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Ron's wife, Leslie, has a Ph.D. in Organic Chemistry and works at Noram Chemical Co. in Wilmington. Ron spends most of his free time playing with his daughters, Jennifer, four, and Rebecca, six months. He says the new toys are much better than when he was a child. When he is not playing with his children, he enjoys golf, tennis, theater, and travel.

# *Contemporary Mathematics: A New Type of Liberal Arts Math*



*Ronald J. Czocho*

Many students who come to Glassboro State College will take only one college mathematics course, and it will be our last opportunity to address an attitude toward mathematics that has been soured by three to four years of high school mathematics. In high school, students have taken mathematics courses that focus on drill and computation with the overriding goal of preparing them to take calculus in college. These courses are designed to prepare those students who already like mathematics to take more mathematics. They are not designed to win converts. Our new course at GSC is called Contemporary Mathematics, and it is designed to change attitudes and win converts.

Many recent reports have documented that our nation's technological superiority will not endure unless we improve our math and science education. We are certainly "A Nation at Risk," and to change this situation, we must be sure that future parents do not say to their children that mathematics was never easy nor useful for them. This sends a message that doing poorly in math is unimportant. Too many people in our society think of poor performance in mathematics as a badge of honor. It is disconcerting that many people I

meet see no problem in telling me how poor they were in mathematics. These people do not seem to think it is important to hide this ignorance because they do not see the value of mathematics. They all see the value of reading, so being unable to read is something many are ashamed of, but being unable to do mathematics is apparently not considered to be worthy of shame.

We designed this course to focus on these issues and to incorporate a number of goals:

1. To expand student understanding of and appreciation for contemporary mathematics and its uses
2. To develop student problem solving and critical thinking skills
3. To promote student understanding of the relationship between discrete and continuous mathematics
4. To improve student skills in applying computational and computer-related algorithms

These were the unstated goals:

1. To instill an appreciation of the value of mathematics in an increasingly technological society
2. To change an internalized view of mathematics perpetuated by secondary school mathematics (The second goal attempts to address this statement: “In my adult life, I have never needed to solve an equation, so I don’t know why mathematics is valuable.”)

The course we designed to meet these goals focuses on the modern applications of mathematics in our technological world. Students learn that they are living in the Golden Age of Mathematics and that more new mathematics is being discovered now than has been at any time in the past. They recognize that mathematics did not die with the ancient Greeks, and this is made clear by viewing videos that include interviews with mathematicians who are currently working

on problems in fields such as management science, statistics, health science, social science, and geometry, to name but a few. The computer and the way it has affected our thinking are also focuses of the course. That is why the course has as a goal the understanding of the distinction between discrete and continuous mathematics. It is only through this understanding that we can study the relationship between the computer and the human mind.

In designing the course, the first thing we did was to eliminate Intermediate Algebra as a prerequisite. Although this limited the amount of mathematics to be covered in the course, we reasoned that it would lessen the amount of hostility toward mathematics and that the trade-off was well worth it. We did not want students coming into Contemporary Math after having taken Intermediate Algebra because the college algebra course is an intense study of the same material that created a hatred of math in high school. Having math haters take algebra again would hinder our efforts to change their attitude about mathematics.

Next, we selected a relatively new textbook called *For All Practical Purposes*, that is quite unlike any other mathematics text. The book reads like a science text rather than the traditional math text that can often be made up of what seems to be just examples and exercises. This text requires our students to read carefully rather than scan the text for an appropriate example to help solve a problem. The text also requires changes in pedagogical techniques, which I will discuss after I present a topical outline of the course.

The course includes a study of the main topics of Statistics and Probability, Circuits and Networks, Real Numbers and Apportionment, and Geometry and Modelling. Under Statistics and Probability, topics include elementary sampling, experimental design, descriptive measures (including fitting data to the equation of a line), the mathematical theory of probability, and an overview of inference. Under Circuits and Networks, topics include applications to management science, such as scheduling, routing, and network design.

Under Real Numbers and Apportionment, topics include fair division (concerning both discrete and continuous structures), the structure of the real numbers, questions of rounding fractions in apportionment problems, and an example of an impossibility theorem. Finally, under Geometry and Modelling, topics include symmetry, patterns, tilings, and modelling growth and form for scale problems. Special attention is paid to the distinction between discrete and continuous mathematics, and a great deal of emphasis is placed on what an algorithm is and how it is used in problem solving.

This is a new type of mathematics course because of the way the textbook forces us to teach. Understanding the concepts discussed in each chapter is really much more important than merely computing the answers to exercises. Therefore, students must concentrate on reading the text for insight into concepts and knowledge of vocabulary. The course incorporates video tapes that enhance the use of the text and force the course to be taught in a discussion format that includes assignments in writing and oral communication. When I teach the course, I like to present it much like a biology course might be presented in which knowledge of vocabulary, concepts, and the correct application of concepts take precedence over the development of laboratory skills. I remember when I took a biology course, and we were asked to dissect an earthworm. I mangled the earthworm beyond identification. Still I knew and understood the earthworm because of my classroom study. I also recognized that I would never be a surgeon. When I look at the results of a Precalculus exam, I see a lot of mangled earthworms. Unfortunately, in Precalculus, I'm afraid the understanding of the concept isn't there, and that all that students get is the recognition that they will never be mathematicians.

Despite the discussion format, problem solving and computational skills are still very important parts of this course. This "laboratory skills" aspect of the course is still more heavily emphasized than it would be in any science

course; it simply is no longer the whole point of the course. Students find our text more difficult than other math texts because there are very few examples which can be translated to exercises. In fact, “exercises” is an inappropriate term in this case since the text provides problems that require students to make assumptions, to build a model, and to solve the problem.

Traditional topics, such as the equation of a line, the real numbers, algorithmic thinking, and elementary geometric shapes are still covered. It is only the context in which these traditional topics are studied that is different. For example, the equation of a line is studied as a linear model expressing the relationship between the day’s mean temperature and the number of soft drinks sold at a baseball game. Also, the text discussion of the least squares method of fitting data to a line allows students to see how the simple mathematical object is used to model a real-world situation. The question of how to round off numbers is illuminated by an example of apportioning seats in the House of Representatives. How to schedule the turn-around time for an airplane if a number of sequential tasks must be completed or how to route garbage collection so that as few streets as possible have to be traveled twice are illustrations of algorithmic thinking, a main focus of the text. Finally, simple geometric shapes are studied in elementary scale problems, such as How high can we build a pyramidal-shaped mountain out of granite before it collapses under its own weight? or Will a scaled-up version of a model boat sink?

We have also designed the course so that we use state-of-the-art computer and video technology. The text has videos, which closely follow each chapter, produced by the Annenberg Project and the Consortium for Mathematics and Its Applications (COMAP). These videos not only use the best in visual demonstrations for presenting the mathematics, but also include interviews with current mathematicians who describe the work that they are doing

and its applications. The videos are viewed on the average of once a week for twenty minutes, after which the instructor can lead discussion or further develop the idea in the video with more sample problems.

Since much of modern mathematics relies on the computer as a tool, just as biology relies on a microscope, some of the mathematics discussed is also demonstrated with computer technology. For example, in studying the computation of the mean and median in elementary statistics, the concepts of stored programs, elementary programming languages, sorting, and relative efficiency of algorithms can be demonstrated through using the computer. Again, in the study of least squares fit to a line, computer demonstrations provide a visual of the data and superimpose the fitted line. Finally, when discussing the traveling salesman problem (i.e., find the shortest circuit among  $n$  cities), we can demonstrate the “brute force” method of testing all possible routes for a small number of cities and then a heuristic method such as the “nearest neighbor” method. We can show the difference in the time it takes to use each method and extrapolate to twenty-five cities. The “brute force” method would take a computer testing one million circuits per second a total of ten billion years to check each circuit.

We have been teaching this course at GSC for two years now and have run student evaluations. We have found that many of the course goals are being met to some degree. We have also found that although the use of the videos does not significantly affect the grades students receive, it does significantly improve their opinion of the text. Informal discussion with faculty who have taught the course indicates that the text is well received as interesting but difficult to teach from. Although there have been concerns about the students’ attitudes in class, most faculty enjoy teaching this class more than teaching Precalculus or some other elementary mathematics course.

Since the students are often instrumental in the survival of a course, I thought I would end with their responses to the question, "What did you like about this course?"

*"Taking this course really helped me overcome my fear of math."*

*"I have been able to generalize the teachings into everyday situations."*

*"It's the best possible math course for a math hater like me.... This is the most useful math course."*

*"I finally saw how you could use math in the real world."*

*"The material covered was interesting, and I could apply it to everyday life. This usually doesn't happen in any course."*

*"Mathematics can be very interesting when it's applied for practical purposes."*

*"It isn't Calculus, and it's over."*