

The Emerging Scholars Program
in the
Department of Mathematics

A Comprehensive Report

submitted by

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April 24, 2002

Acknowledgements

The Emerging Scholars Program (ESP) began in Fall Quarter 1990 under the Directorship of Dr. D. A. Kouba and with the generous, patient, and expert advice of McArthur Fellow Dr. Uri Treisman (from UC Berkeley at that time and now at the University of Texas, Austin), the wisdom and humor of Dr. G. T. Sallee, the enthusiastic support of The Department Of Mathematics Chair, Dr. Arthur Krener, and the generous financial and moral support of Assistant Vice Chancellor for Student Affairs, Yvonne Marsh. It was modeled after similar and highly successful ESP Programs at UC Berkeley and the University of Texas, Austin, and shaped by Kouba's 8 years of first-hand experience teaching group problem solving to minority and low-income premedical students in the Summer Academic Study Program (SASP) under the experienced Directorship of the late Margie Beltran in the School of Medicine at the University of California, Davis.

Brief History of ESP

The Emerging Scholars Program was created to provide a laboratory enrichment experience for first-year engineering calculus students taking Math 21ABC in sequence at UC Davis. Students were selected from the following categories of entering freshmen:

1. Student Affirmative Action (SAA)
2. Educational Opportunity Program (EOP)
3. Rural or Other Small High School Experience

Approximately one-third of the ESP students were selected from each of these three categories when the Program began in Fall Quarter 1990. When ESP was expanded from one lab of at most 25 students to two labs of at most 25 students in Fall Quarter 1993, any new vacancies were made available to the UC Davis student population at large. Since that time ESP has been made available, not to just SAA, EOP, and rural students, but to all qualifying Math 21ABC students.

Regular enrollment in Math 21A requires a score of at least 35 out of 60 on the Mathematics Placement Exam. Students entering ESP in Math 21A are required to score at least 40 out of 60 on the Mathematics Placement Exam. Those students who fail to meet the threshold of 40 are allowed to take this exam a second time. It should be noted that this criterion for selection to ESP is not enforced if the applicant otherwise shows promise for success (based on such items as a personal interview, SAT scores, previous math courses completed, or choice of major) or enthusiasm for participation

in the Emerging Scholars Program. Those students entering ESP in Math 21B or Math 21C are required to have received a course grade of at least a C- in the prerequisite course.

The Emerging Scholars Program is composed of the traditional Math 21ABC lecture and discussion (4 credits) meeting four hours per week, and a nontraditional and innovative calculus laboratory (two credits) meeting an additional four hours per week and with an emphasis on personal responsibility, small group communication, and cooperative problem solving. Lab time is devoted to worksheets and chalkboard problems, which include both routine and challenging problems, especially designed for ESP.

Faculty, graduate student, or undergraduate student assistants act as learning facilitators in the ESP lab in the following way. ESP students are asked to first work on problems by themselves and to go as far as their experience and creativity will carry them. If difficulties are encountered they are to then ask their classmates for assistance. ESP students are encouraged to use the ESP lab facilitators as their last resort. As often as is possible the facilitators simply point wayward students in the right direction and let the students finish the problem unassisted.

Originally, the ESP lab met from 8 to 10 a.m. on Tuesdays and Thursdays and from 2 to 4 p.m. on Fridays with the bulk of Friday's time devoted to written quizzes on the week's material. However, a high incidence of class scheduling conflicts each year has led to the official removal of Friday's lab. In its place, ESP students now have a short problem set which is handed out as they leave lab on Thursday and which is to be written up and returned to class for grading on the following Tuesday.

From Fall Quarter 1990 until Spring Quarter 1993 the Emerging Scholars Program lab was staffed by Dr. Kouba, one graduate teaching assistant from the Department of Mathematics, and one qualified undergraduate assistant. From Fall Quarter 1993 until Spring Quarter 1998 each lab was staffed by a lecturer or Visiting Research Assistant Professor (VRAP) and one or two former ESP students. From Fall Quarter 1998 until Spring Quarter 2000 one lab was staffed with a lecturer and one or two former ESP students, and one lab was staffed with a graduate teaching assistant from the Department of Mathematics, and two or three former ESP students. For the 2000-2001 academic year ESP had one lab of 50 students (capacity) staffed by Dr. Kouba and three former ESP students. For Fall Quarter 2001 ESP had one lab of 42 students (capacity) staffed by Dr. Kouba and three former ESP students. For Winter Quarter 2002 ESP again expanded to two labs. One lab was staffed by a graduate teaching assistant from the Department of Mathematics and two former ESP students and the other lab was staffed by Dr. Kouba and two former ESP students.

The Emerging Scholars Program lab has provided UC Davis students enrolled in Math 21ABC the unique opportunity to learn calculus in an intimate and stimulating academic setting with other motivated, enthusiastic, and communicative students, and where assistance is provided by experienced teaching/research faculty, enthusiastic and knowledgeable graduate students, and highly skilled and successful undergraduates who are often former ESP students. There is ample evidence that this learning environment has been a significant factor in increasing participating students' scores on final exams, raising course grades, and dramatically reducing the failure rate in Math 21ABC.

It also appears that the collaborative and supportive environment of the ESP laboratories has attracted and retained an inordinately high percentage of EOP/SAA and female students, both traditionally underrepresented in calculus, mathematics, and the natural sciences. ESP has also attracted a high proportion of students declaring mathematics as a major or co-major. This should be especially gratifying to the UC Davis Department of Mathematics, which is continually seeking avenues through which to increase the number of majors. All of these factors have created, for an extremely diverse collection of motivated and dedicated students, a unique and unparalleled opportunity for academic success, not just in engineering calculus and other lower division and upper division mathematics courses, but in their entire UC Davis curriculum.

Quantitative Comparisons

Table 1 shows the total enrollment of ESP students for each year beginning with the 1990-1991 academic year and ending with the 2001-2002 academic year.

Table 2 shows the exam averages (out of 200) on in-sequence common final exams in Math 21ABC for three different groups of students— honors calculus students (HON), regular non-ESP and non-honors students (REG), and Emerging Scholars Program students (ESP) from Fall Quarter 1990 to Winter Quarter 1995, when the common final exam ceased being required for honors students.

Table 3 shows the exam averages (out of 200) on in-sequence common and individual final exams in Math 21ABC for REG and ESP only from Spring Quarter 1995 to Spring Quarter 2001. Participation of the honors student section was optional during the time period shown from Fall Quarter 1990 until Winter Quarter 1995 but it was a participant in 12 of 14 common final exams. (The honors program was temporarily terminated after the 1995-1996 academic year and the Department of Mathematics is currently waiting for an appropriate time for its revival.)

It should be pointed out that a Math SAT average for each of the three groups of students was determined during each of the first four years of operation of the ESP Program. During this time period HON had the highest math SAT average with 697, REG was second with 637, and ESP was third with 628. Though it was not computed for this report, it is very likely that the math SAT averages for REG and ESP are comparable.

ESP has had a higher average than REG on every final exam comparison from Fall Quarter 1990 through Spring Quarter 2001. ESP had a higher final exam average than HON in Spring Quarter 1991 and every quarter from Spring Quarter 1993 until Winter Quarter 1995 (HON did not participate in Spring 1994.). This early period was a defining moment for the ESP students and the Program. Students came to realize that they had discovered a way not only to compete with the 'elite' students in Math 21ABC, but to outperform them on the level playing field of the common final exam. It validated the ability and participation of traditionally under-represented students in the field of mathematics. This realization continues to create a deep sense of pride and satisfaction among ESP students. Many ESP students now view themselves as honors students and ESP as an honors program.

Table 4 shows the percentage of EOP/SAA students in all in--sequence sections of Math 21ABC (ALL), including ESP students, and the percentage of EOP/SAA students in ESP (ESP) for academic years beginning with 1990-1991 and ending in 2000-2001. ESP is higher each year with an average of approximately double that of REG.

Table 5 shows the percentage of female students in all in--sequence sections of Math 21ABC (ALL), including ESP students, and the percentage of female students in ESP (ESP) for academic years beginning with 1990-1991 and ending with 2000-2001. ESP is higher each year with an average of about one-third more than REG.

Table 6 shows the percentage of students declaring mathematics as a major in all in--sequence sections of Math 21ABC (ALL), including ESP students, and the percentage of students declaring mathematics as a major in ESP (ESP) for academic years beginning with 1990-1991 and ending in 2000--2001. Since the 1991-1992 academic year ESP has been several times higher than REG.

Table 7 shows the percentage of A's and B's given as course grades for all in--sequence sections of Math 21ABC (ALL), excluding ESP students, and the percentage of A's and B's given as course grades for ESP students for all in--sequence sections of Math 21ABC (ESP) for academic years beginning with 1990-1991 and ending with 2000-2001. Honors Calculus course grades are not included in these computations. ESP is higher each year with an average of about 50% more than REG.

Table 8 shows the percentage of D's and F's given as course grades for all in-sequence sections of Math 21ABC (ALL), excluding ESP students, and the percentage of D's and F's given as course grades for ESP students for all in-sequence sections of Math 21ABC (ESP) for academic years beginning with 1990-1991 and ending with 2000-2001. Honors Calculus course grades are not included in these computations. ESP is lower each year with an average of about 50% less than REG.

Table 9 shows the Grade Point Average (GPA) for all in-sequence sections of Math 21ABC (ALL), excluding ESP students, and the GPA for ESP students for all in-sequence sections of Math 21ABC (ESP) for academic years beginning with 1990-1991 and ending with 2000-2001. Honors Calculus course grades are not included in these computations.

Awards, Acknowledgments, Publications

Several former ESP students have been honored for their academic excellence.

Henry Bui won First Place in the 1992 Freshmen Mathematics Contest in the Department of Mathematics.

Gabriel Moreno won First Place and Philip Truong won Honorable Mention in the 1994 Robert Lewis Wasser Contest in the Department of Mathematics.

Hien Bui won Third Place in the 1995 Spring Math Contest in the Department of Mathematics.

Laura Loos won a Regent Scholarship for 1994-1995 and 1995--1996, a 1995-1996 Lawrence J. Andrews Prize from the College of Letters and Science, and was a University Scholar for 1993-1994. In addition, she received highest honors for her senior thesis entitled "Matrix Integrals and the Topology of the Moduli Spaces of Riemann Surfaces" under the direction of Professor Motohico Mulase.

Caleb Emmons won Second Place in the 2000 Spring Math Contest in the Department of Mathematics.

Ting Liao won Second Place and Josephine Yu won Third Place in the 2001 Spring Math Contest in the Department of Mathematics.

Jennifer Cordial received a 2001 Departmental Citation in the Department of Mathematics.

Tony Lam was chosen as the Undergraduate Advisor in the Department of Mathematics for the 2001-2002 academic year.

Josephine Yu will be the Undergraduate Advisor in the Department of Mathematics for the 2002-2003 academic year.

An article entitled "The Emerging Scholars Program at UC Davis—A Recipe for Success" was published by D. A. Kouba in the November 1995 edition of the Undergraduate Mathematics Education Trends (UME Trends).

An article entitled "Has Proposition 209 Affected the Participation of Minority Students in the Emerging Scholars Program at UC Davis?" was published by D. A. Kouba in the 1999 summer issue of the *National Association of Mathematicians Newsletter*.

**Qualitative Evaluations
by Former ESP Students and Faculty**

Attached to this report are brief evaluations or remarks from the following individuals:

Laura Loos, former ESP student and ESP lab assistant

Deborah Isabelle, former ESP student and ESP lab assistant

Caleb Emmons, former ESP student and ESP lab assistant

Jennifer Cordial, former ESP student and ESP lab assistant

Charles Morris, former ESP student and ESP lab assistant

Sara DeLeon, former ESP student and current ESP lab assistant

James Parmenter, former ESP student and current ESP lab assistant

Tony Lam, former ESP student and current Undergraduate Advisor in the Department of Mathematics

Carlton Kong, current ESP student

Mas Kimura, former graduate teaching assistant in the ESP lab

Tyler Evans, former graduate teaching assistant in the ESP lab

Bori Mazzag, former graduate teaching assistant in the ESP lab

Brad Ballinger, former graduate teaching assistant in the ESP lab

Michael Penkava, former graduate teaching assistant in the ESP lab

Lawrence Marx, former lecturer in the ESP lab

Appendix

The data represented in Tables 1 through 9 can be found in the Appendix following this report.