mathlink
everyday learning corporation
ELC's Newsletter for Secondary Mathematics Teachers
Vol. 1, No. 1
Spring 1998

Introducing *ELC's Mathlink*

Dear Readers:

Everyday Learning Corporation proudly presents the first issue of *ELC's Mathlink*—a resource for secondary mathematics teachers. For those of you unfamiliar with Everyday Learning Corporation, let us introduce ourselves: We publish classroom-tested, research-based mathematics curricula. At the elementary level, we publish *Everyday Mathematics,* the Elementary Component of the University of Chicago School Mathematics Project (UCSMP). We also publish a rich selection of secondary titles, which we acquired from Janson Publications in August 1996, including the following:

- *Concepts in Algebra*—an algebra program from The University of Maryland and The Pennsylvania State University
- *Connected Geometry*—a geometry program from Education Development Center
- *Contemporary Precalculus through Applications* and *Contemporary Calculus through Applications*—precalculus and calculus programs from The North Carolina School of Science and Mathematics
- *Contemporary Mathematics in Context*—an integrated mathematics program from the Core-Plus Mathematics Project at Western Michigan University

The newsletter comprises articles about implementing these secondary mathematics curricula. Teachers share ideas with one another, program authors communicate with teachers, and we inform you of new and revised products as well as staff-development opportunities. A "Focus on" icon identifies the mathematics topic of each article—algebra, geometry, precalculus, calculus, or integrated mathematics. Look for the topics that interest you, and read on!

We welcome letters in response to *ELC's Mathlink*. Please send them to Everyday Learning Corporation, Attn: Christine Longcore, Two Prudential Plaza, Suite 1200, Chicago, Illinois 60601. We especially encourage readers to comment on this first issue. Tell us what you would like to see in future issues. If you would like to receive two issues of *ELC's Mathlink* each school year, please call John Estrada at 1-800-322-MATH ext. 4620.

Sincerely,
Everyday Learning Corporation

CONTENTS

elc's **math**link

Vol. 1, No. 1

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College Mathematics Placement

Helping students make the transition from
Contemporary Mathematics in Context
to university-level mathematics

Focus on Integrated Mathematics

by Michael Shelly, Ed. D.; Teacher, Contemporary Mathematics in Context

Is everyone ready?

Both students and their parents want to know whether high school students using a research-based, integrated mathematics program such as *Contemporary Mathematics in Context* will be prepared for mathematics at the university level. They also want to know if universities are ready to teach high school graduates who have studied mathematics using such a contemporary, research-based curriculum. How will the changes in program emphases in this kind of high school mathematics program influence student placement in first-year college mathematics courses? How do universities determine first-year placement?

Located in the northwestern Detroit suburb of Bloomfield Hills, Michigan, Andover High School is one of 19 pilot schools in the Core-Plus Mathematics Project (CPMP), and we are now in our fifth year using the CPMP curriculum, *Contemporary Mathematics in Context.* Graduates of Andover High School, in nearly every case, plan to complete some form of post-secondary education. In the case of the graduating class of 1997, 219 of 220 graduates enrolled in a college, university, or technical school for the 1997–98 academic year. Approximately two-thirds of these students studied secondary mathematics in a curriculum based on *Contemporary Mathematics in Context.* Beginning with the graduating class of 1998, all Andover students will use *Contemporary Mathematics in Context* as the primary textbook series.

We have sent about 150 students on to college after high school study in a mathematics program based on *Curriculum and Evaluation Standards for School Mathematics* (National Council of Teachers of Mathematics, 1989). Our work with college instructors and admissions personnel has raised several issues and questions. Students' and parents' anxieties about college mathematics placement have led to additional questions and concerns. These questions are very important to teachers who implement programs based on the NCTM *Standards.*

How have undergraduate mathematics programs changed?

The breadth of undergraduate mathematics programs has increased. Up until a decade ago, high school teachers could anticipate, with very few exceptions, the expectations and content of first-year college mathematics courses. Course titles such as Intermediate Algebra, College Algebra, and Introductory Calculus all carried familiar meanings ten years ago. We knew that it was very likely that students would be placed in a lecture setting, perhaps with one or two recitation sessions during each week. We also knew that students would be primarily learning algorithms, with a focus on manipulating symbols rather than on learning concepts. Students

> *Up until a decade ago, high school teachers could anticipate, with very few exceptions, the expectations and content of first-year college mathematics courses.*

were expected to learn processes and facts, but they gained little experience in applying those processes and facts.

Some colleges and universities have implemented few, if any, changes in their mathematics programs during the last decade. Others have adopted a laissez-faire attitude and allow individual instructors to implement the approach deemed most appropriate for a particular course. This attitude has led to disjointed curricula. For example, in some cases, different sections of the same course are taught in lecture or cooperative-learning format, with or without calculator use, with emphasis on applications or algorithms, all within the same university. Certain universities, such as the University of Michigan and Duke University, have taken a more collaborative path: They have established common philosophies for their calculus courses that emphasize concept learning and application as well as communication and calculator technology to support investigation and understanding.

Secondary school mathematics curricula are also more varied today. Many middle and high school programs now reflect the NCTM *Standards,* but many do not. Students with broader sets of high school learning experiences enter colleges with broader sets of expectations and philosophies in beginning mathematics courses. The result: Placing these students into the college program is now a more complex and challenging task.

What can teachers and their students expect to find on mathematics placement exams?

Last summer, university mathematics professors, lecturers, and instructors met in Traverse City, Michigan, at a conference sponsored by the Michigan Section of the Mathematical Association of America. One session at the conference addressed mathematics placement procedures. It was evident from the discussion that college first-year mathematics placement is currently based primarily on students' knowledge of algebraic manipulation and their knowledge of procedures. No college represented at the conference evaluates student ability in data analysis, probability, or discrete mathematics. Few colleges test understanding of geometric concepts.

Placement procedures vary widely. Michigan State University, for example, relies on a 28-question multiple-choice test available to students on the World Wide Web. (A sample is available at http://math.msu.edu.) This assessment is supported by the ACT mathematics subscore. The combination of placement–test score and ACT score determines whether students will be required to complete (a) a noncredit, remedial mathematics course (0–9 correct), (b) a precalculus course (10–19 correct), or (c) one of several calculus-level courses (20 or more correct). The latter two options satisfy the university's mathematics requirement. Students scoring satisfactorily in a proctored setting may be able to waive the university mathematics requirement altogether. MSU allows students to use calculators on placement examinations, and while most of the questions test knowledge of symbolic algebra, some questions test knowledge of geometric concepts, trigonometry, number sense, and graphical representation of functions.

The university educators were asked, "If a high school designed its mathematics curriculum based on your placement test, would you be satisfied with that program?" The unanimous response was, "No." Expect to see placement procedures evolve in the coming years.

While MSU relies heavily on the placement examination, the University of Michigan uses a somewhat different method. It bases placement recommendations on a combination of grade point average, college entrance examination score, mathematics subscore (either ACT or SAT), and achievement on a 25-question, 25-minute symbolic computation test. U. of M. draws questions from materials available through the Mathematical Association of America; most of the questions are traditional algebra questions. Students receive placement advice, but they are free to enroll in any course they choose.

None of the participants at the Traverse City conference session expressed confidence that current placement tests are adequate in assessing students who come from contemporary, research-based mathematics programs, yet there was a general understanding of the pressure on high school teachers to prepare students for the tests. The university educators were asked, "If a high school designed its mathematics curriculum based on your placement test, would you be satisfied with that program?" The unanimous response was, "No." Expect to see placement procedures evolve in the coming years.

How can teachers help students prepare for entrance examinations and placement tests?

Teachers cannot gear their instruction to a particular university program or placement test under current circumstances. Until colleges broaden the scope of their placement examinations or begin to use other methods for placement (such as requesting placement advice from high school teachers), secondary teachers can include learning activities in mathematics instruction that will afford students the best opportunities for

(Placement, continued on page 4)

(Placement, continued from page 3)

optimum college placement. The opportunities that already exist in *Contemporary Mathematics in Context* are worth highlighting. The activities include algorithmic/procedural supplementation, attention to the formal language of mathematics, and the development of a taxonomy, or classification, of mathematical terms and concepts.

Maintenance

Beginning in Unit 4 of Course 1, *Contemporary Mathematics in Context* includes maintenance supplements in the *Teaching Resources.* These tasks offer periodic review and additional practice in computational skills, procedural tasks, and algorithms. The work sheets present the content in the investigative-learning format and style on which *Contemporary Mathematics in Context* is based. Teachers may use these activities to support the content learning of the current lesson, or they may use the activities at other times to review or bring a slightly different perspective to topics that have been studied previously. The maintenance materials and other supplemental activities of the teacher's choice help students succeed in settings where mathematics problems are not contextualized.

At Andover, we use a mix of *Contemporary Mathematics in Context* and teacher-produced activities as homework. This combination offers two benefits. First, by not spending lengthy class time on tasks designed to build algorithmic skills, we prioritize "mathematics in context" above "mathematics as rote learning." Additionally, when students have the more rote type of activity for homework, parents recognize more of the mathematics and are more likely to be able to help their children. This connection to more traditional mathematics curricula can help build community support for the integrated mathematics program.

Technical language

Success with mathematics activities may increase if we encourage students to learn the terms of mathematics and mathematical computation, such as "rationalizing" and "isolating the variable." For example, a student may be aware that a quadratic function that crosses the x–axis at x = a and x = b has linear factors (x–a) and (x–b). If that student connects this concept with the terms "factoring" and "roots," then he or she is able to communicate a conceptual understanding. I discovered, through a conversation with the father of one of my students, what happens when a student does not make this connection. The parent telephoned to express concern that his son was not learning the basics of mathematics. During our conversation, it became clear to me that the problem was not the student's lack of understanding, but rather his inability to interpret the questions his father had posed. *Contemporary Mathematics in Context* provides numerous opportunities to introduce and reinforce the use of formal mathematical language. For example, investigation questions and the student materials that appear after a "Checkpoint" section in many lessons often include definitions of highlighted mathematical terms. In addition, students should regularly be encouraged to use appropriate mathematical terminology and symbols in their class notes and journals.

Taxonomy of mathematics

Technical language extends to include broad terms such as "algebra," "geometry," and "statistics." Students need to clearly understand the definitions of these broad terms in order to communicate effectively about their learning. We should carefully assist students in classifying the terms, procedures, algorithms, concepts, and problem types according to related mathematics strands. In Course 1, Part A, *Contemporary Mathematics in Context* students begin to construct Math Toolkits in which they record and organize mathematics concepts and methods by strand. Students continue to add to and use this set of tools throughout their study of mathematics. Word- processing technology and other software, such as Microsoft's Research Organizer, can help students to revise, organize, and present the Math Toolkit information.

What is most important for our students' success?

I offer one final note about preparing our students to be appropriately placed in their first college mathematics courses. Professor B. A. Taylor, Mathematics Department Chair at the University of Michigan, wrote:

> At the national level, it will probably take some time for universities' placement procedures to adjust to the varying curricula in use nationwide. However, at Michigan we are not too concerned with the particular curriculum students have followed. We are concerned with the level of mathematical skills and sophistication they have developed. In fact, the range of backgrounds for students using identical curricula but from different schools is at least as wide as that of students from different curricula.

This is a time of emotion and anxiety concerning mathematics education. Parents, teachers, counselors, administrators, and peers all have the power to influence a student's confidence about the mathematics under study. As teachers, we must do all we can to minimize the anxiety levels of our students. There is a great ongoing debate, but we do not need to bring our students into the center of this debate. Let's all become advocates of change regarding the placement procedures of the colleges and do all that is in our power to highlight for our students the positive aspects of contemporary, research-based mathematics curricula. It is in their best interest, and ours, that we do this.

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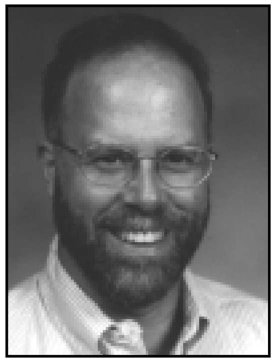
About the contributor



Michael Shelly

Michael Shelly, Ed.D., is the Mathematics Department Chair at Andover High School in Bloomfield Hills, Michigan. He has taught *Contemporary Mathematics in Context*, Courses 3 and 4. A teacher in the Bloomfield Hills School District for 23 years, Shelly currently serves as the district's Eisenhower Professional Development Grant Coordinator. Shelly is also currently an adjunct faculty member at the University of Michigan–Dearborn. He has taught university-level courses in instruction, curriculum design, educational computer use, mathematics, and statistics.

ASK the Authors

Focus on Precalculus

Jo Ann Lutz; Author, Contemporary Precalculus through Applications

Given the opportunity, what would you ask the authors of the mathematics program you teach? Here's your chance! In Ask the Authors, program authors respond to teachers' questions about curriculum, instruction, assessment, and program content. You may submit your questions using the Suggestion Box form on page 15.

Q: Teachers in my school are really excited about teaching *Contemporary Precalculus through Applications*. They are learning lots of new mathematics and the students are becoming good problem solvers. But, I'm the Advanced Placement Calculus teacher, and when I have these students in my class, they often cannot do algebra. In the old days, my students could easily simplify the derivative of $f(x) = x(x-6)^{2/3}$ to find the relative extreme. Now, they act befuddled. What is mathematics coming to?

A: First of all, my students cannot do that problem either. But, if I remember correctly, I have never had students who could do that problem very well. The difference is that now we have to take the time in calculus to teach students the harder algebra ideas as they need them. My students enjoy this challenge as a change in routine, and now that I am planning for it, the time I spend on these topics is better organized and more efficient.

Also, as I look at my *Contemporary Precalculus*-prepared calculus students, I realize that they understand so much about functions and the related graphs that teaching them the concepts in calculus has become easier. These students more easily understand the relationships between a function and its first and second derivatives. For example, this fall, as we talked about a particular situation that we were describing with a function, my students described the point of inflection as the point of the graph where the rate of change of the function is greatest—a description for the point of inflection that I had not considered. Their insight into the properties of the graph added much to the discussion.

In particular, the solid background of my students in functions, graphing, algorithms, and problem solving allows me to spend time on algebra when I need it.

I have to change how and what I teach my calculus students because of their background knowledge from *Contemporary Precalculus through Applications*. In fact, my students are challenging me to rethink the goals and emphases of the entire calculus curriculum. I think my course and my students will be better as a result—and so will I.

Dr. Jo Ann Lutz, one of the authors of Contemporary Precalculus through Applications *and* Contemporary Calculus through Applications, *answered the above question. This particular question and answer appeared previously in the "Dr. Discrete" column in a mathematics newsletter published by The North Carolina School of Science and Mathematics, where Dr. Lutz is a faculty member.*

Focus on Algebra

Web sites

Send *ELC's Mathlink* a list of your favorite mathematics-related Web sites!

Everyday Learning Corporation
http://www.everydaylearning.com

Connected Geometry
http://www.edc.org/LTT/ConnGeo

Core-Plus Mathematics Project
http://www.wmich.edu/math-stat/cpmp/front.html

techLINK
In **Techlink,** mathematics teachers find out about software, Web sites, calculators, and creative computer and calculator projects. If you want to share your ideas, please complete the **Suggestion Box** form on page 15.

Software Review

By Christine Longcore
Note: The opinions about software reviewed in this issue are those of ELC's editorial staff. Everyday Learning Corporation understands that the educational benefits of the software we review depend a great deal upon the classroom situation in which the software is used.

Algebra Smart
Developed by The Princeton Review
Distributed by Mindscape, Inc.
88 Rowland Way
Novato, CA 94945
Web site:
http://www.review.com/tools/
Recommended for students ages 12 and up.
Available on CD-ROM in a Smart Pack (includes *Science Smart* and *Word Smart*). $29.99

The *Smart Pack* package says that *Algebra Smart* "covers a typical full year of Algebra I." While this software program cannot replace the rich experience of constructing mathematics knowledge in the classroom, it does offer review and practice of important algebra topics. Students who use *Contemporary Mathematics in Context* and *Concepts in Algebra* will be able to find a section of the program that can help them review and practice their skills.

If a student decides that he needs some extra practice, he can go to the "Algebra Training Center." Here, he chooses from a list of topics that includes everything from arithmetic and basic concept reviews to solving equations and graphing. The student can take a five-question pretest and then go through any lessons he needs to review. Students are quizzed on word problems, equations, number lines, and graphs.

As soon as a student feels that she is mathematically fit for competition, she can progress to the "Algebra Games." Here, she will enter the stadium to face off against a group of three young men, identified as "nerds," complete with identical pocket protectors and bow ties. A sign behind them says "Beat the Nerds." (This may seem like a minor detail, but it can be argued that the negative portrayal of mathematically knowledgeable people subtly undermines the program's attempts to increase students' enthusiasm for mathematics.) Students have to think fast and accurately in these games, which test their abilities to solve equations mentally and to evaluate word problems, number lines, and graphs. The animated mediator, opponents, and crowd keep enthusiasm high throughout the games.

While this software package does not include a Teacher's Guide or User's Guide, the program itself does offer extensive guidance. Students can click on the "Info Center" to gain access to a variety of resources. They can look up lessons by topic, see a checklist of their cumulative performance in all of the mathematics topic areas, or investigate some SAT testing strategies.

Overall, the software program successfully balances competitive play with review and practice. Students of varying abilities will be able to find challenging problems and independently track their own progress in different mathematical areas.

tip trade

Focus on Integrated Mathematics

Block Scheduling

Jenny Diekevers teaches *Contemporary Mathematics in Context* Courses 3 and 4 to junior and senior students at Caledonia High School in Caledonia, Michigan. She has taught the Core-Plus curriculum for five of her seven years as a teacher and is Mathematics Department Chair in her school. Diekevers currently teaches on a three-block schedule in two 90-day semesters. Students take three classes each semester. Each class runs for 95 minutes. The following quotes are from a conversation with Diekevers about teaching *Contemporary Mathematics in Context* within a block-schedule format.

Overview "The greatest benefit I see for Core-Plus students in the block-schedule class is that every class is a laboratory situation in which students are usually able to complete a full investigation. In each one-hour class, there are so many administrative tasks that have to be done that, typically, the class may be able to actually work for only 45 minutes. The longer class period allows students plenty of time to work steadily. They don't have to restart their work at the beginning of each class. In a block-schedule class, students have more time to argue their points."

"One concern with block scheduling at my school is that first-year students will have a mathematics course either first or second semester, but not both. However, this hasn't been a problem as students seem to be learning a process rather than simply memorizing a skill. I haven't been able to tell the difference between students who have had mathematics first semester or second semester the previous year."

"I have never felt as though the block-schedule class is too long. There is not really a worry that I will have to spend the longer class time lecturing or giving busy work. Many times, we work through the whole time and I give homework assignments in the last thirty seconds of class."

Finding the focus "If you want to know what is important to cover in a lesson, look at 'Checkpoint' and read 'Teaching Notes.' 'Checkpoint' highlights the main ideas in the lesson, and 'Teaching Notes' gives helpful hints."

Organizing class time "I spend about twenty-five percent of the class period launching the new investigation and talking about the previous day's findings. I introduce the lesson and give instructions on what has to be done. Then, students work on the investigation for about fifty percent of the time. Typically, students can complete one investigation during the 95-minute class period. Finally, we do the 'Checkpoint' section for about twenty-five percent of the time, discussing any questions and possibly doing some problems on the board."

Homework "I assign the MORE [*Modeling, Organizing, Reflecting,* and *Extending*] problems for homework. I typically assign two to four problems from the MORE section. Most often, I will give students one Modeling problem, two Organizing problems, and one Reflecting problem. I may also assign a problem from the 'On Your Own' section. We talk briefly about the homework problems the following day. Sometimes, I may give a couple of the MORE problems to do in class."

Collaborative learning "You can help students stay on task during investigations by making sure that each group member has a responsibility. [Editor's note: *Contemporary Mathematics in Context* suggests four roles for group members: coordinator, measurement specialist, recorder, and quality controller.] Make sure each person records what his or her group is doing. I walk around the room and monitor how different groups are working. I also check their notebooks to make sure they are all making progress in the investigation."

tip trade
is the place to exchange hints for effective instruction and classroom management. Share details about activities, time-savers, extensions, and other creative ideas you use in your classroom. Use the **Suggestion Box** form on page 15 to submit your ideas.

PLANNING A MATHEMATICS PROGRAM FOR THE FUTURE

by Rose Mary Zbiek and M. Kathleen Heid; Authors, Concepts in Algebra: A Technological Approach

Despite the increasing availability of mathematics computing tools, very little curriculum material capitalizes on these tools' potential for helping students of all abilities to develop and extend their understanding of mathematics. In response to this situation, mathematics educators at The Pennsylvania State University and The University of Iowa under the Computer Algebra System–Intensive Mathematics (CAS–IM) Project (funded by the National Science Foundation) are developing a curriculum that helps students use technology to learn important mathematics.

Central to the development of the CAS–IM curriculum is research focused on how students learn mathematics in an environment that includes a computer algebra system (e.g., the TI-92 calculator from Texas Instruments, *Derive* from Soft Warehouse, Inc., or *Maple* from Waterloo Maple) and a dynamic geometry package (e.g., *The Geometer's Sketchpad* from Key Curriculum Press, or *Cabri Geometry* from Texas Instruments). Currently, parents, teachers, curriculum developers, and others are troubled by how little students know about the meanings and uses of symbolic expressions. However, this same group of people expresses concerns about providing students with computer algebra systems. They fear that access to computing tools will undermine students' mathematical facility by decreasing attention to paper-and-pencil symbolic manipulation skills. Research, however, has demonstrated, in case after case, that students acquired a deeper understanding of mathematics in algebra and calculus when the curricula focuses on concepts and applications and allocates paper-and-pencil symbolic manipulation to computing technology (Heid, 1988, 1992; Heid, Sheets, Matras, & Menasian, 1988; Judson, 1990; O'Callaghan, 1994; Palmiter, 1991). When technology allows a curriculum to focus on the bigger mathematical ideas instead of paper-and-pencil symbolic manipulation skills, students learn these ideas more quickly and more deeply. In addition, paper-and-pencil skills can be learned more quickly than usual when they are taught after students have acquired the underlying conceptual ideas. The CAS–IM curriculum uses technology to shift students' attention from paper-and-pencil skills to powerful mathematical concepts and applications and to engage them in using technology to reason about symbolic representations. This new focus on symbolic reasoning promises to give students the power to capitalize on the availability of computer algebra-system technology.

A second area of concern is students' difficulty understanding geometric relationships. Research suggests that students learn to think differently about geometric ideas when using computer-based or calculator-based geometry construction tools (Yerushalmy & Chazan, 1990; Yerushalmy, Chazan, Gordon, & Houde, 1986; Yerushalmy & Houde, 1986). CAS–IM students have daily access to dynamic geometry tools that allow them to construct, measure, and manipulate geometric objects. The curriculum engages students in discovering potential geometric relationships and in using technology appropriately to justify or refute their observations.

Development of the CAS–IM curriculum also reflects an extensive history of how students and teachers use *Concepts in Algebra* and related mathematics curricula. Since 1986, CAS–IM project members have observed and talked with teachers and students from Grade 7 through Grade 11 in inner-city, suburban, small-town, and rural areas. These classes used the *Concepts in Algebra* curriculum. This body of research documents the benefits of *Concepts in Algebra* and suggests expectations for CAS–IM students: *Concepts in Algebra* students can learn to use a variety of computing tools and representations (e.g., graph, table, symbolic forms) to explore functions describing real-life situations (Heid & Zbiek, 1993). They can solve algebra word problems and perceive problem structure as well as or better than traditional algebra students can (Matras, 1988). After using only *Concepts in Algebra*, students exhibit greater flexibility in reasoning with multiple embodiments of functions than do juniors and seniors completing a traditional "functions" course (Sheets, 1993). They also develop a broader, richer, and more flexible understanding of the concept of a variable (Boers-van Oosterum, 1990) as well as a deeper understanding of mathematical modeling (Heid, Sheets, Matras, & Menasian, 1988) than do traditional algebra students. Using *Concepts in Algebra* followed by two months or less of working on traditional paper-and-pencil symbolic manipulation skills, students perform as well as their counterparts who have taken courses that focus on traditional skills for an entire school year (Heid, 1992; Heid, Sheets, Matras, & Menasian, 1988; O'Callaghan, 1994). In short, *Concepts in Algebra* students outperformed traditional algebra students with respect to mathematical understanding; they did not suffer from the deemphasis on traditional skills.

The success of CAS–IM, like the success of *Concepts in Algebra,* depends greatly on the classroom activities the curriculum encourages (Heid, Sheets, & Matras, 1990; Heid & Zbiek, 1995; Lynch, Fischer, & Green, 1989; Sheets & Heid, 1990; Zbiek & Heid, 1990). In the CAS–IM curriculum, students have the freedom to use technology in informed ways and to discuss the advantages and drawbacks of various tools and strategies. They develop an appreciation of how various technologies are more or less appropriate for tasks with particular characteristics. Real-world situations are used as catalysts and as sense-making arenas for mathematical work. Students generate mathematical models based on their growing understanding of mathematical constructs. Drawing on experiences with these models, students explore more abstract mathematical ideas. The synergistic relationship between applications and abstractions helps students to understand better both the usefulness of mathematics and the essence of mathematics. Students work within a blend of small-group, large-group, and individual classroom structures. Students have opportunities in small-group settings to conduct personalized explorations; in large-group settings, students report their findings, justify their ideas, and integrate new notions into their prior experiences.

In short, Concepts in Algebra *students outperformed traditional algebra students with respect to mathematical understanding; they did not suffer from the deemphasis on traditional skills.*

The collection of CAS–IM curriculum modules, combined with *Concepts in Algebra,* forms a stand-alone, two- to four-year high school mathematics curriculum. Pilot and field tests of CAS–IM materials will begin in fall 1998 at schools throughout the United States. Final revisions will be made by fall 2001. Input from teachers and data about students' learning will influence the curriculum development process.

Rose Mary Zbiek is assistant professor in Mathematics Education in the Department of Mathematics and the Department of Curriculum and Instruction at the University of Iowa. M. Kathleen Heid is associate professor in Mathematics Education in the Department of Curriculum and Instruction at The Pennsylvania State University.

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interview

Focus on Integrated Mathematics

From time to time, ELC's Mathlink *will present conversations with teachers, authors, and administrators in Interview. The conversations will cover notable events, research, and activities of interest to mathematics teachers. If you would like to participate in an interview, jot down your name and your proposed topic on the Suggestion Box form on page 15.*

THE INTERNATIONAL BACCALAUREATE PROGRAM

Barbara Crucs

Barbara Crucs is a mathematics teacher and coordinator of the International Baccalaureate (IB) Program at Firestone High School in the Akron Public Schools in Akron, Ohio, where she has taught for the last 13 years. Crucs has been a Core-Plus field-test teacher since 1993 and is a presenter at *Contemporary Mathematics in Context* teacher-training workshops. She is currently field-testing Course 4, Part B. Crucs answered some questions about the International Baccalaureate program and about how the *Contemporary Mathematics in Context* curriculum fits in with the IB program.

ML: What is the International Baccalaureate program?

Crucs: It came out of the International Schools Program in the 1960s as a way for students to prepare for exams, regardless of their country of origin. It combined the best of all programs from around the world. Currently, it is the most rigorous secondary curriculum available, and its graduates can go on to any university in the world. In IB, the students are engaged in two years of college-level work.

My school requires all IB students to attempt the IB diploma rather than select individual courses. Students must take six courses: three at Higher Level (courses offered in depth, much like the European approac) and three at Standard Level (courses offered in breadth, like the U.S. system). Additionally, students must complete a two-year Theory of Knowledge Course, 150 CAS (Creativity-Action-Service) hours, and write a 4000-word essay based on independent research.

ML: Who can take the IB courses and tests?

Crucs: Only schools accepted into the IB program can offer the courses and tests, and only students accepted into the IB program can take them. There is a rigorous application process culminating in a two-day, on-site visit in which IB representatives evaluate students, teachers, school facilities, school-board support, and parent support. Teachers are required to be trained, and their student assessment is monitored by IB officials. The students are also assessed by an outside agency at the end of each course.

ML: How are students selected for the program?

Crucs: Students are selected for most IB programs based on scores of 80 percent or higher on a standardized test, such as the Iowa Test of Basic Skills; a grade point average of 3.0 or higher; foreign-language background; teacher recommendations; a writing sample; and completion of algebra by the end of eighth grade. Self-discipline and self-motivation are the most important prerequisites to success in the IB program.

ML: What mathematics courses do IB students take?

Crucs: You would have to take a look at the whole IB mathematics course of study. Two different programs, Math Methods and Math Studies, are offered at Standard Level; and there is also a Higher Level course (for engineering and physics majors) and an Advanced Mathematics Standard Level course (for students intending to major in mathematics). Firestone offers both Math Methods and Math Studies.

Math Studies requires completion of a project in which students use mathematics techniques to define a problem and search for ways to solve it. The syllabus includes Functions, Computation, Data Analysis, Structure (Sets and Logic), Business Techniques (Sequences and Finance, Linear Programming), and Geometry and Trigonometry (Vectors, Matrices, 3-D, Trigonometry). The students sit for two papers, or tests, in May. In the papers, they are required to draw from all areas of their learning, show clear reasoning, explanation, and/or logical argument. We believe Core-Plus is an especially good preparation for Math Studies. The Math Methods syllabus includes Number, Algebra and Coordinate Geometry, Geometry and Trigonometry, Functions and Calculus, Vectors and Matrices, and Probability and Statistics. Additionally, candidates are expected to cover one of two optional topics: either Analytical Geometry and Further Calculus (conic sections and further calculus) or Further Probability and Statistics (discrete random variables and continuous random variables). These students also take two tests in May.

In the program, students receive a more detailed breakdown of the topics they must know for the examinations. This is our first year testing seniors in the program at our school, so we will be closely monitoring their performance.

ML: Where does *Contemporary Mathematics in Context* fit into an IB student's plan?

Crucs: During their pre-IB years (freshman, sophomore—and eighth grade, when we can implement it), students take the Core-Plus courses. Once the students enter the IB program in their junior year, they begin the IB course work. Some of this can be supplemented and implemented with Core-Plus materials as well, but it is no longer the Core-Plus curriculum. The IB students take their tests at the end of the course during their senior year.

ML: Do IB students also take the SAT and ACT?

Crucs: Yes, those scores are required of all students who are applying to the different universities.

ML: What are your Core-Plus teachers doing to help students prepare to enter the IB program?

Crucs: We are experimenting with a Core-Plus class that is entirely pre-IB. The intent is to help these students move faster through the materials so that they can benefit from more of the excellent units available in the Core-Plus materials. We would like to put Core-Plus in eighth grade as a pre-IB class for the same reason.

ML: How can teachers find out more about the International Baccalaureate program?

Crucs: They may call or write the IBNA (IB–North American) office:
Bradley W. Richardson, Regional Director
International Baccalaureate, North America and the Caribbean
200 Madison Ave., Suite 2007
New York, NY 10016 USA
Tel: (212) 696-4464
E-mail: IBNA@obo.org

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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.

In my classroom

Focus on Integrated Mathematics

REFLECTIONS OF A FIELD-TEST TEACHER

by Craig Evans; Teacher, Contemporary Mathematics in Context

Over the past five years in which I have taught *Contemporary Mathematics in Context,* my ideas about effective mathematics education have changed. Prior to using *Contemporary Mathematics in Context,* the mathematical instructional practices at my school were not working for all of our students. Many students moved out of high school mathematics programs back into arithmetic classes that covered the same type of mathematics they had done poorly in throughout elementary school. Those students who remained in the high school-level courses saw mathematics as a list of algorithms that led to nothing but more mathematics having nothing to do with preparing them for adult life. But once our students began to use *Contemporary Mathematics in Context,* they saw their mathematics courses as an opportunity to learn how to solve problems, not just do arithmetic. The best comment I hear from my students is, "This class makes me think."

With regard to research-based mathematics education, I have made the following discoveries while teaching *Contemporary Mathematics in Context:*

Discovery 1: The method has changed. The mathematics has not.

One important thing to remember—and communicate—is that the mathematics we teach in *Contemporary Mathematics in Context* is not completely new. The biggest changes are (1) the method of instruction and (2) the greater role of conceptual knowledge in assessment. The amount of text and the number of applications may be greater than what students are used to seeing in traditional programs, but the mathematics content remains essentially the same. We are still teaching all the major secondary mathematics concepts, but we also are addressing new topics that will prepare our students for the next century. For example, solving an equation is still important in the study of algebra. However, we now stress what the solution represents in the context of a real-world problem. In addition to using algebraic reasoning to solve an equation, students also use tables and graphs to better understand the relationships among number patterns and related equations and graphs. In addition to the traditional topics such as algebra (linear, exponential, polynomial, rational, and radical) and geometry (plane, space, coordinate, transformational, and trigonometry), students also study statistical analysis and discrete mathematics.

Discovery 2: Students respond to hands-on, active learning.

If we want our students to actively use mathematical thinking, then we need to use a hands-on approach that supports and encourages active learning. Students build geometric shapes when studying geometry and look for the connections between graphs and tables as they study functions. The investigations in *Contemporary Mathematics in Context* are the primary source of this learning. In each part of the investigation, students are actively involved with the mathematics topics and materials. The MORE (*Modeling, Organizing, Reflecting,* and *Extending*) tasks in each lesson, usually used for individual practice, allow students to extend their active learning.

Discovery 3: Collaborative learning means working with others to construct mathematical knowledge.

We need to carefully select the problems that students work on collaboratively. These problems should require students to construct new mathematics concepts. In each *Contemporary Mathematics in Context* chapter, each mathematics topic arises from a situation the students are familiar with. However, the mathematics concepts they need to completely solve the problem are new to them. Through the investigation questions and through conversations with their peers, students construct knowledge that is more powerful than any mathematics they learn only through rote memorization or independent work. The students, along with the teacher, in many cases, discover mathematics concepts that they are likely to remember. It is much easier to recall and use a skill if one has first explored, discussed, and understood the underlying concept.

Students bring their mathematics backgrounds and ways of thinking to group work. For example, I have found that sometimes those students who do poorly in algebra find success in geometry and are able to demonstrate that strength in a group setting. When one student does not understand a certain concept, another group member may be able to share problem-solving strategies. The students who provide such assistance can deepen their own understanding of the material through questioning and explanation.

Discovery 4: Teachers learn by collaborating.

In each school, mathematics teachers need to work together. I have enjoyed the close relationship of the mathematics department faculty at Sturgis. We may not always agree with each other, but we all try to communicate with one another, while keeping the needs of the department in mind. Because we work in a smaller school with six mathematics teachers, we are usually able to communicate face to face. I try to speak to all five of my peers in the department at least once a week. Through this regular communication, we share many tasks, including creating assessments and finding teaching resources, thus freeing more time to work on other areas of instruction. What is most important is that we are working together—just as we expect our students to do.

Discovery 5: Community involvement benefits students.

It is critical that *Contemporary Mathematics in Context* teachers initiate a dialogue with parents and others in their community in order to help everyone understand how the mathematics program meets the needs of the community. With this understanding, the community members can support the efforts of teachers and students. There are three fronts that mathematics teachers must address:

The most important connection to make is with parents. They want to see that the curriculum meets the needs of their children. All parents want their children to have the best opportunities possible, but many parents are apprehensive about change. And some parents may think that if we change the way we teach their children, we are indicating that their own education was inferior. When talking to parents, I emphasize that the workplace is changing and that we need to change how and what we teach in the mathematics classroom, too. And some parents who achieved success in traditional mathematics programs are uncomfortable helping their children with homework. Fortunately, within the *Contemporary Mathematics in Context* program, students may receive more personal help from their teacher and peers during class. But it is also a good idea to let parents know you are available to meet with them any time questions arise.

Second, it is important to maintain contact with educators from all grade levels in your district. Elementary and middle school teachers need to know what they can do to prepare their students for this program. Teachers in other secondary subject areas should be aware of the expectations students must meet in the mathematics classroom so that they may set similar or complementary requirements. For example, our mathematics and science departments set some similar standards for student work, such as improved quality of written explanations and descriptions. The administration is another important point of contact. When my school began to use *Contemporary Mathematics in Context,* teachers helped administrators understand that our mathematics classrooms would look different from traditional settings. Specifically, students work together in groups instead of quietly sitting in rows working by themselves. Often, in this situation, the noise level seems to increase tenfold. What might appear at first to be a chaotic classroom is actually students actively engaged in learning. With this knowledge, the administration was able to support our efforts to implement the new curriculum.

Finally, it is important to establish a relationship with businesses in your community. Once a month at my school, each school staff member meets with a group of students and, often, members of the business community. The business representatives and teachers guide the students in preparing for college and employment. The goal of this relationship is to provide communication between the school system and local businesses. Through this alliance, the business representatives are able to see what students are doing in mathematics classes and offer their perspective to teachers on what businesses look for in employees. When business representatives visit our mathematics classrooms, we often hear comments such as, "I didn't study this topic until after high school" or "The ability to work collaboratively on projects is something we look for in our employees." The students learn more about the real-world applications of mathematics through this contact with members of the business sector.

To connect with the community on all three of these fronts—parents, other educators, and business people—we made presentations at board meetings and open houses. It is important for the community to see the curriculum material and how we organize and teach it.

Reflecting on Mathematics Teaching and Learning

Each year in the late spring, I reflect on the past year and start deciding what changes I want to make in my classroom during the upcoming school year. I always ask myself whether I am satisfied with my current teaching practices and materials. As part of my reflection, I ask whether *Contemporary Mathematics in Context* is preparing my students to think mathematically. Each year, my answer is yes. I have never taught a mathematics program that uses such rich applications with the student at the center of learning.

Craig Evans has taught Contemporary Mathematics in Context *for five years and currently teaches at Sturgis High School in Sturgis, Michigan. Previously, he taught the Core-Plus curriculum at Kalamazoo Central High School in Kalamazoo, Michigan, and in an at-risk program within* eLc

Everyday Learning Corporation

eLc news

Check ELC News in every issue of *ELC's Mathlink* for information on new products, special offers, and staff-development opportunities.

STAFF DEVELOPMENT

CONTEMPORARY MATHEMATICS IN CONTEXT

1998 SUMMER WORKSHOPS

Everyday Learning Corporation and the Core–Plus Mathematics Project will be working together this summer to provide training for new users of *Contemporary Mathematics in Context*. Teachers can register for any of the workshops through Everyday Learning®. Brochures with registration forms will be sent to everyone on our secondary mathematics mailing list. If you have any questions about the summer workshops, please contact Janet Meyers at (800) 382-7670, extension 5850.

Regional workshops for Courses 1 and 2

Locations	Dates
Rye, NY	July 16–18
Universal City, CA	July 30–August 1
Chicago, IL	August 4–6

Extended workshops for Courses 1–3

All of the extended workshops will be held at Western Michigan University in Kalamazoo, MI.

Levels	Dates
Course 1	July 26–31
Course 2	July 26–31
Course 3	June 22–26

(Please note that there will be a Fall Follow-up Session at WMU for Course 1 users on November 13–14.)

NEW PRODUCTS

CONTEMPORARY MATHEMATICS IN CONTEXT

The following is an update on the availability of *Contemporary Mathematics in Context* materials:

Course 1, Parts A and B	Available now
Course 2, Parts A and B	Available now
Course 3, Part A	August 1998
Course 3, Part B	Fall 1998

CONTEMPORARY PRECALCULUS THROUGH APPLICATIONS

Contemporary Precalculus through Applications Second Edition available Winter 1999

The revised materials will include a student edition, an instructor's guide, assessment resources, and a solutions guide. The revised program will use an updated approach to the precalculus curriculum. It will integrate accessible technology through graphing calculators. The revision will better complement *Contemporary Calculus through Applications*.

CONNECTED GEOMETRY

New! Sampler available now

This 32-page sampler provides an overview of the *Connected Geometry* curriculum and the contents of a new *Connected Geometry* CD-ROM. The sampler provides details about program philosophy and sample activities from each of the modules on the CD-ROM.

CD-ROM available Fall 1998

This software presents six complete student modules with accompanying teaching notes and solutions.

Textbook available Fall 1998

suggestion box

Name ______________________ Position ______________________

School ______________________ City & State ______________________

Secondary Mathematics Program ______________________________________

Home Phone ______________________ School Phone ______________________

Check all that apply. Below is my:

- ❑ Question for the **Ask the Authors** section (Please be specific.)
- ❑ **Tip Trade** idea
- ❑ **Interview** topic
- ❑ Suggestion for **Techlink**
- ❑ Suggestion for **Mathematics Bookshelf**
- ❑ Other ____

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I would also consider:

- ❑ Participating in a survey or interview
- ❑ Writing for ELC's Mathlink. Topic ______________________________
- ❑ Reviewing books, articles, or software
- ❑ Interviewing another teacher or administrator

ELC's Mathlink's success depends upon educators like YOU who are willing to get involved in the exchange of ideas.

Please take a moment to share your ideas, questions, answers, suggestions, thoughts, experience, advice, achievements, or insight.

Return this form to:
ELC's Mathlink
P.O. Box 812960
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You may also call 1-800-382-7670 with your ideas or send E-mail to Clongcore@tribune.com.

Thank you for participating in ELC's Mathlink **Suggestion Box.**

the LAST word

Call for Manuscripts

We encourage teachers who use ELC's secondary mathematics curricula to submit manuscripts on secondary mathematics topics. We particularly welcome manuscripts that focus on your classroom experience and problems and projects you and your students have found challenging.

We are currently accepting manuscripts on the following topics:

Fall 1998 Teaching Mathematics to a Diverse Group of Students

Suggested manuscript topics:

- Accelerated Eighth Grade Students
- Mathematically-Promising Students
- ESL Students
- Low-Achieving Students
- Multicultural Perspectives

You may choose to write on a related topic not listed above. All manuscripts for articles should be 1800–2000 words in length. Please note whether the article focuses on algebra, geometry, precalculus, calculus, or integrated mathematics instruction. We offer $100.00 for each article accepted for publication. Feature manuscripts for "Techlink," "Mathematics Bookshelf," and "Tip Trade" related to the issue topics should be 500–600 words in length. The articles and features should be written in a practical and informative teacher-to-teacher professional style, with reference to specific program components and materials wherever appropriate. We offer $25.00 for each feature manuscript accepted for publication.

Send one double-spaced copy of the completed manuscript for review to *ELC's Mathlink*, Everyday Learning Corporation, Two Prudential Plaza, Suite 1200, Chicago, IL 60601, no later than July 1, 1998. If you have ideas for a manuscript, please note them in 3–4 sentences on the Suggestion Box form on page 15 of this issue of *ELC's Mathlink*.

If you would like to discuss any manuscript ideas, please contact Christine Longcore at the above address or by E-mail at Clongcore@tribune.com.

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