



EMERGING SCHOLARS PROGRAM

A COMPREHENSIVE PROGRAM FOR STUDENTS INTERESTED IN
CALCULUS, PROBLEM SOLVING, AND PEOPLE

The Emerging Scholars Program (ESP) is an intensive, innovative program offered by the Department of Mathematics. Students in ESP will study engineering calculus (Math 21ABC) and problem-solving in a nurturing, supportive group of approximately 45 students. Special attention is focused on how students *think* about mathematics, and how to *communicate* their knowledge to others.

LECTURE COMPONENT

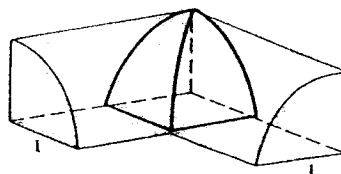
Students in ESP will meet for three hours per week in a standard lecture class, where topics in differential and integral calculus will be introduced, homework assigned, and exams given.

LABORATORY COMPONENT

Students in ESP will meet for four hours per week in a calculus laboratory to collaboratively study additional routine and challenging calculus problems. This component will focus on enhancing individual analytical and study skills, and on effective utilization of small-group interaction, cooperation, and communication.

EXAMPLES OF ESP PROBLEMS

1. Use integration to compute the volume of the solid which lies inside the intersection of the two quarter cylinders in the diagram.



2. Determine the next three terms of the given sequence of integers :

$$1, 2, 4, 9, 19, 36, 62, \dots$$

3. Compute the limit :
$$\lim_{n \rightarrow \infty} \sum_{i=1}^n \frac{i}{n+i}$$

4. Find the derivative $y' = dy/dx$: $y^2 = \sin x + x^y - 3$

For more information contact : Dr. D. A. Kouba, Department of Mathematics, University of California at Davis, One Shields Avenue, Davis, CA 95616, (530) 752-1083 or 752-8130, e-mail: kouba@math.ucdavis.edu .

The Emerging Scholars Program at U.C. Davis—A Recipe for Success in Engineering Calculus

Duane Kouba

Since it began in 1990, The Emerging Scholars Program (ESP) at the University of California, Davis, has been a highly successful, small-group, problem-based laboratory and lecture for students in first-year engineering calculus. It is patterned after the Mathematics Workshop Program created by Dr. Uri Treisman at U.C. Berkeley in 1978. ESP is open to all students at U.C. Davis, but approximately two-thirds of the participants are classified as SAA (Student Affirmative Action) or EOP (Educational Opportunity Program) and about 40% are women. Following is a description of the program and its effectiveness along with comparisons to a traditional Treisman model and other calculus courses offered at U.C. Davis.

ESP (6 credits) is one of the three engineering calculus options available to first-year students. They may also enroll in large lecture sections of calculus (4 credits) or small sections of honors calculus (4 credits). The ESP lecture component consists of three 50-minute lectures, where there are lectures, homework assignments, and exams comparable to those given in all other calculus courses.

The laboratory component of ESP is what sets this program apart from the other calculus classes available at U.C. Davis. It meets five hours per week—two 110-minute labs, and one 50-minute lab. There are no homework assignments or exams given in the lab, but each week a quiz is given in order to measure each student's weekly progress. Each student is allowed no more than three lab absences out of the entire quarter's 30 lab sessions.

Each ESP lab (there are presently two each quarter at U.C. Davis) has no more than 26 students and is staffed with one faculty member and one or two undergraduate teaching assistants (former ESP students), who are trained to facilitate the students' small group problem-solving, communication, and general interaction.

At the beginning of each lab, students pick up new worksheets containing a wide variety of calculus problems and solutions to the previous lab's worksheet, and begin working in pre-assigned, randomly-picked groups of three or four students. Lab worksheets are independent of the homework assignments given in the lecture class, and students are not allowed to work on homework assignments during lab time. In addition, math problems are written on the chalkboard in the ESP lab. Students may work in small groups or with classmates at the chalkboard, where other students can "watch them think."

In addition, students have at least one short 15-minute conference with the faculty member each quarter. This affords students the opportunity to discuss their progress in ESP, concerns with other classes or students, or any other personal or academic matters. The conferences give faculty members the opportunity to know the students in a more personal way, encour-

age them, and better meet their general needs.

This ESP model differs from the traditional Treisman model in a few subtle ways. However, these differences appear to be critical factors in the improved performance of student participants at U.C. Davis. First, the ESP lecture is a relatively small lecture of about 50 students (small by Davis standards) in the Fall Quarter. Thereafter, the students are merged into a large section of about 200 students. Second, the students are presented with many more problems than they can complete during lab time. It's a daily reminder that learning calculus is never finished, but is rather a broad, continuing process. Finally, and perhaps most importantly, each ESP lab is staffed with a dedicated faculty member who has many years of experience teaching calculus, interacting with students, and supervising assistants. It gives the program increased effectiveness and credibility and makes the students feel like an integral part of the Mathematics Department.

The success of ESP has been measured in several ways. Since all calculus students at U.C. Davis take the same final exam, this common exam allows for an effective comparison among the various calculus classes. During the 1993-94 academic year, the ESP students had the highest average performance on each common final exam when compared to both the regular, non-ESP calculus students and the honors calculus students, traditionally the highest performing group.

The Emerging Scholars Program has also greatly reduced the number of failures in first-year calculus and has also dramatically increased the number of those who improve markedly from Calculus I to Calculus III. Specific percentages for the 1993-94 academic year are:

	%D's & F's ¹	%A's from C's ²	%C's to A's ³	%worse ⁴
ESP	4	47	31	22
non-ESP	23	10	3	63

¹ average % of D's and F's in calculus I, II, and III

² % of those who received an A in calculus III among those who had a C in calculus I

³ % of those who received a C in calculus among those who had an A in calculus III

⁴ % of those whose grade was worse in calculus III than in calculus I

The success of ESP suggests to me that the many efforts made to reform calculus—writing more "user-friendly" textbooks, teaching more "meaningful" applications, emphasizing writing exercises, etc.—may be missing the mark. Though all of these efforts can be applauded, I strongly believe that the critical factors in improving the performance of calculus students are an increase in the amount of time faculty spend with students and students' spending considerably more time doing calculus homework.

The ESP lab offers the time needed to patiently learn calculus and a stimulating, enjoyable environment in which to learn it. Because the ESP lab offers a loosely structured, self-paced learning environment, it is not just a place where students work on calculus problems, but where students form friendships and study groups, develop sound study habits (in many cases, for the first time) and communication skills, and learn how to think about problem-solving. The interaction encouraged by the program helps students develop a positive attitude toward mathematics in particular and learning in general.

The Emerging Scholars Program not only increased the survival rate of first-year calculus students, but has become a means by which average calculus students become outstanding calculus students.

Duane Kouba is at University of California, Davis.



EMERGING SCHOLARS PROGRAM

The Emerging Scholars Program (ESP) is a comprehensive program for responsible, motivated, enthusiastic, hard working freshmen and sophomores enrolled in first-year calculus (Math 21ABC) who enjoy the challenge of mathematics and the company of other people. The Program seeks to assist students in successfully meeting the new and exciting challenges offered by the University. ESP will facilitate the development of advanced study skills and establish for each student the firmest possible foundation in calculus, the course which will lay the groundwork for a significant number of courses at the University.

Because calculus is a "make or break" course for so many majors, our efforts are aimed primarily at insuring success in calculus. The Department of Mathematics fully supports this effort and has assigned Dr. D. A. Kouba, twice the winner of the department's teacher of the year award, to coordinate the ESP laboratory, which will meet four hours per week. The four hours per week in the lab will be mandatory for all students in the Program and will focus on interpersonal communication and cooperation and on not simply understanding the calculus material, but in mastering it to the point of excellence.

Clearly, this program is not for all students-- not even all good students. Many students will not want to make the commitment in time and energy required by the Program. ESP students are expected to have the bulk of their regular homework completed before they come to the laboratory and to assist other program members as the need arises. However, all participants should expect to enjoy the most stimulating and supportive environment that the University and Department of Mathematics can provide.

ESP has been a highly successful Program since its inception in the 1990-1991 academic year. If you are interested in the Emerging Scholars Program please fill out and send in the enclosed application. If you would like more information contact the Program Director, Dr. D. A. Kouba, at (530) 752-1083 or reach him by e-mail at kouba@math.ucdavis.edu.

EMERGING SCHOLARS PROGRAM
Student Application Form (PLEASE PRINT CLEARLY.)

Name _____ Student ID # _____

Permanent Address _____

Phone Number _____ Summer e-mail _____

Gender: male _____ female _____ Ethnic Background _____

High School _____ High School GPA _____

Class Rank _____ Number of Students in Class _____

SAT I Scores : Math _____ Verbal _____

Most advanced math course completed in high school _____

Year Completed _____ Grade Received _____

Math AP tests taken & scores (You may send in the application even if you have not yet received these scores.): AB _____ BC _____

Will you be on campus for Summer Advising ? _____ What date ? _____

Will you be participating in: STEP _____ BUSP _____ MEP _____

Prospective Major _____

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Briefly explain what you hope to achieve through participation in this program.

RETURN TO: Dr. D. A. Kouba
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