CALIFORNIA COMMUNITY COLLEGES
AND
PALOMAR
COMMUNITY COLLEGE DISTRICT

#92-0021
**92-0021 --- FII --- SUMMARY**

California Community Colleges  
Curriculum and Instructional Resources Division

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<th>FISCAL YEAR</th>
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<td>92-0021</td>
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**PROJECT TITLE**

Computer Laboratories in Mathematics Education (CLIME)

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<th>PROJECT DIRECTOR</th>
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<td>Wendy Metzger, Associate Prof Mathematics</td>
<td>Diane Michael, Dean Math &amp; Natural/Health Sci</td>
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**PROPOSAL DESCRIPTION**

The proposal is a loan request. The project proposes to enhance mathematics instruction by establishing a 20 station mathematics computer laboratory and developing integrated lecture/laboratory courses that will emphasize development of students' higher order cognitive skills in mathematics rather than rote manipulation. The FII loan funds will be used to augment other funding sources.

This project builds on a previously funded FII grant in 1991-92, which began to revise the curriculum to achieve the above goals using computer technology in an integrated lecture/lab format. This loan will allow the college to expand upon the pilot and institutionalize the program.
Computer Laboratories in Mathematics Education (CLIME)

The Palomar College Computer Laboratories in Mathematics Education (CLIME) project will enhance mathematics instruction by establishing a 20-station mathematics computer laboratory and developing integrated lecture/laboratory courses that will emphasize development of students' higher order cognitive skills in mathematics rather than rote manipulation. The FII loan will be used to augment other funding sources so that the project can commence in 1992.

Educational Program or Service Addressed:
The proposed project addresses funding areas l(e), "Efforts to improve traditional instructional programs," and l(a), "Nontraditional forms of instruction," and Board of Governors Basic Agendas item a.(1), "Transfer Education.

Problem Addressed:
Our students need to learn mathematical concepts and problem solving skills that they can apply in future academic and workplace situations rather than relying mainly on rote manipulation skills that are the typical end-product of traditional mathematics instruction. In 1991-92 we began revising our curricula to achieve these goals using computer technology in an integrated lecture/laboratory format under a pilot program funded by FII grant 91-0017. However, we do not have enough computer laboratory facilities to expand the pilot program.

Population Served:
The project will make it possible to offer the revised curricula to approximately 20 sections of 40 students each per semester, or as many as 1600 students per year.

Objectives:
The objectives of the project are to establish a 20-station mathematics computer laboratory at Palomar College by the end of the 1992 fall semester; to offer the newly developed College Algebra and Calculus I courses during spring semester 1993, and to offer an expanded selection of college-level mathematics courses using computer technology by fall semester 1995.

Activities:
To achieve the objectives, the college will remodel the laboratory site. The co-directors, using reassigned time granted by the college, will oversee the purchase and installation of equipment and software; develop and introduce new curricula in College Algebra,
Trigonometry, and Calculus I, II, and III; and train mathematics department instructors to use the new curricula.

Dissemination:
Workshops for faculty from Palomar College, local high schools, community colleges, and 4-year colleges will be held to communicate our results and to encourage other schools to incorporate computational technology into their courses. Results will also be shared through contributed papers and presentations at selected conferences.

Budget:
The total project cost will be $161,973, of which $56,024 will be contributed by the college, $52,974 will come from a pending NSF grant, and $52,975 is being requested from FII as a loan to be repaid from future funding sources.
Computer Laboratories in Mathematics Education (CLIME)

1. Specific Educational Program Being Addressed

Specific Educational Programs Being Addressed

This is a proposal for a loan to purchase equipment to enhance the mathematics curriculum at Palomar College with computer technology by establishing a 20-station computer laboratory for college-level mathematics courses. It addresses the following specific educational programs as identified in California Education Code Section 84381:

1. "Efforts to improve traditional instructional programs."
2. "Nontraditional forms of instruction."

and Board of Governors 1991-92 Basic Agenda Focus item:

1 "Transfer education." 

The proposed loan will enable Palomar College to establish a mathematics laboratory and offer an expanded selection of college-level mathematics courses in a lecture/laboratory format for those students who prefer to learn mathematics in that environment.

Background Information

Need for College-Level Mathematics Laboratory.

College Algebra and Calculus I curricula are being developed and pilot tested under a 1991-92 FII grant. We propose to expand that program to include other courses and also to increase the number of Calculus I and College Algebra sections being offered with the lecture/laboratory format. Our present mathematics learning center, established using Title m funds, must be used principally for remediation; hence we cannot expand significantly beyond the pilot program without additional laboratory facilities. We have applied for a National Science Foundation Instrumentation and Laboratory Improvement (ILI) grant to help pay for the necessary equipment and software. If that grant is awarded then the FII loan we are requesting would be used to provide the matching funds required by the NSF grant. The FII loan will make it possible
for us to establish the laboratory upon receipt of the NSF grant and then make repayment of the loan from future fund raising activities.

Need to Extend New Curricula and Technology.

Students frequently fail or drop out of college-level mathematics courses because they do not develop the computational skills required by the existing curriculum. At Palomar College, the combined dropout plus failure rate may reach as much as 50 percent for College Algebra and Calculus I courses. In addition, Mayes\(^1\) and Fandreyer\(^2\) have suggested that even successful students spend so much time on computation that they do not gain the conceptual understanding that would be useful to them in their subsequent pursuits.

Furthermore, at the community college level many students, especially women and minorities, are unsuccessful in traditional precalculus level courses and hence do not move on to calculus or other technical courses.\(^3\) This has the effect of closing the door on academic and career opportunities to many potential transfer students.

Most of our students are required to take mathematics courses so that they can understand and appreciate the mathematical foundations of their majors. They do not need to gain expert computational skill in mathematics. In a recent article, Demana and Waits noted that:

> The importance of, and need for, highly proficient skill in arithmetic and algebraic paper-and-pencil manipulation in the workplace has already been rendered nearly obsolete by technology. In the new decade we must help all students acquire the ability to make effective and appropriate use of technology. This ability entails a fundamental understanding of mathematical concepts and processes and their applications, along with critical thinking and reasoning skills in mathematics.\(^4\)

Thus we have a situation in which students must develop significant computational skills (which they probably will never use) in order to satisfy their mathematics prerequisite requirements. We believe that manipulation and computational skills are neither prerequisite for, nor a guarantee of, mathematical understanding. Therefore, we are revising our curriculum to emphasize development of students' higher order cognitive skills in mathematics. Our non-traditional approach to teaching mathematics presents the essential concepts of the subject matter with an integrated lecture/laboratory format in a way that will offer students a greater chance for meaningful success.

The College Algebra and Calculus I courses have already been redesigned into a lecture/laboratory format and one section of each is being taught in the new format during spring semester 1992. These activities have been successful enough to warrant the additional effort to extend computer technology across the entire mathematics curriculum in a systematic and coordinated way. Once the new mathematics laboratory is in place it will be used to continue teaching the enhanced College Algebra and Calculus I courses that are being piloted
under the current FII grant. In addition, the co-directors will use the new laboratory to develop and extend the concepts to other courses in the department. The college administration has agreed to provide 60 percent release time each for the co-directors in 1992-93 and additional time as needed in subsequent years to carry out this project.
2. Specific Problems Being Addressed

Specific Problems Being Addressed

The loan will enable Palomar College to address two problems:

1. The potential delay in fully implementing new curricula for college-level mathematics courses if equipment cannot be purchased next year, and
2. The need to teach mathematical concepts using an integrated lecture/laboratory format that will better prepare our students for future academic and vocational pursuits.
3. Population To Be Served

Population to be Served by the Project

The population to be served will be those students with a variety of goals who need and/or desire college-level mathematics courses at Palomar College. Sixty students are involved in revised courses during spring semester of 1992. The proposed loan will enable us to offer the revised curriculum to approximately twenty sections of forty students each per semester, or as many as 1600 students per year when the laboratory is fully utilized.
4. Objectives

Proposal Objectives

The following objectives are necessary to accomplish the project goals:

1. Establish a 20-station mathematics computer laboratory by the beginning of spring semester 1993.
2. Offer College Algebra and Calculus I courses in the new mathematics laboratory during spring semester 1993.
3. Offer an expanded selection of college-level mathematics courses in a lecture/laboratory format to those students who prefer to learn mathematics in that environment by fall semester 1995.
5. Workplan Narrative

Work Statement:

In order to accomplish the first project objective, Palomar College will use the FII loan proceeds to help establish a Mathematics Computer Laboratory by the beginning of spring semester 1993. The laboratory will be created by remodeling an existing classroom to house the new computers along with associated equipment and furniture. The cost of remodeling and equipping that room with appropriate furniture will be borne by Palomar College. The FII loan will be used to help purchase equipment and software for the laboratory.

The second project objective is to offer several sections of two courses in the new laboratory during spring semester of 1993.

The third objective, to be accomplished by June 1995, is to be ready to offer an expanded selection of lecture/laboratory college-level mathematics courses to those students who prefer to learn mathematics in that environment.

When funding for the equipment and software is assured, Palomar College will remodel room E-1 of the E building during fall semester 1992. Concurrently with those activities, the Mathematics Department will be able to review course offerings and decide which courses would be most appropriate to offer in a lecture/laboratory format. The project co-directors, in consultation with the department, will continue to review software and equipment requirements for the various courses so that a final decision can be made about what equipment and software to purchase. After the equipment is purchased and delivered, it will be installed and operationally tested. The project co-directors will revise their previously developed lecture/laboratory courses (FII grant 91-0017) to be compatible with the new laboratory equipment and software. Those two courses will then be offered in the new laboratory during spring semester of 1993. That will accomplish the first two objectives.

The third, longer term objective, will be accomplished by bringing additional mathematics instructors into the project and training them in the use of the new technology. This will require ongoing activities for the three-year period commencing with the 1992-93 school year. During the spring semester of 1993, two instructors will be recruited and trained to take over the courses then being taught by the project co-directors. For the years following, the anticipated pattern is that the project co-directors revise and teach two new courses each year and "hand those off" to other instructors for the following year. For example, during fall semester 1993 the project co-directors would prepare and offer two new courses in a lecture/laboratory format. Then during spring semester 1994, two other instructors would be trained and scheduled to take over those courses for the 1994-95 school year. In addition, the laboratory would be available to other instructors who may want to develop their own course revisions and materials. We anticipate full utilization of the laboratory facilities and the realization of the third objective no later than the beginning of the 1995-96 school year.
Feasibility of the Project/Institutional Support:

The project is feasible because computer technology (both hardware and software) has advanced to the point where it is possible to teach students quickly the minimal skills necessary to use the technology effectively. Successful completion of the existing 1991-92 FII project will result in the development and testing of two revised courses (College Algebra and Calculus I) along with the supporting materials to teach those courses using our existing mathematics learning center. The experience and expertise gained with the existing FII project will allow us to efficiently modify those materials for the new equipment and software associated with the new mathematics laboratory. The institution has committed to 60 percent release time for the co-directors during 1992-93 and additional time as needed in subsequent years to extend computer technology across the college-level mathematics curriculum. The probable necessary hardware and software have been identified and are available for purchase. Payback of the loan will be funded by a combination of college resources and other fund raising activities such as the Palomar College Foundation, contributions from equipment and software vendors, and private donations.
6. Expected Outcomes

Expected Outcomes of Project Activities:

Project Objectives.

The overall impact of the project will be increased student success in advanced mathematics. As was mentioned earlier, many students, especially women and minorities, are unsuccessful in traditional precalculus courses and therefore do not move on to calculus or other technical courses. Our project will develop laboratory materials for College Algebra, Trigonometry, Precalculus, and Calculus I, II, and III. Our nontraditional courses will include new activities that are effective for laboratory learning, in which the students learn by investigation and discovery. The activities will emphasize higher order cognitive skills, such as analyzing and synthesizing mathematical problems and concepts, and communicating mathematical ideas effectively.

Project Impact.

Most current mathematics curriculum reform is occurring at universities and four-year colleges. If curriculum reform in mathematics is to have significant impact then change must not exclude community colleges. Traditionally, research and curriculum development are minimal at the community college level because of the heavy teaching load required for community college instructors. Palomar College is providing significant support for curriculum development by releasing the co-directors from teaching duties to carry out this project. Our success should motivate other community colleges to follow our lead. Accordingly, we plan to share our experiences, materials, and knowledge with others so that they can make similar changes.

Potential for Continued Support.

Once the equipment is purchased and installed, the continued support of the project will be the responsibility of the college. Palomar will provide for maintenance of the facility. The division dean is highly supportive of the integration of technology into the curriculum and the college has committed to the release time necessary to continue with curriculum development and to train other faculty to use the new course materials.

Potential for Adaptation by other Institutions or Programs.

There is considerable potential for adaptation by other institutions or programs. Many community colleges have computer technology available for use in instruction and therefore need instructional materials that make appropriate use of that technology. Adaptation will be facilitated as we implement our Dissemination Plan.
7. Evaluation Plan

Evaluation Plan:

The evaluation plan is comprised of determination by the project directors and project supervisor that the following have occurred by the target dates stated on the Work Statement Form:

a. Remodeling of the laboratory facility, purchase and installation of equipment and software, and identification of the courses for which new curriculum is to be developed.

b. Adaptation of College Algebra and Calculus I lecture/laboratory courses to the new equipment and software.

c. Use of the new laboratory for instruction in College Algebra and Calculus I and training of two instructors to take over the courses.

d. Use of the new laboratory for instruction in Trigonometry and Calculus II and training of two additional instructors in the new curricula.

e. Use of the new laboratory for instruction in Pre-calculus and Calculus III and training of two instructors in the new curricula.

Monthly reports will be made to the project supervisor during the academic year detailing progress in order to verify that the activities are being completed by the target dates.
8. Dissemination Plan

Dissemination Plan:

An integral part of the project is to encourage all faculty members of the Mathematics Department to revise and modify their teaching methods to incorporate computational technology into their courses. To this end, we will hold workshops for regular and adjunct faculty, to which interested persons from local high school, community colleges and 4-year colleges in San Diego County will also be invited. In addition, we will offer contributed papers and/or presentations at regional and national conferences of various organizations such as the California Mathematics Council, the American Mathematical Association of Two-Year Colleges, the International Conference on Technology in Collegiate Mathematics, and the Mathematical Association of America.
9. Budget Narrative

[NO “BUDGET NARRATIVE” ACCOMPANIES THIS DOCUMENT.]
References:


