CALIFORNIA COMMUNITY COLLEGES
AND
HARTNELL
COMMUNITY COLLEGE DISTRICT

#92-0008
California Community Colleges  
Curriculum and Instructional Resources Division

<table>
<thead>
<tr>
<th>FISCAL YEAR</th>
<th>ID NUMBER</th>
<th>COLLEGE</th>
<th>DISTRICT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1992-93</td>
<td>92-0008</td>
<td>Hartnell</td>
<td>Hartnell</td>
</tr>
</tbody>
</table>

**PROJECT TITLE**

**Using the Computer to Improve Teaching and Learning in Calculus for Business, Biological and Social Sciences**

<table>
<thead>
<tr>
<th>FUNDING CATEGORY &amp; AWARD</th>
<th>ELIGIBLE PROGRAM</th>
<th>PROJECT CATEGORY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combination = $11,614</td>
<td>E --- Improvement of Trad Instruction Prog</td>
<td>Curriculum Design</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROJECT PRODUCT</th>
<th>PROJECT TOPIC #1</th>
<th>PROJECT TOPIC #2</th>
<th>ACADEMIC SUBJECT</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Computer Technology</td>
<td></td>
<td>Inter-Disciplinary</td>
</tr>
</tbody>
</table>

**PROJECT DIRECTOR**  
Kelly M. Locke, Instructor of Mathematics

**PROJECT SUPERVISOR**  
Gustavo Valadez-Ortiz, Dean of Sciences

**PROPOSAL DESCRIPTION**

This proposal is a grant/loan request. This project will develop a Business Calculus curriculum based on the use of computer software as a tool for interactive and discovery learning. Faculty will be taught to use software and provided with the materials to teach a similar course. This proposal addresses the failure rate in Calculus which is about 50%. Current work is being done to address reform for math and science majors.

However, very little is being done for the Business Calculus course. This project proposes to solve this problem by preparing a manual for the computer based Business calculus course.

This a grant portion of the grant/loan combination with loan number 92-0043.
Using the Computer to Improve Teaching and Learning in Calculus for Business, Biological and Social Sciences

This project addresses the following systemwide needs: improving student success rates in Business Calculus, developing curricula that use the available technology, and developing the problem solving abilities of students. The project will meet the needs by developing an interactive computer component for the course and disseminating the results in the form of workshops and a curriculum manual.

Hartnell College's project, Using the computer to Improve Teaching and Learning in Calculus for the Business, Biological and Social Sciences, will develop a Business Calculus curriculum based on the use of the computer software as a tool for interactive and discovery learning. Faculty will be taught to use the software and provided with the materials to teach a similar course.

Educational Program or Service and Basic Agenda Priority Item:
The project will improve the traditional instruction of mathematics and will improve the teaching abilities of faculty members. The project addresses the Basic Agenda Priority Item of Educational Standards. Hartnell College seeks to help students achieve high educational standards.

Problem Addressed:
Nationwide the failure rate in Calculus is about 50%. Currently, work is being done to address calculus reform for math and science majors. However, very little is being done for the Business Calculus course. This is a systemwide problem addressed by introducing technology, real world problems and cooperative learning into the course. Implementing technology is also a problem. The Hartnell College project proposes to help solve the problem by preparing a curriculum manual for the computer based Business Calculus course. This, too, is a solution to a systemwide problem.

Population Served:
Initially the project will serve the students of the Business Calculus courses at Hartnell. Due to the faculty development component of the project, students in other math classes and at other schools will also benefit from the improvement in teaching and learning. Finally, faculty will benefit by learning the software and sharing ideas about using it.
Objectives:
The objectives of the project are to develop and implement the curriculum, evaluate and revise it and, finally, to disseminate the results in workshops, articles and a curriculum manual.

Activities:
The project director will prepare classroom demonstrations, interactive computer learning guides, assignments and real world problems during the first six weeks of the project. The project director will teach two sections of Business Calculus each semester during the 1992-93 year. One class will be computer based. The other will be taught traditionally and used as a control group. After each semester, course materials will be evaluated and revised. The project director will produce a curriculum manual with course materials, ideas for other courses and evaluations of the project.

Dissemination:
The dissemination of the results is an objective of the project. The project director will attend conferences to present talks and will hold workshops for interested faculty. Articles will be submitted to newsletters and papers will be prepared for professional journals. The project addresses a systemwide need and so the materials and results must be distributed throughout the system.

Budget:
The total project cost will be $26,803. Of this, $7,217 will be contributed by Hartnell College in the form of in-kind matching and $5,972 is requested in the form of an Fll loan that will be paid by the college. The remaining $13,614 is requested from Fll.
Using the Computer to Improve Teaching and Learning in Calculus for Business, Biological and Social Sciences

1. Specific Educational Program Being Addressed

Proposal Narrative

The calculus reform movement has spawned several studies, seminars, and workshops about using computers and technology in the calculus classroom. However, these efforts have focused almost exclusively on the three semester calculus sequence designed for math and science majors. In Fall 1990 Hartnell College reported 200 students who were majoring in math, physics, chemistry or pre-engineering. These are the students who would take the three semester calculus sequence. On the other hand, over 800 students declared business as their major. These students will take Calculus for Business, Biological and Social Sciences.

Goals of the Project

This project proposes to improve traditional methods of instruction and to help students achieve high educational standards in the Calculus for Business, Biological and Social Sciences course at Hartnell College. During the project, the project director will develop and implement a calculus curriculum based on learning by discovery, using the computer software Theorist. In addition, this project will improve the teaching abilities of faculty members, at Hartnell and elsewhere, as they receive instruction on the Theorist software and Expressionist equation editor and learn ways that they might use the computer software in their classes.

The software will be used in several ways. First, the instructor will use it for classroom demonstrations and examples, as well as for writing and editing mathematics for handouts and exams. Students will use it in the classroom to become active participants. It will also be used to lead students through discovery of new topics. Students will use learning guides of narrative, equations and illustrations, composed using the software. They will be interactive requiring the students to work examples, answer questions and create graphs with the software. Finally, students will do classroom-independent and collaborative learning using the computer. They will use the software to do homework assignments, some exams and to prepare midterm and final projects using real world data.
Presently, the Hartnell College faculty use a statistical software package in the Statistics class and computer aided instruction in an algebra class. Presently no instructor teaches a math class using any of the available computer algebra systems, such as Derive, Maple, Mathematica or Theorist. Thus, the implementation of this project will improve the teaching abilities of the Business Calculus instructor by providing knowledge and facility with one of the computer algebra systems, namely Theorist. The implementation of this project will also improve the teaching abilities of other faculty members at Hartnell and ultimately at other colleges. The project includes a faculty development component, which will include producing a curriculum manual and presenting workshops for interested math, science and even social science faculty in the use of Theorist. Workshops will be held at several mathematics conferences and will be made available to faculty at Hartnell and neighboring colleges. These workshops will include instruction on Theorist as well as the methods used in the Business Calculus course. The curriculum manual will include examples of learning guides, assignments, projects and tests. It will also provide ideas that can be adapted for other courses.

Basic Agenda Priorities

This project addresses the Basic Agenda Priority of Educational Standards. Its implementation will maintain and improve the quality of instruction and learning in the Business Calculus course. Calculus is a visual topic since it is a study of change and dynamic systems. Classroom demonstrations and hands-on work with dynamic equations and graphs on the computer can be an improvement over the static nature of textbooks and chalkboard drawings. In addition, the Business Calculus course is an application oriented course designed to meet the needs of the client disciplines. The students must see applications of the techniques they are learning. Unfortunately, many real world examples involve complicated functions that are too time consuming for the classroom or too difficult for students with limited mathematical backgrounds. As a result, many applications currently used are oversimplified and unrealistic. The use of Theorist will allow the instructor to use real data for examples and will allow students to work with actual problems faced in business, social sciences or biology.

Instruction and learning in other courses will also improve. For example, classroom demonstrations from the Business Calculus course could be used in the three semester calculus sequence. Theorist could be used to work with actual real world data in other business oriented courses such as Finite Math.

Retention of underrepresented students is another important consideration. In an article in *Calculus for a New Century*, Newman and Poiani emphasize that two ways to promote success among minority students are to integrate the resources of the personal computer and to develop interactive methods of teaching and learning calculus. Malcolm and Treisman stress the role of cooperative learning, peer tutoring and technology in making calculus accessible to all students. This project will incorporate technology along with interactive and cooperative learning, and thus will improve the retention of underrepresented students.

In addition, it will provide access and knowledge of personal computing power to all Business Calculus students regardless of their financial resources. As the use of computers grows at the...
state university, university and private college, access to and knowledge of computers will become increasingly important. If low income students, many of whom are minority students and many of whom attend the community college, do not have experience with personal computers, they will be at a disadvantage when transferring to a four year college where the use of computers is the norm.\textsuperscript{3}
2. Specific Problems Being Addressed

Defining the Problem to be Addressed

Currently the failure rate for Calculus classes nation wide is about 50%.\(^4\) According to grades from three semesters at Hartnell College, approximately 54% of students enrolled in Business Calculus completed the course with a C or better. An immediate problem caused by this high failure rate is that many students take the course more than once. This is inefficient for the student and for the college. General enrollments at Hartnell and other community colleges are increasing. The number of business majors is also growing. The demand for Business Calculus is increasing and yet limited sections of the course are being taught due to budgetary constraints. In a class of 40 students, approximately 18 will need to retake the course. This means that many students needing to take the course will be denied access. If access is to remain an essential part of the community college mission, it will be increasingly important to improve the success rate of our students. This project will improve access by improving the success rates.

Calculus for Business, Biological and Social Sciences is a prerequisite for the business programs at many Universities. It is also a prerequisite for some social science, biology and allied health programs. Thus, it can be a major obstacle to a large segment of the transfer population. Failure in the course has undoubtedly caused some students to limit their options to schools or programs that do not require the course. Some of the reasons for the difficulty are: lack of strong algebraic skills, lack of visualization skills, lack of experience reading and analyzing graphs, lack of confidence in mathematics, too much time spent on the algebraic mechanics and as a result too little time spent conceptualizing, too little time spent on homework or studying and a lack of interest due to perceived irrelevance of content.

This project addresses all of these possible reasons for student failure in Business Calculus. The design of the curriculum, with its focus on discovery, will improve understanding and de-emphasize traditional drill and practice problems. In combination with the use of Theorist it will allow students to concentrate on the calculus that is being learned rather than the routine algorithmic manipulations. This will allow even students with weak algebra backgrounds to see the concepts of calculus that are being learned. They will learn one thing at a time, focusing on calculus rather than algebra. As a result, they will spend less time on the mechanics, and yet will be able to work many more problems than they would ever attempt with paper and pencil. Thus they will develop "an Inquisitive and Experimental Attitude" which will encourage them to spend the time necessary to learn. As students achieve an understanding of and competence with calculus, they will gain confidence in their mathematical abilities and may even see the need to do remedial work in algebra.\(^5\)

The visual nature of the examples and assignments on the computer will improve their ability to visualize and their ability to read and analyze graphs as models of dynamic systems. The use of the computer will also allow the introduction of real world, rather than excessively simplified
and unrealistic examples. The incorporation of real problems obtained through actual companies and agencies will serve a dual purpose. First, it will provide the relevance needed to spark interest in the students. Second, the interest generated will provide motivation for students to spend more time working on their homework than they might in a traditional class.

Finally, the completion of projects which include modeling and problem solving will require a conceptualization of calculus as a whole subject and not just a collection of techniques for differentiation and integration. Students will use calculus as a tool in the process of problem solving and thus will have a better understanding of its importance and uses.

Another problem that is being addressed by this proposal is the difficulty for faculty of implementing available technology. One reason that implementation is difficult is the cost of software and hardware. As a result of this project, instructors at Hartnell will have access to Theorist and a Macintosh computer for use in the classroom as well as curriculum development. A second reason that implementing technology is difficult is the time that is required to learn to use the tools appropriately. Course objectives must be revised to reflect the use of technology. The faculty development component of this project seeks to remedy this problem. Instructors will not have to start from scratch to develop competency with the software or revise their courses. The methods and results of this project will be available to assist instructors in applying the technology in their own courses.

Other alternatives may be available that will address these problems. For example, the curriculum could be designed to incorporate discovery without using a computer algebra system. However, given the limited mathematics background of the students, this would almost certainly require more class hours if attempted without the advantages provided by the computer. The course could be designed using one of the other computer algebra systems and many of the advantages would be retained. In fact, one could argue that there is an advantage in working with a program such as Mathematica, which is available in DOS and Macintosh versions. Nonetheless, the advantages of working with Theorist outweigh the advantages of using the other software. Theorist is available in a Macintosh version that will be used in the Macintosh Lab. The lab is available for use by math classes as well as open labs and has 27 computers.

Theorist was designed for the Macintosh and as a result it is easy to learn. Students who have not used a Macintosh before will not take long to learn the basics. With a little more instruction they will be able to use Theorist. Theorist is menu driven so students won't have to learn a long list of commands. The most appealing feature is the look of the mathematics in Theorist. All functions look just the way they would in paper and pencil work. Theorist uses the familiar mathematical symbols instead of unfamiliar function names. This may not be as important for the engineering calculus students. However, for students who are not comfortable with mathematics the familiar look is an advantage.
3. Population To Be Served

The Target Population

The project will serve three different populations. The primary focus will be the students who enroll in Calculus for Business, Biological and Social Sciences at Hartnell College. The vast majority of these students are business majors, according to informal surveys taken during previous semesters. A few are planning to continue in the biological sciences or allied health fields and a few are social science majors. These students typically have not been highly successful in mathematics. They would not consider math to be one of their favorite or strongest subjects. To most of them the course is an obstacle. In fact, the course has been used by some major departments as a weeding out process.

The students would benefit immediately from a more visual method of teaching calculus. The concepts of calculus are abstract and making them concrete and visual using the computer will help the students. Giving them the tools with which they can be active learners and discover the ideas for themselves will also help them. In the short term, the methods used in the course will enable more students to learn the topics of calculus and successfully complete the course. In the long term, the modeling and problem-solving using real data will better prepare them for both their major and future career. Likewise, the writing and the computer literacy will give the students tools that they will certainly use in their academic life and their careers.

The second population that will be served by this proposal is the faculty in mathematics, sciences and possibly social sciences. They will have the opportunity to participate in workshops and talks about using Theorist. Faculty at Hartnell will have access to the software and hardware and may begin to use Theorist right away, either in the classroom or in their own work. Faculty from other schools will also be served by the workshops, talks and articles about using Theorist. They will be able to use the curriculum manual to design a similar course for their school. Whether or not instructors choose to use this particular computer algebra system, the exposure enables them to better decide which of the many programs to use.

The third population that will be affected, albeit indirectly, are students in other math classes. As faculty learn about this method of instruction and begin to implement portions of it in their own classes, the students will benefit. Business Calculus is not the only math course that has an alarming attrition rate. According to data from Fall 1991, over 40% of the 2,280 students who took math classes were unsuccessful. Many math courses could be improved by the addition of a computer component which encourages discovery, collaborative learning, real world applications and writing. In the short term math students will gain more visual abilities in mathematics and more understanding of graphs. In the long term they will develop modeling and problem solving skills and produce well written reports which interpret their results.
Project Objectives

1. The project director will prepare a curriculum plan and materials to be used in teaching Calculus for Business, Biological and Social Sciences using Theorist. The initial plan will be developed during the first six weeks of the project. It will include classroom demonstrations, interactive learning guides and assignments. Some of the assignments will consist of real problems gathered from local companies.

2. All students will demonstrate competency with the Macintosh and the Theorist software by scoring 70% or better on a computer competency exam given during the first three weeks of the semester. To prepare for the exam, students will complete an orientation on the Macintosh and will complete a learning guide designed to teach them the basics of Theorist.

3. During both Fall and Spring, seventy percent of the students enrolled will complete the course with a grade of C or better. They will demonstrate problem solving abilities by completing assignments composed of open ended questions. They will model real problems using the techniques of calculus. Students will demonstrate the ability to write summaries of the methods used and interpretations of their results. In addition, students will pass exams on the mechanics of calculus without using the computer. These exams must be passed at a level of 80% accuracy. Finally, students will work as a productive member of a project team on the midterm and final projects. Another group of students, who will serve as the control group, will learn Business Calculus in the traditional classroom.

4. The project director will share the goals, methods and initial results of the project at American Mathematical Association of Two Year Colleges (AMATYC) and California Math Council of Community Colleges (CMC3) conferences and through workshops for faculty. Participants will be informed of the development of the curriculum manual and, if interested, will receive a copy at the end of the project.

5. The project director will evaluate the project based on student evaluations, scores, and qualitative data collected in a project journal. The project director will also evaluate the poster session at the AMATYC conference and the faculty workshop. The means of evaluation will be comments and surveys completed by participants as well as a qualitative self evaluation. As the evaluation process goes on, course materials and presentations will be revised.

6. Objectives 2 and 3 will be repeated for the Spring semester.
7. The project director will share the results of the completed fall semester by presenting a paper at the CMC3-South conference. She will submit articles to various association newsletters and request feedback from instructors who are trying the ideas of the project. The director will also hold another faculty workshop, this time inviting faculty at neighboring colleges.

8. Objective 5 will be repeated after the Spring semester.

9. The project director will produce, at the end of the grant period, a final version of the curriculum manual for Calculus for Business, Biological and Social Sciences. The curriculum manual will contain classroom demonstrations, learning guides, assignments, projects, sample exams and other materials used in the course. It will include the results of the evaluation and statistical analysis of both groups of students. In addition, it will include ideas about how Theorist can be used in other courses such as the three semester calculus sequence, Finite Math or Precalculus.
5. Workplan Narrative

Work Statement

The work involved in this project will begin with the Project Director thoroughly learning the Theorist program and the Expressionist equation editor. While learning the program she will develop demonstrations, write assignments and design learning guides which develop the concepts of the Business Calculus course outline. She will also develop real world examples and projects utilizing data obtained from local companies and agencies. The bulk of this work will take place during the first six weeks of the grant period but will continue throughout the entire year. The second stage of the project will begin when classes start and the project is implemented. The students will be introduced to the Macintosh and the Theorist software. Then they will begin using the learning guides and working on assignments, including midterm and final projects using real data. During the semester, materials will be evaluated and revised based, in part, on student comments, performance and interest. The same process will be repeated with a new group of students during the second semester. Finally, a revised curriculum manual will be produced. The manual will include the objectives of the course, methods used in the classroom, learning guides for students, assignment ideas, real world examples, and ideas for student projects. It will also include an evaluation of the methods used and problems encountered. The manual will include some material on disk in the form of Theorist notebooks. The purpose of the curriculum manual is to enable other faculty to easily use the materials developed for this project and to adapt the materials for use in other courses.

The third component of the work done for the project will be to prepare and deliver talks and workshops on using Theorist. The talks and workshops will be given at conferences and during Hartnell college's professional growth days. Articles will be submitted to the newsletters of AMATYC, CMC3 and other association newsletters. The articles will outline the efforts of the project and will serve to alert faculty to the curriculum manual that will be produced. Interested faculty will then be able to request a copy of the final curriculum manual. In addition, after the project has ended, the project director will submit articles to professional publications and a paper for conferences held during the following year.
6. Expected Outcomes

Expected Outcomes of the Project

The project has both short term and long term outcomes. In the short term, students in the Business Calculus course will learn to use a tool that will improve their understanding of calculus. Gail Young of the National Science Foundation says "with freedom from the necessity of manipulative skills, more students will be able to actually use calculus in their major fields, and more graduates will be mathematically competent."6 This is especially true of non-math and science majors whose manipulative skills are often weak. A result of the increased understanding will be more student success and therefore, more spaces available in the course. Another short term outcome will be student knowledge of the capabilities and power of the computer. It is important for community college students to have the same access to technology that students in other institutions have. They must not be at a disadvantage when transferring to a four year college or university.

In the long term, the project will change the way Business Calculus is taught at Hartnell College and the change will move into other courses as well. As faculty learn about the software available and begin to find ways to use it in the classroom or in classroom-independent learning, instruction will improve. Finally, due to the emphasis on dissemination, the results of the project will move onto other campuses. The problems of low success rate in calculus and other math classes is a systemwide problem. The problem of access in times of tight budgets, and increasing enrollments is a systemwide problem. The high numbers of Business majors and their need for better quantitative skills in a competitive job market is likewise seen across the state. This project proposes some solutions to those problems and as such meets a systemwide need for improved teaching and learning in mathematics. It also addresses the question being asked by mathematics faculty across the state. "What are some appropriate ways to use technology in the classroom?" The project not only will provide specific ideas to use in the classroom, but it will expose faculty, statewide, to another option in computer software. The curriculum manual will give faculty a place to start if they wish to revise their Business Calculus class and once again, the ideas can be implemented in other courses as well.

This project is certain to continue at Hartnell College after the grant period has ended. The project will require continued funding from local funds for maintenance of the computers in the lab and the computer purchased with loan funds. However, the computers in the lab are used for a variety of courses as well as for open lab hours so the commitment for maintenance has already been made. In fact, hardware upgrades and maintenance are already in the budget for the next three years. The computer purchased with the loan funds is also in the budget and so the commitment has been made for its continued maintenance. Upgrades of the software may be available at some time and would be included as part of the department applications and site licenses budget. The project could easily continue with no funding other than these items to which the college is already committed. Ample materials will be available for any Hartnell
The flexibility of the software will allow for the course to be taught according to individual preferences. Business Calculus courses on campus could continue to be taught using Theorist and the methods used during the project.

The project could be adopted in its complete form by any college with the computer facilities and the software. The curriculum manual will describe, in detail, the objectives of the course and the methods used to achieve those objectives. It will include the learning notebooks, which lead the students to discovery of the concepts of the course, ideas for classroom demonstrations, assignments and problems obtained from real companies and agencies which use the techniques of calculus in decision making. The manual will be composed of printed pages and Theorist notebooks on disk. So not only does the course meet a systemwide need, it could easily be implemented throughout the system as well.

Schools which do not yet have the facilities for a course with a computer component, but have a single Macintosh, will be able to use Theorist as a tool for demonstrations in the classroom. For colleges with other types of computers or software, the ideas for discovery learning, cooperative learning and modeling projects will be adaptable to a variety of settings.

Potential users of the project materials will be informed of the project and the available curriculum manual during conference talks and faculty development workshops. Articles submitted to association newsletters will inform other faculty members. The materials should be as widely disseminated as possible in order to maintain and improve calculus instruction throughout the community college system.
7. Evaluation Plan

Methods of Evaluation

The program will be evaluated several times during the year. The first evaluation will come after the first six weeks of working with the Theorist and Expressionist programs. The first evaluation report will consist of a statement that preparation has been completed. This preparation will include learning guides for development of the major topics of calculus, classroom demonstrations and data and problems obtained from local companies and agencies. The evaluation will include a list of problems or limitations as well as positive aspects of the software. It will also include any limitations of the hardware being used and suggestions for overcoming those limitations. In addition the report will evaluate the ease or difficulty with which students learned to use the Macintosh and Theorist and may include a list of recommendations for making the orientation period go more smoothly. It will end with a list of areas to explore further during the semester. This first evaluation will coincide with the first Quarterly Performance Report due September 30, 1992.

The second evaluation will begin with a list of the assignments completed by students. It will describe the execution of classroom demonstrations, the students’ completion of the learning guides and assignments using the software. Using student comments, scores, quality of midterm and final projects and the qualitative observations in the project journal, the project will be evaluated. Problems that students had with the topics will be identified by student comments and analysis of assignments and exams. Successful assignments and demonstrations will also be identified using the same methods. In addition, the retention rate will be calculated and the diversity of the successful students will be compared with that of the students originally enrolling in the course. Recommendations will then be made that can be implemented in the following semester.

In addition to evaluating the instructional component of the project, the second evaluation will include a discussion of the poster session at the AMATYC conference. Problems and successes identified in the dissemination process will be identified using evaluations and comments from conference participants. Recommendations for how to improve the presentation before presenting talks or workshops will be included in this evaluation report.

The third evaluation report, corresponding with the third Quarterly Performance Report, will begin with a statement of the changes that were implemented during the second semester of instruction. It will identify any problems that are still to be found in the assignments, exams and projects. Once again the problems will be identified by student scores, comments and the project journal notes. Methods that continue to be successful will be noted. New methods or types of assignments that are successful will also be noted. Recommendations about the learning guides, assignments, exams and projects will be made for inclusion in the curriculum manual.
At least two talks will have been presented about the project. One during the January flex days to Hartnell faculty and one at the CMC3 South Conference. The evaluation of the talks will be included in the evaluation report. Effective methods of communicating the methods of the project as well as problems with the presentation will be noted. It will include any suggestions about the project made by workshop participants. Recommendations will be given for improving the talk before possibly presenting during the Fall 1993 AMATYC conference.

The final evaluation report will include all of the same components as the previous evaluation reports. A summary of the evaluation will be included in the curriculum manual. The report will also evaluate the response of workshop participants and newsletter readers to the knowledge that the project exists and a revised curriculum guide will be available. The final report will include recommendations for improvement of the curriculum and also for the adaptation of the computer component to other classes, especially the three semester calculus sequence and Finite Math.
8. Dissemination Plan

The Dissemination Plan

Dissemination of the results will begin after the course has been taught for almost a full semester. Information will be distributed by the project director in a poster session at the fall conference of the American Mathematical Association of Two Year Colleges (AMATYC). Methods and initial results will also be shared by attending the annual conference of the California Mathematics Council of Community Colleges (CMC⁹) in December.

Once the semester has been completed and an initial evaluation has been completed, a workshop will be held for Hartnell faculty. Faculty will be taught the basics of the Theorist software and will see ideas for using it in the classroom. This workshop will be held during one of the college's professional growth days. In addition, a talk will be presented at the CMC⁹ South Conference in the Spring and a workshop will be held for interested faculty at local colleges.

Articles will be submitted to the newsletters of AMATYC and CMC⁹. The articles will outline the efforts of the project. Both the articles and the talks will serve to alert faculty to the curriculum manual that will be produced. Interested faculty will then be able to request a copy of the final curriculum manual. In addition, after the project has ended, the project director will produce articles for submission to professional publications and a presentation for conferences held during the 1993-94 school year. Finally, the project director will participate in any Fall conferences and publications.
9. Budget Narrative

[NO “BUDGET NARRATIVE” ACCOMPANIES THIS DOCUMENT.]
BIBLIOGRAPHY


4 Rodi, Stephen B. “Some Systemic Weaknesses and the Place of Intuition and Applications in Calculus Instruction.” Toward a Lean and Lively Calculus. The Mathematical Association of America, 1986
