge in order to satisfy the curriculum expectations specified by Ministry of Education policy documents and local courses of study. Sometimes I conducted an oral review. On other occasions, I administered a pre-test. Frequently, I referred to widely

disseminated curriculum continua. The strategy worked well for me throughout my 21 years in elementary and secondary classrooms.

Then in September 1998, I joined the Faculty of Education at Queen's University. I continued to operate from my basic assumption – that I would start with what my students knew and build upon that knowledge – but I was puzzled about how I would establish what my teacher candidates knew not only about mathematics, but about its teaching and learning. At the same time, I wanted to gather accurate and extensive information about their mathematical background, beliefs about, attitudes toward and personal experiences with mathematics. In short, a tall order.

This data-gathering exercise was extremely important and I sensed that the approach needed to be very different if I were to succeed in gathering sufficient-, accurate- and sensitive-enough information to enable me to think and feel like my teacher candidates. My goal was to be able to use the data I obtained to put myself in their place so that their views became my views; their problems, my problems, and conversely, my solutions, their solutions, my knowledge, their knowledge … and so on.

Enter, one of my favourite books – the classic written by Margaret Wise Brown in 1949, *The Important Book*. I have been using this book in classes and workshops for nearly twenty years now in a variety of ways because of its power to challenge us to observe and reflect. *The Important Book* is deceptively simple. Wise Brown takes familiar things like an apple, spoon, or shoe and makes us think about the essence of these everyday entities in new ways using rhythmic words and vivid illustrations. As most primary teachers will know, the most important thing about *The Important Book* is that you let your students tell you what is important about anything … the sun or the moon or the wind or the rain or a bug or a bee or a chair or a table or a pencil or a bear or a rainbow or a cat. But the most important thing about *The Important Book* is that the book – and its lessons – goes on long after it is closed.

As my first class in September comes to an end – after making paper-fold tangrams and reading the *Tangram Magician*, acting out Alexander who to used to be Rich Last Sunday using play money, creating an origami pencil box, exploring the wonders of paper plates, learning about "perfect square" people and puzzling over a few brain teasers – I read *The Important Book* aloud.

After reading the book, I lead the students through a paper-folding exercise that culminates in the creation of a five-page origami book called a *Lotus-Flower Book*. I re-read *The Important Book* and ask my students to consider how they might use this book in a classroom. The responses are predictable. "To teach patterning". "To encourage children to observe their world". "To stimulate self-reflection".

"Great responses. Now, the challenge is for each of you to create your own version of *The Important Book*. The first part is a reflective exercise – a sort of personal mathography – tell me about your mathematical background and your personal experiences with mathematics. The second part is like looking into your own personal crystal ball – give me a sense of how you envision yourself and your classroom during math time."

I provide the sentence stems, and the teacher candidates, using the pattern established by Margaret Wise Brown in the original *Important Book*, complete them. The stems are:

The important thing about math is … and the way I intend to address this is …

The important thing I remember about math teachers is … and the way I intend to address this is …

The important thing I remember about math students … and the way I intend to address this is …

The important thing about math class is … and the way I intend to address this is …

The important thing about me and math is … and the way I intend to address this is …

The student teachers' Important Math Books are very important for a number of reasons. I have transcribed the books over the past five years, and there have been a remarkable number of patterns that have helped me to understand where my students are and why. By gathering accurate and extensive information about their mathematical background as well as their beliefs about, emotional responses to and personal experiences with mathematics, I can begin to understand how their experiences have led to the development of their beliefs and attitudes. By conducting a gap analysis on the data between the student teachers' starting point and the new vision of mathematics teaching and learning which has been articulated for Ontario, I believe that I am better able to plan the best strategy for helping them to move up the learning curve so that after a few short months in the B.Ed. program, they will be ready to begin the challenge of teaching math effectively.

On reflection, it occurred that this information would be helpful not only to me, but to those teachers who are about to mentor students teachers beginning in the fall by hosting them for their practicum or field-based experiences. The information should be useful for those individuals who organize and deliver professional development opportunities for early career teachers. The information should also be useful to all elementary and secondary teachers … because we never know exactly which student(s) in our classrooms may themselves become an educator and the research is

clear: teachers' beliefs about mathematics and teaching mathematics are significantly influenced by their mathematical experiences as a student in many ways. There is a mountain of research that proves beyond a shadow of a doubt that the influence of the classroom is enormously powerful in shaping educators' vision, attitude and behaviour and that all practicing teachers (consciously or not) are role models who impact the ways in which developing teachers teach, assess and manage their own classrooms.

What the teacher candidates said

Over five years, I have gathered nearly 700 Important Books. As with any set of data, there is a range in responses along many variables. The smallest subset (5% - 15% annually) is represented by a small number of teacher candidates who had developed a love of mathematics over their elementary and secondary school experience. These student teachers make one thing very clear: one or two influential teachers and the support of parents made all the difference. This small cadre of beginning teachers couldn't wait to get into the classroom and emulate the characteristics of those to whom they attributed their success, confidence and positive attitude. This is what they had to say:

The important thing about mathematics is that it is cosmic. Math is poetic, math is universal, math is meaningful, math is mysterious.

The important thing about learning mathematics is that it is exciting – like solving a mystery.

The important thing about mathematics teachers is that the best ones I had knew how to tickle my brain and turn it on. That makes me feel multi-faceted – a part of the physical world.

The important thing about teaching mathematics is that it helps make sense of the world. Teaching math is lyrical, teaching math is like storytelling, teaching math is heroic, teaching math is powerful. But the most important thing about teaching math is that it unleashes creativity.

The important thing about me and mathematics is I love it. Me and math have always connected. Me and math have been through a lot. Me and math have a lot to offer.

While there are always some (15%) teacher candidates who are ambivalent about their mathematics learning experiences and sincerely unsure what their own classroom would look like (at least until they had completed their B.Ed. program), each year the vast majority express negative emotions and attitudes towards math and emphasize their own lack of confidence toward teaching mathematics. What follows are a few typical quotes from the largest percentage of the teacher candidates and a brief narrative.

The Important Thing about Math is …

The important thing about mathematics is that it is everywhere it uses numbers, letters and symbols. You use it in money matters, stocks and bonds. You use it everyday.

The important thing about mathematics is that you use it every day, and knowing mathematics will make your life better.

While they wrote that mathematics is 'everywhere' and used by 'everyone', the teacher candidates clearly view mathematics from a purely utilitarian (and almost always numerical) perspective. For example, they said that they used mathematics daily when they: interacted with an ATM, calculated the tip at a restaurant, read the baseball results, baked cookies, checked their change at the supermarket cash register; purchased potatoes, determined a discount on a purchase, found the time difference between two cities before making a long-distance phone call, or, computed the number of tiles needed to cover their kitchen floor. Almost every teacher candidate stated that the important thing about mathematics is that it is logical. Only a handful of students over five years has associated mathematics with creative or recreational endeavours.

Mirroring their utilitarian view, nearly all of the teacher candidates reported that 'the important thing to remember about teaching mathematics' is to make it 'relevant' by tying it to the 'real-world'.

Because of its perceived ubiquity and practical application, many teacher candidates wrote that success in mathematics is the essential key to opening doors to the future for students with respect to technology and employment and they intended to ensure that every student in their class became a strong math student. They also said that they will emphasize to their own students how important math is to success in school, career and life.

The Important Thing About Math Teachers is …

My teachers managed to take all the joy out of the subject - I don't remember ever having a teacher that was excited or enthusiastic about teaching math.

The important thing about teaching mathematics is to make it fun. Even the best mathematician can't be the best teacher if he doesn't make math fun.

The important thing about teaching you do not always have to know more than your students do. Wouldn't it be fun to know what 100kg of chocolate would look like? It is okay if you are not so good at math, but it's more fun to be good at math and like it.

In five years, not one teacher candidate has written about an elementary teacher on this page in their

mathography. To prospective elementary classroom teachers, 'math teachers' are specialists found within the walls of secondary schools. They acknowledged the fact that elementary teachers had a crucial role in teaching foundational concepts, skills and processes and they, themselves, worried that in Primary/Junior they would be teaching a challenging and complex curriculum; however, neither realization translated into equating elementary teachers to "math teachers".

Many student teachers singled out an individual teacher who made them feel that they would be forever 'stupid' or 'incapable of learning math' and those who did said that these often one-time 'off the cuff' comments led to cumulative anxiety, failure and self-doubt that was felt up until the present day.

With the exception of the 'outlier' quotation above, most students stated that they believed that their math teachers were very smart and generally agreed that this was the most important thing about teaching mathematics, i.e.,'knowing' mathematics. It was also generally accepted among the teacher candidates that their teachers' 'smarts' often made it impossible for them to explain ideas clearly … "they could never come down to our level". Unfortunately, the students' perceptions were that math teachers had time and patience mainly for those students who were strong in math.

When they themselves teach math in an elementary setting, the student teachers' were unanimous in saying that they would emulate the characteristics of favourite elementary teachers by being patient, providing continuous positive feedback and using encouraging words – the most important thing about teaching mathematics is encouragement. Their focus will be on clear communication and on making sure that every student in the class understands before they move on.

The Important Thing about Math Students is …

that they are always wondering why they have to do these stupid questions.

that they cherish a good eraser as their best friend

that I could always get the right answer even when I didn't have a clue what I was doing. I could think back to yesterday's example, write down the formula, plug in the numbers and churn out the solution like magic. I got great marks! I helped other kids in my class! But I never understood any of it. So, the important thing about mathematics and me is that I could always get the right answer even when I didn't have a clue what I was doing.

The most common response from the teacher candidates was that they often got good marks on math tests but never understood what they were doing or why. They believed that a number of their public school classmates were bored, frustrated, intimidated or simply not engaged by math. Many communicated that their palpable fear of failure resurfaced when they realized that there would be some mathematics in their elementary math curriculum course.

The teacher candidates' voices were almost unanimous in stating that learning mathematics must be a better (i.e., more positive) experience for their students than it was for them. Although there was some variety in the responses, more than half of the teacher candidates emphasized that it was important that the classroom be a 'comfortable and happy place to be' and that the teacher be sensitive to student difficulties, and interesting, i.e., always connecting math to the real world.

The Important Thing about Math Class is …

That I didn't enjoy learning it! Math was the hardest subject for me, especially when I just didn't get it. I remember math as textbooks and equations. . I found math frustrating because concepts on tests seemed different than they did in class.

In my math class we were never told or shown why something works in math, just that this is the way it works and we should memorize it.

Almost all teacher candidates associated math class with tests and quizzes. Most of the teacher candidates remembered their math class being notably quieter than other subject classes. Unlike geography or biology classrooms, they remembered that there were no points of interest in their math class such as bulletin boards, posters, visuals or models. And there was nothing to break the routine, like movies, experiments or field trips. They described that they 'got' mathematics in classrooms where the teacher went page by page through a textbook and told them how to do 'it' using a step-by-step, repetitive approach. They remembered that math class, like math, was formulaic: 1 Math Lesson = 35 minutes (take up homework) + 25 minutes (lesson at board) + 5 minutes (work individually) + 5 minutes (assign homework).

The teacher candidates were unanimous in saying that that it was crucial for students to find learning mathematics to be 'fun'. About one-quarter of teacher candidates replied that it is important for students not to realize that they were learning mathematics. They suggested that you could introduce mathematics through videos and storybooks and 'sneak' the math into the lesson via the back door.

The Important Thing about Me and Math is …

Math makes me nervous. I wouldn't hesitate to say that I fear math.

The important thing about me and mathematics is that I have a math phobia. I have never done well in

all of my math classes after grade 2, due to a traumatic experience with subtraction.

that I am sticking with it! Despite the fact that me and math are often like oil and water, that me and math are sometimes akin to obligingly tolerant siblings, that if I am ever so lucky, me and math can reside in a relationship that can be enjoyable and stressfree.

My background is very limited - I only got the 2 math credits I needed to graduate high school and both credits took me 2 tries. I took math courses out of necessity - not out of interest.

In describing their relationship with math, most of the teacher candidates begin by self-evaluating. Typically, about 75% describe themselves as 'weak' in math and only 5% rate themselves as strong math students. Annually, about 15% report that they like mathematics. An alarming number of the teacher candidates write that their last official mathematics course was in the second year of secondary school – six or seven years ago (and for mature students, often twenty years ago) and their memories of mathematics were foggy at best! Nonetheless, they were in general agreement that university-level math courses were not going to help them to be better elementary teachers. Some two-thirds of the teacher candidates voiced concerns that their own comfort-level, attitude and background made them feel extremely inadequate and lacking in confidence about teaching the Ontario Curriculum.

Implications

The explicit motto of my elementary mathematics curriculum course is through the eyes of a child. My classes are hands-on workshops in which teacher candidates are given opportunities to reconstruct their personal knowledge of and attitudes toward mathematics while experiencing the new vision of mathematics instruction that has emerged in Ontario.

On any given day, the teacher candidates are challenged to hypothesize about even and odd numbers or model the commutative property of multiplication, for example. They are challenged to think about what algorithms are and why we use them. They are told that a formal solution to a given problem does not in and of itself demonstrate understanding. They are encouraged to discard their old ideas and to call upon their flexibility and creativity by doing the same problems, using the same materials and hopefully, constructing the same rich set of conceptual links as the children in Kindergarten to Grade 6 classrooms.

My classes are product-oriented and performance-based. Teacher candidates leave every class with a bag full of paper tools with which they can continue to explore the mathematics they have begun to see through a new lens. My students stand on desktops to conduct visual tests for similarity on geometric figures. They proudly display their tessellated masterpieces in an impromptu art gallery. They stamp. Cut-out. Build. Surf the Internet. Read wonderful children's books like *The Rajah's Rice* and *talk, talk, talk*.

In each session, my students work collaboratively, posing problems, formulating conjectures, and discussing the validity of various solutions, while I guide and scaffold them, frame appropriate contexts, facilitate discussion of the important emergent mathematical ideas and steer them towards conceptual connections. The goal of my course is both to provide students with an opportunity to build a positive emotional relationship with mathematics and to help them to broaden their often very limited perception of the discipline.

But, even with all this, the 36 hour course is not enough to address the mountain of issues evident on the pages of my students' Mathographies (and note that this is a very brief presentation of the findings). Without support throughout their initial field-based experiences and during the first years of their careers, there always exists the possibility that early career teachers may teach just as they were taught ... and remembering that these teacher candidates have not experienced the recent reform efforts in either secondary or elementary mathematics programs, the research predicts that they are highly likely to fall back into old, disappointing and unsatisfactory patterns of teaching and learning.

While the teacher candidates' mathographies cry out for the introduction of formal mathematics education mentorship programs in every board, we cannot sit back waiting for these to be instituted, given today's education budgets. We must be proactive, taking advantage of each and every formal and informal professional development opportunity that comes along.

And who is "we" ? Teacher educators at boards of education, Associate Teachers who supervise the practica, Administrators and School Leaders, Divisional colleagues, Grade partners – all must provide consistent messages and support in order to help our current student teachers and recent graduates to become strong teachers of mathematics in the constructivist tradition.

The teacher candidates' voices speak volumes. Their perceptions are their reality. They have been open, candid and frank about what they need and what they want. It behooves us to listen and respond carefully.

First, we must accept the fact that math anxiety (and in extreme cases, math phobia) was not just a hot-topic from the '70's. It is very real and highly evident in much of the largely female elementary teaching population across North America. We must work together to create safe

opportunities for small communities of elementary math teachers to get together for discussion and study. It is essential that workshops are facilitated in which teachers who identify with each others' similar experiences are brought together and helped to use those experiences, not only to connect with one another, but to acknowledge how their attitudes could be negatively affecting their classrooms. Only then, will they commit to developing the mathematics skills and processes that are connected to a positive disposition.

To their credit, new teachers recognize that they need, and are the first to say, that they want math content support (especially in areas such as fractions, geometry and probability). Therefore, professional development and resources must strive to help them to understand concepts thoroughly themselves. But we must not stop there – those same opportunities and materials must also help them to discuss, instruct and assess math concepts in ways that are understandable and meaningful to primary/junior children. The Van de Walle book clubs, that are growing in popularity, provide a perfect opportunity for balancing content with pedagogy, helping teachers to increase their expertise.

While early career teachers also want help in designing units and lessons that are 'real-world' based, we must work together to help everyone expand the repertoire of standard numeric applications that appear over and over again in elementary resources. We must broaden the applications-base to include examples of mathematically-dependent multicultural artifacts from the worlds of music, art, and architecture. Ron Lancaster's Math Trails and Photo Math features in the *Ontario Mathematics Gazette* are an impressive beginning to this trend.

We must support and encourage recent graduates' creative efforts to make math fun, but we must always ask them, "where's the math"? A colleague from Australia, Sandra Schuck, refers to the "empty gift box" syndrome. So eager are we to create innovative, dynamic and exciting units, that we often lose sight of the content/concept fundamentals. Our classroom seems to be a "happening place" with lots of activity and engagement and there is lots of glitz by way of blackboards, displays and unit journals, but once the beautiful trappings are lifted, there is little significant, conceptual or foundational learning. Lesson studies and structured opportunities to share and critique each others' materials could be highly effective to this end.

We must never let beginning teachers lose their idealism. We must never discourage them when they say they want every child to succeed in their classroom, but we must help them to broaden their definition of 'success' so that it measures all steps forward, big or small. The recent publication of the *Ontario Exemplars* is an important resource that provides an early career teacher with a window into many classrooms.

Conclusion

For now, I can say with confidence that the vision of mathematics teaching touted by the *Ontario Curriculum* is significantly different from what my recent students experienced as elementary and secondary school learners. But I am hopeful that down the road, I will see a dramatic change in the *Important Books* written by my teacher candidates every September. If Ontario's Early Numeracy Strategy, school-based action plans formed to improve EQAO scores, and the secondary curriculum implementation continue to be as effective as they have been to date in improving teaching, learning and assessment, then in 12 years or so, my classes should be filled with students whose experience with school mathematics has been characterized by relevant and motivational learning, purposeful integration of technology, hands-on/minds-in experiences, the use of manipulatives, cooperative learning groups, critical thinking, problem solving, rich tasks and discourse. I look forward to that day and I am confident that it will come. Until then, you know what I'll be doing in my first class. ▲

▲ Directors' Dialogue

JACQUELINE HILL
PRMA PORT PERRY ON



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 simple question about the material read, and you too could be a winner!

This edition of *Directors' Dialogue* highlights events at the Friday and Saturday, June 6 and 7, 2003 OAME Board of Directors' meeting at the Delta Airport West Hotel in Mississauga.

The Board Meeting began at 6:55 pm with the new President Stewart Craven calling everyone to order. He welcomed the new members to the Board and Executive. He walked everyone through the Vision document video. The video is a very visual piece of the project. It paints a picture of the important pedagogy in Math from K-12. Kathy Kubota-Zarivnij then spoke on the Professional Development package that will accompany the Vision package.

The Chapter Reps Meeting began at 7:30 pm. Greg Clarke, MAC^2 Chapter rep, gave welcoming comments. He facilitated a discussion on how to rejuvenate our Chapters, and presented to chapter reps a computer program that he has fine-tuned to enable Chapters to more easily hold registration at mini-conferences and the OAME Annual Conference.

The Standing Committees also met on Friday evening. All OAME Directors are members of at least one Standing Committee. Here are the brief reports.

Futures: Dave Hessey reported on two issues that were discussed: 1) The financial implications of OMO 2) The OMO guideline revisions

Promotions: Mary Bourassa reported that there is a good supply of t-shirts available for purchase. The main focus of this committee is the packaging and advertising of the Vision Project.

Publications: Chris Suurtamm reported that Frances Schatz provided a complete report indicating materials from the NCTM Annual Conference. These will be in the September *Gazette*. New ideas are always welcome!

Doug Evans reported that about 1600 people visit the web site monthly. Many are searching for grades 9-11 resources and/or conference information.

Equity Breakfast: John Ferguson reported that 10 people attended the Equity Breakfast. The group discussed potential speakers for the 2004 OAME Annual Conference breakfast.

Vision Project Workgroups: Gord Cooke and Kathy Kubota-Zarivnij outlined the parts of the project that needed to be completed soon. The groups were asked to adapt what they had already constructed and place it into a template that was created to be consistent with TIPS and EQAO. The second task was to look at student work using the parameters outlined.

wintergreen

Report on OAME 2003: Jacqueline Hill (me!) reported that OAME 2003 was a success despite board sanctions and SARS. I submitted the final conference report with a draft financial statement. I stressed that an Annual Conference is doable by smaller Chapters and recommended the following steps:

- read and use the binder of guidelines provided
- take your committee chairs to the year before conference and job-shadow
- get advance funds from OAME
- read former final reports
- try new ideas like 3-day sessions

NCTM: Frances Schatz reported that Board members and others should visit the following web sites:

Elementary School http://www.nctm.org/elementary/

Middle School http://www.nctm.org/middle/

High School http://www.nctm.org/high/ (This site presents a weekly problem and highlight of the month.)

How Much of Yourself Do You See in a Small Mirror? http://www.figurethis.org/challenges/c09/challenge.htm. (Explores angles, reflections, lines of sight, triangles, and more)

OAME 2004: Paul Fennell reported that the OAME 2004 Conference theme is "*Applications and Beyond"*. Dates are Apr 28 - May 1, 2004 at the University of Waterloo. Residences are booked and will be reasonably priced. A flyer and speaker application forms were distributed. Keynotes are Chris Hatfield (astronaut) and Jock McKay. See the GVMA web site, http://home.golden.net/~gvma for further details and speaker forms.

Discussion

Provincial Curriculum Review: Mathematics. Stewart Craven led a discussion on: " What are the key messages that OAME should be conveying to the Ministry of Education about the Curriculum Review?" Discussion followed in groups.

Project Committee Reprots

JK-6: The group revised the tasks to improve them. They piloted in June.

7&8: The two tasks were updated and samples have been gathered. The group needs to look at them.

9&10: The group needs time to work.

11U/C: They have an introduction to a unit and a performance task. They did some refining and are ready to go. Some of the samples of student work were gathered before the revisions. They may need to field test again in October.

11C: They met on June 6. They have a 4-day open-ended assessment and are developing a spreadsheet to help teachers assess.

Chapter Reports

(See upcoming events section for conferences near you!)

CHAMP - Rep: Fred Fernyhough: fred.ferneyhough@peelsb.com. No report

COMA - Rep: Peter Lenczewski: petelenc@compmore.net. COMA continued its popular series of Forums with an elementary one held at Elmwood School on Monday April 14, 2003 from 4:30 to 6:00 pm. Some 75 teachers heard Mary Lou Kestell speak on "Connecting Research and Instruction: Strategies for Translating Research into Classroom Instruction". The session was extremely well received. Unfortunately the secondary forum had to be postponed due to labour disputes. It will be rescheduled for next year. The Carleton-Ottawa Math Olympics (COMO) was held this year at St. Mathews High School on Saturday April 26, 2003 and, as expected, was a sold out event again. Hopewell and Cedarview School Teams traveled to the provincial OMO to represent COMA.

GOLDEN - Rep: Ed Haines: ed.haines@dsbn.edu.on.ca. The workshop evening in April at Brock University was again well attended with approximately 120 participants in a variety of workshops from Grade 7 to 12 levels. It was followed by an always excellent dinner. In the fall Golden Section is looking at a Saturday morning meeting with a focus on the Early Math Strategy for K to 3 and set of workshops for 4 to 6. Also we are considering, another 7 and 8 PD session. These workshops will be posted on the web site as more information becomes available. http://www.dsbn.edu.on.ca/Schools/Golden/. Anyone interested in participating in the planning of these sessions can contact Ed through the web site. All volunteers are welcome.

GVMA - Rep: Paul Fennell: pmfennell@rogers.com. GVMA held a successful spring conference on Thursday, April 10, 2003 at Kitchener Collegiate. The dinner speaker was from the new University of Ontario Institute of Technology (UOIT). Plans are in full swing for the GVMA sponsored OAME 2004 conference, Thursday April 29 to Saturday, May 1, 2004. The theme for the

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