

Selecting and Implementing Standards-Based Mathematics Curricula

The following article is an adapted excerpt from the September 1998 issue of Curriculum Connections, a newsletter published by the K-12 Mathematics Curriculum Center (K-12 MCC). The NSF-funded K-12 MCC assists school districts as they select and implement standards-based comprehensive mathematics curricula. The center offers a series of seminars, resource guides, cases, referrals, and phone consultations to facilitate discussion and decision-making within a district. These efforts are geared toward key aspects of selecting and effectively using mathematics curricula consistent with the NCTM Standards. The center supports 13 curricula including two published by Everyday Learning Corporation: Everyday Mathematics for elementary students from the University of Chicago School Mathematics Project and the secondary curriculum, Contemporary Mathematics in Context (CMIC) from the Core-Plus Mathematics Project.

Through interviews with teachers and administrators, the K-12 MCC has gathered some useful pointers about the process of selecting and implementing standards-based mathematics programs.

Think long-term.

Successful selection and implementation of new standards-based curricula requires a thoughtful process. These programs are vastly different from their predecessors in varying degrees. They introduce significant changes in teaching (and learning) practices: students learn mathematical reasoning, ways of communicating about mathematics, and ways of making connections between mathematical ideas; students interact with a range of materials representing problem situations (manipulatives, calculators, computers, diagrams, etc.); and students work collaboratively as well as individually.

The materials that make up these comprehensive programs look different. Many of the new texts include content that has not been part of conventional mathematics programs (for example, data analysis) and are organized much differently than traditional texts. Ideas are learned in different sequences than in traditional programs. Mathematical concepts are embedded in applications; the more teachers become acquainted with the materials, the better they comprehend the depth of the mathematics

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ELC's Mathlink is published
by Everyday Learning
Corporation.

ELC's Mathlink is available
upon request to teachers
and administrators who use
the secondary mathematics
programs published by
Everyday Learning
Corporation.

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within lessons. A thoughtful and involved review of the materials you're considering will help your committee make an informed decision.

The differences in the new materials imply a significant change for teachers in their approach to teaching mathematics. Understanding the philosophy behind the development of the programs has helped teachers fully appreciate the need for new pedagogical practices. Consequently, before selecting or using new programs, teachers need more time not only to learn the materials, but also to adapt their classroom strategies. In addition, building community understanding of the theory and approach of new programs requires a longer timeline. Parents and other community members want assurance that a new mathematics program will improve student learning and can be taught effectively; your selection committee should incorporate time to involve these stakeholders in the process.

Understanding the philosophy behind the development of the programs has helped teachers fully appreciate the need for new pedagogical practices.

Thinking long-term applies to implementation as well as selection. Through our discussions with practitioners, we've learned of a variety of implementation models practiced by districts. The important consideration is for your district to create a plan that will best serve the needs of your students, teachers, and community.

Plan for professional development.

As we've talked with teachers, administrators, curriculum developers, and publishers involved with standards-based curriculum programs, all have stressed the need for ongoing professional development to make these programs effective for students. Teachers need opportunities to be learners of both new mathematical content and new pedagogical practices. Teachers

need time to develop the necessary understanding of the very different ways these new materials represent and teach mathematical concepts. One lead teacher stated, "The school has to make a commitment to give teachers some kind of release time so the teachers can deal with bringing this new stuff into their lives, because it is a big change in their lives." Teacher training is recommended, both prior to and during the process of teaching the new programs. Some successful strategies have included workshops taught by experienced teachers of the curriculum, the assistance of demonstration teachers or classroom coaches during the early phases of implementation, common planning time for teachers of the new curriculum, and peer support for troubleshooting.

Many districts that have had success adopting standards-based materials had ongoing professional development in place, which helped their teachers to be better prepared to teach the new curricula. Districts engaged in long-term planning for a new program might want to think about how their current professional development program could help support a curriculum adoption down the road.

Reach out to stakeholders.

Students and teachers are not the only groups of people who will recognize that these materials are different; parents, other community members, and administrators alike will find that "mathematics" doesn't look the same as it did when they were in school. As one mathematics supervisor said, "It is very frightening to parents when you tinker with the mathematics program."

Keeping parents informed of the changes in their children's mathematics education helps parents feel more comfortable. Some schools host parents' nights, during which parents are invited to "math class" where they experience lessons from the new curriculum. Other schools send home regular letters to parents explaining the philosophy and method behind the mathematics their children are practicing. A K-12 mathematics coordinator from a large rural district told us about a parent handbook the district team

created for each unit: “It’s been our most successful strategy, the best thing for dealing with the questions. It really lays out what the program is trying to do, and helps people see where the math is in some problems.”

A strategic implementation involves various groups of stakeholders in both selecting and implementing the new program. One curriculum consultant for a rural state systemic initiative explains, “Our committee used the community members all the way through the process of identifying what they wanted the content to be They talked together about what was important to look for in a curriculum and what they wanted students to know.” By actively seeking the input and support of members of the community, districts and schools not only promote greater community involvement in education, but also expand the wide range of community resources and support available to their students.

Maintain strong leadership.

Introducing standards-based mathematics into a community can be a challenging process that requires a leader or leaders who can maintain the vision for improved mathematics education within the district. The leadership role includes orchestrating materials selection and implementation that is consistent with the district’s vision, as well as being a public representative of that vision. One lead teacher told us, “Leadership is the key It is important to have someone who will say to the district as a whole, to teachers and administrators and parents, “This is the philosophy. This is the curriculum we are going to use, and this is how we will implement the curriculum.”

Many mathematics supervisors, department chairs, and lead teachers have played this lead role in a variety of ways. They facilitate a selection process that gives people adequate time to learn about the materials, has clear selection criteria, and involves appropriate stakeholders. They establish a strategic plan for introducing the new materials to the schools. They arrange for adequate professional development. It is evident that they create lines of communication and discussion among teachers, parents, and administrators.

Seek support.

While the change to standards-based curricula may seem daunting, it is necessary for schools and districts to recognize the challenge and seek appropriate support. Several mechanisms exist to nurture your district’s process. Some of these resources reside within the district: the lead teachers interested in innovative materials and methods, the funds districts normally have for mathematics and science, such as Eisenhower funds, that could be directed toward supporting curriculum implementation, and local universities that may already provide professional development. National resources also exist. The National Science Foundation has funded elementary, middle, and high school level imple-

mentation centers, as well as the K–12 MCC, to help provide schools and districts with information and resources about standards-based curricula. Additionally, each of the curriculum programs has a corresponding “satellite” implementation center to help schools learn specifically about that program. Resources like the National Science Foundation’s Local Systemic Change grants provide funding for teacher enhancement.

Think about cross-grade transitions.

In standards-based curricula some concepts are learned in different sequences than they have been with traditional materials. When students transition into a standards-based program, there are multiple structural changes in their mathematics classroom and style of learning. Therefore, districts thinking about using a standards-based program should give some consideration to their mathematics curriculum from a K–12 perspective. Whether your district seeks to implement new curricula at all grade levels or at only one grade level, it may be impossible to find programs that “perfectly match” those at other grade levels. As you plan your K–12 curriculum, examining the articulation between grade levels will help your district find the areas of overlap or the gaps, and will help you anticipate where students may need extra support with new pedagogy. Good communication across grade levels is helpful in this process, as is information from publishers, developers, and users of the programs.

For more information

The themes presented above constitute some guidelines for your curriculum selection process. To provide more in-depth guidance in thinking about selection and implementation strategies, the K–12 MCC will soon offer *Choosing a Standards-Based Mathematics Curriculum*. This guide provides an in-depth look at the selection and implementation process, addressing topics such as committee selection, development of selection criteria, designing professional development, and implementation. For more information about these and other materials, please contact Ki McClennan, K–12 Mathematics Curriculum Center, Education Development Center, 55 Chapel Street, Newton, MA 02458-1060; phone 1-800-332-2429; E-mail: mcc@edc.org.

Everyday Learning publishes *Connected Geometry*, written by authors at Education Development Center, Inc. Please see page 14 of this issue of *ELC’s Mathlink* for more information about *Connected Geometry*.

mathematics bookshelf

Book Review

Once Upon a Number

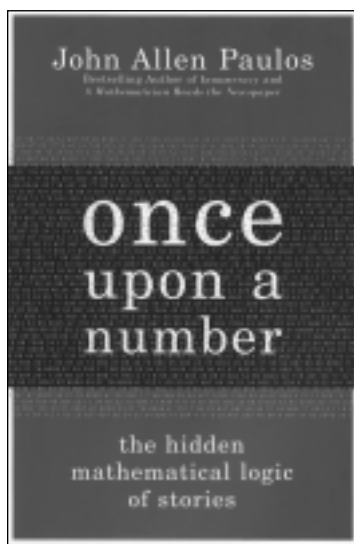
The Hidden Mathematical Logic of Stories

by John Allen Paulos

Basic Books, 1998, New York.

\$23.00

Reviewed by Christine Longcore



John Allen Paulos has written such best-selling books as *Innumeracy* and *A Mathematician Reads the Newspaper*. In his most recent book, *Once Upon a Number*, Paulos writes daringly about current events and everyday phenomena as part of a rich landscape where theories and problems from many different disciplines interact and conflict with those in mathematics. Paulos

argues that there is a gap between stories and statistics and related gaps between subjective viewpoint and probability, informal discourse and logic, and meaning and information. In five connected essays, Paulos explores the nature of these gaps and whether and how we can bridge those gaps. He enters into a lively, humorous discussion that respectfully involves thinkers from the scientific and literary cultures, inspiring his readers to thoughtfully examine the relationship between mathematical reasoning and narrative in their own lives.

One of the strengths of *Once Upon a Number* is that Paulos effectively enters into conversation with other scholars. He does not pose his central questions in an isolated monologue, but describes the context in which that question arises, allowing his readers to listen to the voices of other thinkers. In this conversation, Paulos excels at making connections across disciplines and discussing the interdisciplinary knowledge in a focused way that does not overwhelm his audience. He gives his readers just enough of a taste of the knowledge from these disciplines so that they can follow his argument and investigate certain ideas and concepts later if they are interested. Paulos writes concisely about important concepts

and questions from physics, biology, history, philosophy, and literary theory without losing sight of his central argument about stories and statistics. For instance, in his essay about meaning and information, Paulos gives his readers a focused view of Stuart Kauffman's ideas about order and pattern and Mark Turner's literary theory about basic actions and plot elements.

In his conversation with mathematics scholars and those in other disciplines, Paulos' makes his book accessible and readable through humor and an easy, casual writing style. His frequent use of personal anecdotes, parables, jokes, everyday problems, and parenthetical asides emphasizes the pleasure with which one can argue about mathematical problems and questions. In a discussion of probability and Murphy's Law, Paulos solves a problem of missing socks, but, he says, "the solution to the problem of the socks' disappearance and their whereabouts is yet another holy grail."

A secondary mathematics teacher would find this book valuable for two reasons. First, it is a stimulating discussion of how mathematics relates to other areas of human thought. Teachers will want to read this book to expand their own perspective on the mathematical topics they teach.

Second, teachers can select some of the mathematics problems that Paulos uses and pose them to their students in class discussion. One problem that might be appropriate for teachers to share with their students appears in the essay entitled, "Between Viewpoint and Probability." It deals with probability and the influence personal viewpoints and psychology have on our choice of options phrased in mathematical terms. Teachers may want to introduce this problem at the beginning of a lesson on probability and ask students which option they would select. Students can explain their answers and analyze the cases that are presented.

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mathematics bookshelf

Have you read any good books about mathematics lately? In Mathematics Bookshelf, tell other teachers about what you've been reading. We welcome book and article reviews about mathematical concepts, current research in mathematics education, and first-hand experiences of mathematics teachers. Use the Suggestion Box form on page 15 to tell us which book or article you would like to review.





ELECTIONS PROVIDE GROUND FOR MATHEMATICS LEARNING

By Maureen Laude

Choosing a candidate in an election, a fast-food meal for dinner, a scholarship winner, or a most valuable player on a sports team often requires some difficult decision making. The method that one uses can make the difference in the winning choice. Is there a fair method to use? Is one method less “unfair?” Elections take place all the time in students’ lives. Students witness and participate in mayoral, presidential, class, and Homecoming elections. Their favorite football, basketball, or baseball players may be elected as Hall of Fame members or “Most Valuable Players.” Students are chosen as scholarship winners or valedictorian for a graduating class. It is necessary for students to know the rules of the particular types of elections and how to recognize and keep elections fair. Accordingly, *Contemporary Mathematics in Context (CMIC) Course 3A* includes a unit on modeling public opinions with a lesson on voting models. Throughout the lesson, students apply the methods of voting to real-world situations and test their mathematical thinking and ideas about fairness. The concepts in this lesson can be applied to any election as they occur in the news or in school. The following explanations of the different types of election methods may guide you in discussing elections with your students.

Elections take place all the time in students’ lives.

Plurality and Majority

Probably the most common method of election is to vote for the favorite, and the one with the most votes is the winner. This method is used when we vote for political candidates—if there are only two candidates, one of these candidates will be the **plurality** winner. The plurality method awards the person or item with the most votes by declaring that candidate the winner of the election. The **majority** winner in an election is the person or choice who receives more than 50 percent of the votes. If there are only two candidates in an election, unless there is a tie, the plurality winner will also be the majority winner. In an election with more than two candidates, the plurality winner may not be a majority winner.

Borda Method

When people are given the opportunity to rank the items for election, different results may occur. For instance, if Joe, Juan, and Jessica are asked to choose what fast-food they would like to have they may record the following preferences:

Joe: hamburgers, chicken, tacos

Juan: chicken, hamburgers, tacos

Jessica: chicken, tacos, hamburgers

Since “chicken” was chosen as a first-preference by two of the three, that may be what they order, but they may not be aware of the fact that chicken is not Joe’s favorite. Because of this dilemma, a different method of voting may be applied. It is a points-for-preferences method named after the Count de Borda so it is often referred to as the **Borda Method**. Points are assigned to each preference and the candidate with the most points is the winner. In this case, “hamburgers” gets six points: three points for a first ranking, two points for a second rating, one point for a third rating. The winning selection is “chicken,” with a total of eight points.

Run-Off Method

Another method of voting is called the **run-off method**. In this method, a vote is taken and the top two vote-getters are then run-off against each other. This method is used in primary elections. There may be many candidates, and voters then have a choice of voting for anybody they want. The two candidates with the most number of votes then run against each other in the major election. Another type of run-off election is a sequential run-off method. In this method, one candidate at a time is eliminated until there are only two candidates; then they run against each other using the majority method. This method is less fair because it sometimes eliminates strong candidates in early rounds who may have won if they had come up for election against other opponents.

Condorcet Method

The **Condorcet method** is a pair-wise comparison method. Each choice is matched head-to-head with every other. The winner, if one exists, is the one that beats all the others. This particular method may not show a winner. It is possible that there is no candidate that could beat everyone else in head-to-head competition.

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(Elections, continued from page 5)

Each of these methods is not completely fair. Some may cause people to vote insincerely, or other methods may not even designate a winner. Kenneth Arrow won a Nobel Prize in economics for proving that no method of election is completely fair and that the most that can be done is to eliminate the most “unfairness” and to use the method that is the least unfair. One of the least unfair is the **approval method**. In this method, the voters are allowed to vote for as many candidates as they choose or as many as they would be willing to have win. The winner is the one with the most votes.

How can I show my students these methods at work?

Real-life examples from the sports world

Sports is a familiar topic in which students can examine different methods of voting. The Borda Method is used to determine Most Valuable Players. A panel of media personnel from the United States and Canada lists players in order of preference on individual ballots. The players are given points for their position on the ballot. Michael Jordan was voted the 1998 NBA Most Valuable Player with a total of 1,084 points. The next closest point total was 842 for Karl Malone.

Figure skaters are given both points and ordinals which determine their final position in competition. In the 1994 Winter Olympics, a different skater could have won if another voting method had been used. The top three skaters were Oksana Baiul, Nancy Kerrigan, and Chen Lu, finishing first, second, and third, respectively. By any count, Lu was the third place scorer. However, in the Condorcet, or head-to-head, method of scoring used to determine the winner, Baiul edged Kerrigan by one vote even though the judges gave both skaters the same total score. The win went to Baiul since she had the highest score in a single category. If we use the Borda method and score three points for first choice, two for second, and one for third, then Kerrigan is the winner by a two-point margin: Kerrigan achieved only rankings of first and second; Baiul was ranked third by three of the nine judges.

Projects and explorations

Students enjoy conducting their own elections. In my class, they select the subject (movies, TV shows, TV or movie stars, cars, candy, prom themes), conduct the election, and apply the different methods of voting to their results. They soon discover that the outcome of the election often depends on the method applied. I give the students about three weeks to complete the project. They choose a topic that is interesting to them: Who is the most preferred movie star? What type of chewing gum do most teenagers chew? What kind of car is the most popular among student drivers and/or faculty drivers? What is the favorite flavor of pie served at Thanksgiving or Christmas dinner? My students have come up with some very creative topics and questions.

One of my students chose hair styles from one of the fashion magazines and asked her classmates to rank them in order of what they would like to wear to prom. I also ask students to have at least 30 people rank the choices that they have selected ahead of time. I tell them to make sure that they ask a variety of people to do the ranking unless their purpose is directed to a particular age group. For example, if they are interested in ranking the movies that teenagers prefer they may keep their “rankers” to teenagers, but if they are interested in which movie anyone prefers they should include older and younger people.

The students must limit the number of choices that people should rank to four since the number of possible rankings gets very large (72 possible with just five choices). They then total the number of different preference lists and conduct each of the following methods on the lists—plurality, majority, run-off, sequential run-off, Borda, and Condorcet. They are also told to have voters select a winner by the approval method. They then write a summary on the different winners depending on the method of voting and compare the results to those of the approval method. Their write-ups must be at least one page and state what they thought were fair or unfair results of their election. They present their results to the class orally and show a visual display with the correct results and computations. One student asked the class what kind of cookie they would prefer if they could only choose one. She gave the students a list of cookies that she knew how to bake and they ranked their preferences. Then on the day of her presentation, she brought them the winning type of cookie to eat while she shared her results.

Another way to give students hands-on experience with voting methods is to conduct the following exploration: tell them to make a list of three snack foods. Then have them list their order of preference. Say that you will bring a snack to class but can only bring one and want to please the most students. Small groups discuss how to determine what you should bring and then each group of students shares its method of selection with the whole group. Student should focus on which method seems to be the “fairest” and what they can do to ensure that they get what they want.

After you have outlined the different voting methods mentioned above and in the *CMIC* materials, see how many of your students came up with these methods and how many of them have discovered new methods on their own. A culminating project enables students to take ownership of the methods. For example, your students can investigate how a person could manipulate the voting methods to keep the real winner from winning. Someone else could do research on Arrow’s rules of fairness and how students could apply those rules to their methods of selection.



Whether we are choosing our president, our top sports figures, or our favorite fast-foods, the voting methods that we use make a difference. Outcomes of an election are sometimes made not by how the votes were cast but by how they were counted. To make our choices fairer and our selections more meaningful, it is important that the voting methods are fully explained ahead of time and that the method of choice is known by all involved.

Maureen Laude teaches at Queen of Peace High School in Burbank, Illinois. She has been teaching for 25 years. She commented, "I am especially interested in teaching students math in the context of real-life situations. I feel that they will find it much easier to learn if they know where it will be used or how to apply it in real situations."

(Bookshelf, continued from page 4)

Teachers could also use this book to spark conversation, presenting some of the central ideas in this book before or after a related mathematics lesson. Paulos points out that important ideas in probability and statistics have roots in ordinary language: "Consider first the notions of central tendency, average, median, mode They most certainly grew out of such workaday words as *usual, customary, typical, same, middling, most, standard, stereotypical, expected, non-descript, normal, ordinary, medium, conventional, commonplace, so-so, and so on.*" With Paulos's idea in mind, a mathematics teacher could ask students to list other ordinary words and parts of stories that express concepts related to statistics and probability, such as chance, fate, likelihood, and luck. Teachers will want to add this book to their classroom collection of books about mathematics and mathematics teaching.

Most secondary students will find this book challenging. Given the opportunity to discuss the book with a peer or teacher, student readers will find themselves agreeing and disagreeing with Paulos and expressing their own ideas about statistics, probability, and logic. The essays in this book best-suited for secondary students are those on stories and statistics and viewpoint and probability.

John Allen Paulos introduces readers to his thoughtful arguments through humor, knowledge from other disciplines, and analysis of everyday situations and current events. In his book, Paulos aims to "limn the intricate connections between two fundamental ways of relating to our world—narratives and numbers." He accomplishes his goal and in the process provides teachers and students alike with an example of how mathematicians not only solve problems but also formulate and argue theories in conversation with others.



Web site review by Christine Longcore

The Core-Plus Mathematics Project Web Site
<http://www.wmich.edu/cpmp>

The Core-Plus Mathematics Project's (CPMP) Web site is an excellent way for teachers and administrators to get up-to-date information about program organization, content, research, and training opportunities. Whether your school has been using *Contemporary Mathematics in Context* for one year or five years, you are bound to find information on the site to benefit your instruction, assessment, and professional development goals.

The site offers both a broad description of the CPMP curriculum and more focused descriptions of *Courses 1, 2, and 3*. The course-specific material is especially useful if you want to find out what is studied in courses above or below the one you currently teach. The curriculum and course overviews may prove helpful when preparing for presentations to parent groups or parent-teacher conferences. You may also refer parents to this site to find answers to questions that arise at home.

The "Instructional Design" page concisely explains the four-phase cycle of classroom activities and gives samples for each phase. This is good information to use in instruction planning sessions with teachers who are just beginning to teach the curriculum. The "Assessment" section outlines several different modes of assessing progress: informal, group, and individual. Once again, parents may be interested in reading or hearing about this material.

If you are interested in reading about research and studies related to the CPMP curriculum, click on "Evaluation" or "Publications." The former includes abstracts of field-test progress reports and the latter is an annotated bibliography of publications written by CPMP authors and others involved in mathematics education research.

To find out what you should consider before implementing the CPMP curriculum, look at the "Adoption" section. In addition, the "Inservice" section provides dates and locations for 1999 implementation workshops and NCTM regional conferences. This is a quick way to check upcoming training and professional development opportunities.

The CPMP Web site allows teachers, administrators, and parents to quickly access answers to their questions about program organization and content, research data on student achievement, implementation suggestions, and information about upcoming staff development opportunities.

interview

AN INTERNATIONAL PERSPECTIVE ON MATHEMATICS TEACHING

Nina Shteingold is a mathematics teacher who has taught in both Russian and American schools. She came to the United States six years ago. In this interview, Nina describes life in a Russian mathematics classroom and shares some ideas about mathematics education in the United States.

ML: Where did you teach in Russia? What was the school and surrounding community like?

NS: I taught in Moscow, in a mixed community. There were mostly children of factory workers and engineers in the school. In Moscow, the average educational level was generally higher than the statewide average educational level.

When I was teaching, there were 10 grades in the school. Now, in some schools, there are 11 grades. In some schools, children start school at age six and cover elementary school in four years instead of three; ten years ago, everybody started at age seven. There were two, sometimes three, groups in each grade level. Students studied in the same group for all 10 years of their school life. There were 30 to 35 students in each of the groups. People in Russia do not move as often as in the United States, so students do not change schools very often.

ML: What courses and grade levels did you teach?

NS: I taught mathematics in grade 4 through grade 10, including everything from basic mathematics to calculus. Then, in an experimental elementary school, I taught younger students as well. In Russia before the 1990s, children entered first grade at age seven, and studied for 10 years, instead of the 12 years students in the United States usually spend in school.

ML: What qualifications did you need to become a mathematics teacher in Russia?

NS: I had to graduate from a five-year college to be a teacher in grades 4–10. In those grades, different teachers teach specific subjects. One could also attend a five-year college to teach in elementary school or could attend a two-year college. In grades 1–3, students have the same teacher for all subjects.

ML: How would you describe the philosophy of teaching mathematics in Russia?

NS: There was one curriculum for the whole country—no tracking. A student was taught by the same mathematics teacher through all middle and high school years. Teaching was directions-oriented and teacher-centered—no teamwork. Instruction included a lot of individual drills and problem-solving activities.

ML: What did you like about this philosophy? What did you dislike?

NS: I liked the fact that there was a clear understanding of what must be done and what skill was being mastered. As a result, students gained a solid knowledge of basic skills. They also developed good working habits and the ability to assess themselves.

On the other hand, I found that some students may grow to be passive learners and poor team workers with a rather narrow image of learning.

ML: What was a typical day in the classroom like for you?

NS: A full load was 18 teaching hours per week. Many teachers had more, none had less. Usually, I was at school from 8:00 A.M. until about 3:00 P.M. Later, I spent time at home grading assignments and preparing for the next day's lessons.

ML: What mathematics courses are Russian students required to take?

NS: Students in grades 4 and 5 spend one hour each day six days a week studying basic mathematics and prealgebra. Students in grades 6 through 8 study geometry for three hours per week and algebra for four hours per week, for a total of seven blocks of mathematics per week. In grades 9 and 10, students work on three-dimensional geometry three times a week as well as advanced algebra and introduction to calculus four times a week. This schedule does not include discrete mathematics, graphs, statistics, and data analysis, but has a bit of combinatorics, derivatives, integrals. All that is the same for all students in all schools; everybody studies from the same books.

ML: What happened during a typical mathematics lesson? What did you expect from students?

NS: A lesson was 45 minutes long in all grades—1st to 10th. We spent five minutes warming up. I asked short



questions related to topics studied previously and then we checked homework for about 10 minutes. A few problems were done on the board by selected students, who were graded for their work. Everyone in the class could see how the problem was done and hear what grade each student received. While the students prepared their work on the board, I went around the class and looked at individual homework. Then we spent 10 minutes on a few problems on the material that was studied for homework. As students worked individually, I went around the class and helped individual students and assigned enrichment problems as necessary. I presented new material in the form of a question-and-answer dialogue rather than in lecture form. I explained a few problems on the board, then students did individual work, and I gave a homework assignment at the end of the period.

ML: How did you communicate with other teachers in your school?

NS: We talked during lunch blocks. We did not visit each other's classrooms.

ML: What concerns, questions, and ideas about teaching did you discuss together?

NS: In our school, there were no two math teachers who taught the same grade (and therefore, the same material) at the same time. For example, when I taught grades 6 and 7, another teacher taught grades 8 and 9, and another one grades 4 and 5, and another one grade 10. But then I could talk with the teacher who taught grade 8, and ask him: "How did you introduce this concept last year?" So, there was little grade-level teamwork among teachers, except that sometimes our physics teacher and I worked together and our literature and history teachers did the same. Mainly, our concerns and conversations were the same as those of American teachers.

ML: How did you communicate with parents?

NS: For each group of students there was a special teacher assigned, something like a homeroom teacher in America. This assignment lasted for seven years and allowed the teacher to build a deep connection with his or her 35 students. This teacher held parent meetings two or three times a year. All parents were supposed to come to school and the teacher told the entire group of students about school issues and how individual students were doing. So, all parents knew about all students in the class.

If a teacher wanted to discuss something with a particular parent, he would write a note to a parent (delivered—or not delivered—by a student) and ask the parent to come to school at a certain time.

Another way of communication was the student's day-book. This was a combination of a student schedule, assignment notebook, and a report card. As soon as a stu-

dent got a grade, the teacher wrote this grade in the day-book. The parent was supposed to sign this book at the end of each week, and the homeroom teacher was supposed to sign it afterward. Subject teachers sometimes wrote short notes to the parents in the daybook, too.

ML: What grades and topics did you teach here in the U.S.? How many years did you teach?

NS: I've taught Basic Math in grade 6 and Algebra 1, Algebra 2, Advanced Algebra, Advanced Placement Calculus, and Geometry in high school. I spent five years teaching part-time. Also, I did enrichment programs for grades 4–6 and 7–8. And, for two years I participated in a summer math program for high school students at Rutgers University.

ML: What were the most surprising aspects of teaching mathematics in the United States?

NS: First, many schools use a tracking system; there is rarely tracking in Russia. Second, individual schools within the same public school system use a wide range of curriculum and materials. Third, instruction proceeds at a much faster pace. Finally, some schools repeat certain topics in the same way year after year.

ML: How did your teaching change once you came to the United States?

NS: I did more group work with my students in the United States than I had in Russia. Up until about five years ago, Russian students were not performing well in group work while American students have become strong in that area. Also, in the United States, I learned not to rely on my students' prior knowledge. For example, my Algebra 2 students might not remember anything from Algebra 1, and my Precalculus student might be not able to factor. This forced me to change my teaching style.

ML: What have you learned about your American colleagues?

NS: Basically, I found out that there *are* brilliant mathematics teachers in the United States. The best teachers in both countries are on the same high level. Each of these teachers is a real artist, with his or her own spectrum of teaching approaches, which is a pleasure to observe and a challenge to learn.

ML: In your opinion, what qualities and abilities do the best mathematics teachers have?

NS: The best teachers have energy, and the gift to inspire; they infect their students with passion for the subject. They have the ability to see the class as a whole and focus on each individual student. They are flexible in their approaches and exhibit broad knowledge. The best teachers are persistent in their requirements, hold high expectations for their students, and respect their students as able learners.

Contemporary Mathematics in Context *Meets Needs of ELL and LEP Students*

By Bill Bokesch

I teach in the Sweetwater Union High School District in National City, California. The district includes 10 high schools and 10 middle/junior high schools in the southwesternmost area in the United States. For the past two school years, all the teachers have been taking a 45-hour professional development course called “Specially Designed Academic Instruction in English (SDAIE)”. The California legislature requires all California teachers, of every grade level and in all subject areas, to take this course. The importance of this requirement continues to increase as the population of students who are limited English proficient (LEP) students grows. Some SDAIE teaching methods include the use of real objects, manipulatives, visuals, graphics organizers, and planned opportunities for interaction among all individuals in the classroom. SDAIE methods are for LEP students assigned to the core instructional classes, and are not remedial instruction, English as a second language (ESL) instruction, or bilingual instruction. The methods do not involve tracking, or provide watered-down content. As one of the original field-test teachers of Core-Plus Mathematics Project materials, I feel that the curriculum, *Contemporary Mathematics in Context*, already incorporates many methodologies similar to those emphasized in SDAIE. These methodologies benefit all students in core content area classes, including those whose first language is not English. The following are some strategies I use to teach mathematics to students in my *Contemporary Mathematics in Context* class. These strategies enhance mathematics learning for all of my students.

- Vary the settings in which students learn. Like SDAIE, *Contemporary Mathematics in Context* provides opportunities for students to learn in a variety of settings other than the traditional classroom setting of straight rows and rigid, one-way teacher delivery of material. In my classroom, the setting depends on the activity. For tests and quizzes, the classroom looks like the traditional classroom. For Investigations or projects, the class may be divided into groups of two, three, or four, depending on the assignment. Except for times when the class is acting as one group or taking an exam, the classroom environment is much like a workplace where the employees are working toward a goal. They are talking about the problem, checking with other groups, or asking me questions.

- Call on students' existing knowledge, observations, and experience.

In each *Contemporary Mathematics in Context* lesson, students discuss a familiar situation as a launching point into new mathematical concepts they are about to experience. Often, this involves talking about movies they have seen, books they have read, lessons they have learned in other classes, places they have been, or jobs their relatives have. The “Think About This Situation” of a *Contemporary Mathematics in Context* lesson allows students to have informal social interaction during mathematics class so they can practice their language skills and make connections between their experience, real-world situations, and mathematical concepts.

- Make the most of recurring problems and mathematical experiences.

In *Contemporary Mathematics in Context*, students may encounter problems, such as finding rates of change, in increasingly deep and complex forms throughout their time in the curriculum. The familiarity with the problems allows LEP and English language learner (ELL) students, as well as other students, to draw on their past learning experiences to develop their understanding of mathematics concepts over time. Students build their knowledge and confidence in solving and discussing problems at increasing levels of difficulty.

Like SDAIE teaching methodologies, CMIC emphasizes the idea that students retain more by doing and discussing as compared to just watching and listening.

- Require students to learn through hands-on investigation.

I am currently teaching the field test of *Contemporary Mathematics in Context Course 4*. Students at this level use a nautical chart with 360-degree protractors and plot courses as I did while serving in the U.S. Navy. As in the Navy, students solve problems by working together, questioning each other, and trying different options until they reach the correct solution. Students work with authentic materials, tools, and problems in a collaborative environment. Hands-on investigation is especially appropriate for LEP and ELL students because they practice and develop their language skills through contact with concrete materials and tools as well as peer interaction. Like SDAIE teaching methodologies, *Contemporary Mathematics in Context* emphasizes the idea that students retain more by doing and discussing as compared to just watching and listening.



- Emphasize how students' mathematics and language skills will benefit them in the future.

I address two key questions with my students throughout the year: "What is 'the real world'?" and "What do businesspeople want from graduates?" In answering the latter question, my students and I have found that employers want graduates who think for themselves and are able to work with others toward the mission and goals of their companies. I try to convey to them that their bilingual ability coupled with their ability to read and understand the mathematical concepts presented in *Contemporary Mathematics in Context* will make them marketable as they begin their careers, especially after college. During Career Day at our school, the human resources administrator from an international satellite communications company reinforced the idea that mathematics and language skills are crucial to success in the world of work.

I try to convey to them that their bilingual ability coupled with their ability to read and understand the mathematical concepts presented in Contemporary Mathematics in Context will make them marketable as they begin their careers, especially after college.

- Work as a whole group to understand new concepts and vocabulary.
I asked students in my *Contemporary Mathematics in Context* class (75 percent of whom are ELL students) what they thought about the reading required in the course. Most responded that by working as a class on the "Think About This Situation" section and the first two or three exercises in each Investigation, they could gain understanding of the concepts and vocabulary required to finish the Investigation as well as the related "MORE" questions assigned for homework. When the class works as group, students can benefit from asking questions and hearing other's ideas before they work in smaller groups or individually.
- Integrate technology.
An added bonus in *Contemporary Mathematics in Context* is the full integration of technology throughout the curriculum. In the *CMIC* classroom, it appears that technology bridges language-related and cultural barriers in mathematics problem-solving because it aids in visualizing problems and expressing solutions. For example, one ELL student in my class this year can describe the derivative of a function as a rate of change at a point and visually show it using the graphics calculator. She can succeed in more advanced mathematics because she has an additional tool with which to demonstrate her knowledge and abilities, regardless of her current English language abilities. After four years of observing students using the graphics calculator on a daily basis, my impression is that they look at the graphics calculator like many people of older gen-

erations look at a pencil: it is one of several tools they can use to approach a problem.



During Investigations and projects, students collaborate in small groups with teacher guidance.

- Conclusion
Literacy in all content areas is a major goal of my school and district for all students, including those whose first language is not English. Required professional development courses like SDAIE encourage teaching strategies that will help LEP and ELL students reach this goal. The *Contemporary Mathematics in Context* curriculum incorporates many of the same teaching strategies taught in the professional development courses. By using appropriate settings, discussion, investigation, and tools, I help students in my *Contemporary Mathematics in Context* class learn mathematics in a way that strengthens their language skills and allows them to build on their existing mathematics knowledge. I sincerely believe that *Contemporary Mathematics in Context* provides valuable language learning in a first-rate mathematics curriculum.

Bill Bokesch has been teaching Contemporary Mathematics in Context for five years. He has field-tested Courses 1, 2, 3, and 4 and piloted Course 4. Bokesch is in his eighth year of teaching after retiring as a Captain from 25 years of service in the United States Navy. He is currently President of the Greater San Diego Mathematics Council.

MATHEMATICS

in the news

NCTM Releases Draft of Updated *Standards*

This past October, the National Council of Teachers of Mathematics (NCTM) released a discussion draft of the updated *Standards*, entitled *Principles and Standards for School Mathematics*. For a full year, Fall 1998 through Fall 1999, NCTM members will collaborate in a "Year of Dialogue" to gather input and make changes in the draft. An NCTM Writing Group will meet in Summer 1999 to make final revisions. The revised *Standards* will be released in Spring 2000.

The draft is organized into four grade bands (pre-K-2, 3-5, 6-8, and 9-12) instead of three, providing more detail on the elementary and middle grades. The same 10 standards are applied in each grade band. This treatment enables teachers to see by content area what students should know coming into their grade band, what they should learn within that grade band, and what they will be taught later. Five of the standards focus on content (address the mathematics that students should know), and the other five focus on process (addressing ways of acquiring and using that knowledge). Each standard describes two to four focus areas for mathematics instruction. The standards include the following:

Content Standards
Number and Operation
Patterns, Functions, and Algebra
Geometry and Spatial Sense
Measurement
Data Analysis, Statistics, and Probability

Process Standards
Problem Solving
Reasoning and Proof
Communication
Connections
Representation

Along with standards, the draft includes a new facet, principles, which are the basic underlying assumptions about a high-quality mathematics instructional program. These six central principles form the foundation on which the *Standards* are built. The six principles address equity, mathematics curriculum, teaching, learning, assessment, and technology. The central ideas behind each principle are listed below.

Equity: Mathematics instructional programs should promote the learning of mathematics by all students.

Mathematics Curriculum: Mathematics instructional programs should emphasize important and meaningful mathematics through curricula that are coherent and comprehensive.

Teaching: Mathematics instructional programs depend on competent and caring teachers who teach all students to understand and use mathematics.

Learning: Mathematics instructional programs should enable all students to understand and use mathematics.

Assessment: Mathematics instructional programs should include assessment to monitor, enhance, and evaluate the mathematics learning of all students and to inform teaching.

Technology: Mathematics instructional programs should use technology to help all students understand mathematics and should prepare them to use mathematics in an increasingly technological world.

Information in this news article was taken, in part, from "A First Look at Principles and Standards in School Mathematics: Discussion Draft," an on-line news bulletin from NCTM. The Web site address is <http://www.nctm.org/standards2000/>

MATHEMATICS in the news

offers news on research findings, mathematical discoveries, and events that concern elementary mathematics teachers. If you would like to submit a news item to *Mathematics in the News*, whether it is something you have read or an event in which you have participated, please complete the **Idea Exchange** form on page 15.



Everyday Learning Corporation

CORE-PLUS REGIONAL WORKSHOPS

At each of these three-day professional development workshops, participants will learn about the structure and scope of *Contemporary Mathematics in Context Course 1, 2, and 3*. The instructional model will be examined by exploring selected units in detail. The focus is on the mathematical content, the instructional model, assessment, pacing, and communicating with parents. Sessions will include modeling lessons and sharing ideas for facilitating collaborative learning. All sessions are facilitated by experienced *Contemporary Mathematics in Context* teachers.

Make plans now to attend one of the following workshops for *Contemporary Mathematics in Context* users:

Madison, Wisconsin	June 30–July 2
Annapolis, Maryland	July 8–10
Stamford, Connecticut	July 21–23
Bellevue, Washington	July 28–30
Minneapolis, Minnesota	August 11–13

HUMAN BIOLOGY

Human Biology is a unique approach to life science that can supplement or extend any middle grades science or health curriculum. Developed by the Human Biology Middle Grades Life Science Curriculum Project at Stanford University, *Human Biology* introduces life science concepts geared to the needs and interests of adolescents. It fully aligns with National Science Education Life Science Standards for the middle grades. Teachers can select modules about human systems, the environment, or adolescent topics. Each of the following modules includes a set of softbound student books and a Teacher’s Guide. A *Human Biology* Program Guide for teachers is also available.

- | | |
|--------------------------------|---------------------------|
| <i>Breathing</i> | <i>Nervous System</i> |
| <i>Circulation</i> | <i>Reproduction</i> |
| <i>Digestion and Nutrition</i> | <i>Sexuality</i> |
| <i>Ecology</i> | <i>Your Changing Body</i> |
| <i>Genetics</i> | |
| <i>Lives of Cells</i> | |

To find out more about *Human Biology*, contact ELC Customer Service at 1-800-382-7670.

EVERYDAY MATHEMATICS MIDDLE SCHOOL MATHEMATICS

Everyday Learning is collaborating with a well-known author team to develop an innovative mathematics program for grades 6–8. When completed, this middle grades program will be an excellent first step for students who will later use any of ELC’s secondary mathematics curricula. If you would like to receive prepublication information and materials or find out how you can become a teacher reviewer, please indicate your interest by completing the form below and mailing it to Everyday Learning Corporation, attn: John Estrada, Two Prudential Plaza, Suite 1200, Chicago, IL 60601.

Name: _____

Position and Grade Level: _____

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Home Phone: _____

School Name: _____

School Address: _____

School Phone: _____

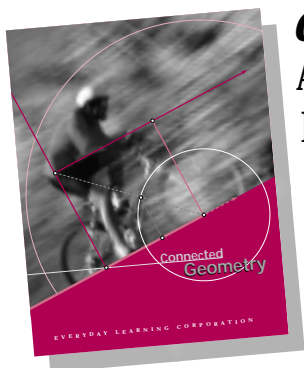
E-mail address: _____

Current middle grades mathematics program: _____

Yes, I would like to find out how to become a teacher reviewer for ELC’s new middle grades mathematics program.



new & revised **PRODUCTS**



Connected Geometry A Mathematical Habits of Mind Approach to Geometry

Connected Geometry, a new full-year geometry course, uses a mathematical habits of mind approach to teaching geometry. In this course, funded by the

National Science Foundation and developed by Education Development Center, Inc., students learn important mathematical ways of thinking while mastering the important ideas of geometry. *Connected Geometry* is an in-depth course in the essential ideas of geometry, not merely a survey of geometric topics. Each lesson is designed to connect active student learning and mathematical thinking to geometry content. Geometry and problem solving are connected to other fields of mathematics, other academic disciplines, and students' own experiences.

What are mathematical habits of mind?

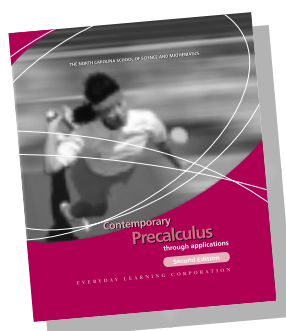
Mathematical habits of mind are characteristic ways of thinking used by mathematicians and other effective problem solvers. By emphasizing these ways of thinking, *Connected Geometry* fosters a classroom atmosphere in which students learn to act like mathematicians. They communicate about mathematics, delve into problems, conjecture, attempt to verify their conjectures, and define their reasoning about mathematical results.

Connected Geometry emphasizes the following 10 mathematical habits of mind:

- Picturing the visible, picturing the invisible
- Looking for invariants
- Using precise language to describe and analyze
- Reasoning by continuity
- Tinkering with problems
- Using different systems
- Mixing deduction with experimentation
- Proving
- Reasoning about processes
- Analyzing and interpreting figures

The *Connected Geometry* Teacher's Resource Package includes a Student Edition, Teaching Notes, a Solution and Problem Solving Resource, Assessment Resources, Teaching Resources, and expanded versions of every unit on a CD-ROM that is compatible with both Macintosh and Windows systems.

The *Connected Geometry* CD-ROM, the *Connected Geometry* text, and Teacher's Resource Package are now available. Please call Customer Service at 1-800-382-7670 for more information.



Contemporary Precalculus through Applications, Second Edition

The Second Edition of the highly successful and innovative *Contemporary Precalculus through Applications* is

now available. The authors at The North Carolina School of Science and Mathematics have revised the content, classroom-tested new lessons, and upgraded technology applications.

- **An updated approach to the precalculus curriculum.** Each chapter uses a "big picture" approach to meet specific learning goals. Lessons offer opportunities for open-ended exploration and discovery activities. The content also has a stronger algebraic base. The integration of data analysis provides good preparation for Advanced Placement (AP) Statistics as well as for calculus.
- **Accessible and integrated technology.** The Second Edition takes advantage of changes in technology by integrating use of graphing calculators into the problem-solving process. There are more real-world, easy-to-use applications of technology to mathematics content. The technology integration has made it possible to add new topics and present some topics earlier.
- **Improved articulation with *Contemporary Calculus through Applications*.** New chapter sections based on hands-on investigations and experiments are more closely aligned with the labs in *Contemporary Calculus*. They also provide students with a better understanding of how to build and use mathematical models. Consequently, the applications more frequently motivate students' need to learn the mathematics.

Second Edition Table of Contents

- Chapter 1 *Data Analysis One*
- Chapter 2 *Functions*
- Chapter 3 *Polynomials, Rational Functions, and Algorithms*
- Chapter 4 *Exponential and Logarithmic Functions*
- Chapter 5 *Data Analysis Two*
- Chapter 6 *Modeling*
- Chapter 7 *Trigonometry*
- Chapter 8 *Matrices*

Now available, the Teacher's Resource Package includes the Student Edition, an Instructor's Guide, Assessment Resources, and a Solutions Guide. If you are interested in ordering these revised materials, please call Customer Service at 1-800-382-7670.

the **LAST** word

Share your ideas and experiences in *ELC's Mathlink*

Have you ever thought that you might like to contribute to *ELC's Mathlink* but have some questions? Below are some commonly asked questions and our responses.

Who writes the articles for ELC's Mathlink?

Secondary mathematics teachers and administrators write about their ideas, research, and experiences in the classroom. The curriculum authors also write articles for the newsletter. Each contributor offers a unique perspective on secondary mathematics curricula, including algebra, geometry, precalculus, calculus, and integrated mathematics; and current issues in mathematics education.

I would like to contribute an article, but I haven't written for a publication before. Will I receive input from ELC's Mathlink editors as I write the article?

We will be available to answer your questions and offer input on your writing from the time you propose a topic to the time you turn in that well-crafted final draft. Contributing to *ELC's*

Mathlink is a valuable opportunity to write for an audience of fellow teachers. You have the option of writing an article, a book or software review, classroom management hints, or an interview. Or, if you have another idea, tell us about it.

What should I do if I want to write an article for ELC's Mathlink?

Write down your ideas and send them in! Either send in a rough draft of an article or just jot down a few notes about the topic you would like to address. Don't forget to include your name, school name, address, and phone number. E-mail addresses work, too! You can send *ELC's Mathlink* a note addressed to Clongcore@tribune.com.

I want to comment on an article that was in the last issue of ELC's Mathlink. Do you print a "Letters to the Editor" column?

Yes, we welcome your input on the articles and features in the newsletter. You can send all letters and other submissions to Everyday Learning Corporation, attn: *ELC's Mathlink* Editor, Two Prudential Plaza, Suite 1200, Chicago, IL 60601. You may choose to use the **Suggestion Box** form on page 15 of this issue to share your ideas.

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