### Logic: An Interdisciplinary Approach

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<th>FUNDING CATEGORY &amp; AWARD</th>
<th>ELIGIBLE PROGRAM</th>
<th>PROJECT CATEGORY</th>
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<td>Combination = $42,839</td>
<td>E --- Improvement of Trad. Instruction Prog</td>
<td>Curriculum Design</td>
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<tr>
<th>PROJECT PRODUCT</th>
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<th>PROJECT DIRECTOR</th>
<th>PROJECT SUPERVISOR</th>
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<tr>
<td>Patrick Francois, Instructor Electronics</td>
<td>Dean Strenger, Dean Science and Technology</td>
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This project resulted in the development of an interdisciplinary, computer based logic course that is culture/gender bias free. The course has built in components to improve student success, meets general education requirements for critical thinking, improves critical thinking ability of students, is transferrable and show the relationship between humanities and the sciences.
This project is an effort to improve traditional educational programs in logic and critical thinking in response to the special learning needs of educationally disadvantaged students.

According to the Rancho Santiago College 1990/91 Catalogue, "The general education pattern reflects the conviction that those who receive degrees must possess in common certain basic principles, concepts and methodologies both unique to and shared by various disciplines." However, general education requirements, as presented, are offered as unrelated pieces, i.e. one natural science course, two English composition courses, etc. They too often fail to integrate and relate these courses, especially the relationship between science and humanities. In addition, general education classes tend to be presented in traditional formats that do not take into account students’ various learning styles. In an era characterized by diversity, in culture, age, gender and educational background, traditional monological methods of instruction are proving to be increasingly ineffective.

Philosophy 111, Elementary Logic, which satisfies the general education requirement for critical thinking, is one such course. This class has been taught in the traditional lecture format through the Philosophy Department, concentrating on the theory and concepts in formal, philosophical terms without application, experimentation, or active student involvement. Low enrollment, high attrition and teacher frustration is evidence that the course is not being presented or received in an effective manner. Even after successfully completing the class students complain that they are unable to apply the materials to their lives, transfer the skills to other disciplines, or critically interpret the material for themselves. Thus, the usefulness of this course as a means to improving students’ critical thinking ability is devalued.

In response to this, a team of philosophy and electronics instructors propose to:

a) develop a logic course that shows the important relationship between humanities technology by integrating materials from philosophy and electronics;

b) use computer based instruction to broaden the course’s appeal to students with diverse learning styles; and

c) emphasize the importance of logic as a means to improving one’s critical thinking ability.
The expected outcomes of this project are the development of an interdisciplinary, computer based logic course that is culture/gender bias free, has built in components to improve student success, meets the general education requirement for critical thinking, improves critical thinking ability, is transferable, and shows the relationship between the humanities and the sciences. To measure the success of the course, the instructors will seek to improve the retention of students by 25% compared to semesters when the course was taught solely within the discipline of philosophy and before computers were used. To measure the improvement in critical thinking ability, students will be given a pre- and post- standardized reasoning test. An average 5% increase will indicate a significant improvement in reasoning ability.

The curriculum, lab specifications, lab manuals and a report on the outcomes of this project will be made available to all interested community college faculty or other parties. In addition, a presentation will be made at a minimum of two educational conferences.

In addition to a request for FII grant funds ($14,993) to develop and pilot this course, the college is requesting a loan ($27,846) for equipment to help complete a partially equipped lab that will be utilized for this class. The college match ($16,915) will be used to complete the pilot testing of the course.
LOGIC: An Interdisciplinary Approach

1. Specific Educational Program Being Addressed

Specific Educational Program Addressed

This project primarily addresses one item on the list of eligible programs because it is an effort to improve traditional instructional programs in logic and critical thinking. It is also partly a response to the special learning needs of educationally disadvantaged students. Because of their diversity in culture, gender, age, educational background, and learning style they suffer more than most from the limitations of the traditional classroom. The strategies for improving logic instruction that will be developed as a result of this project require utilizing nontraditional forms, content, and methods of instruction, as well as improving teaching abilities of faculty members.
2. Specific Problems Being Addressed

Specific Problems to be Addressed

PROBLEM #1 As stated in the Rancho Santiago College 1990/91 Catalogue, "General Education is designed to introduce students to the variety of means through which people comprehend the modern world. The general education pattern reflects the conviction that those who receive degrees must possess in common certain basic principles, concepts and methodologies both unique to and shared by various disciplines." However, general education requirements, as presented, are offered as unrelated pieces, i.e. one natural science course, one American government course, two English composition courses, etc. General education programs too often fail to integrate and relate these courses. Students commonly fail to see the "big picture" because this piecemeal approach does not reveal the connection between humanities and science and technology. Moreover, teachers working in isolation find it hard to convey the common values that are the point of general education.

PROBLEM #2 By the time they reach college, students have generally identified themselves as science/technology students or are pursuing an humanities/liberal arts education. The decision to chose one path or another may not be the result of success or failure in either but, rather, a predilection toward one cognitive learning style over another. Sheila Tobias, in a study that followed humanities majors at the University of Arizona through selected science courses discovered that, "many of her subjects demonstrated outstanding abilities in science and mathematics. But all were put off by the ethos and design of science instruction. One student complained that a physics professor had neglected to explain 'how the concepts were related'...Another student attributed his boredom to the lecture format used in large classes and a curriculum devoid of opportunity for 'personal expression'." In an era characterized by diversity, in culture, gender, age and educational background, traditional monological methods of teaching are proving increasingly ineffective. Now, with far-reaching demographic changes underway, cognitive diversity cannot be ignored and must be incorporated into the development and delivery of core curriculum.

PROBLEM #3 "Critical Thinking" as defined by Robert H. Ennis in "A Taxonomy of Critical Thinking Dispositions and Abilities," is "reasonable reflective thinking that is focused on deciding what to believe or do." This definition makes it clear that critical thinking is supposed to be used daily and applied to decisions in and out of the classroom. The ability to think critically crosses disciplines and bridges gaps between theory and practice. Logic is one of the most important ways of teaching critical thinking. As traditionally taught, the course has concentrated on the theory and concepts in formal, philosophical terms without application, experimentation, or active student involvement. Low enrollment, high attrition, and teacher frustration are evidence that the course is not being presented or received in a manner that meets the needs of the students, faculty, or college. Even after successfully completing the course most students complain that they are not able to apply the material to their lives, transfer the skills learned to other disciplines, or critically interpret the material for themselves.
The usefulness of this course as a means to improving students' critical thinking ability is thus devalued.

Solution In light of these problems, this project proposes to develop an interdisciplinary, computer-based approach to teaching formal logic as a means of improving critical thinking. The course will be developed and taught by a team of faculty from the philosophy/humanities division and the electronics/science and technology division. By taking this approach, these faculty members will:

a. Develop a course which shows the important relationship between humanities and technology by integrating material from philosophy and electronics. This course will give students a better "general education" by examining how seemingly unrelated principles, concepts and methodologies are actually shared values and ideals that hold the various disciplines together.

b. Use computer assisted instruction to broaden the course's appeal to students with diverse learning styles. The curriculum will be designed to be free of gender, cultural and ideological bias that often effects individuals' ability to learn. By using the computer, the instructors will be able to incorporate many learning strategies into the curriculum. Computer assisted instruction will allow:

1) interactive homework with prescriptive feedback;
2) projects which combine logic theory and practice, giving students a more concrete, synoptic and creative understanding of logic.
3) personalization of assignments for individual students;
4) demonstration of inductive principles and reasoning skills that are vital to understanding formal reasoning but are difficult to teach by lectures alone.
5) metacognitive projects involving programming and editing logic software
6) clear exemplification of predicate calculus and computer thinking by showing their interrelationship.

The curriculum and computer use will also incorporate group learning, which has been shown to be an effective strategy for teaching culturally and educationally diverse students. Studies have shown that when students are able to work in complimentary and cooperative groups they make much easier, better and more rapid progress towards actually using and applying logic, and come to a more meaningful, real world grasp of inquiry. The material to be developed will emphasize the cooperation, practice and dialogue among students. These materials will incorporate group reasoning activities and problem-solving techniques, hands-on application and experimentation with logical abstractions, and the development of communities of inquiry.

Finally, the team teaching approach will enhance and complement various learning styles. It allows students to:

1) experience different individual teaching techniques;
2) experience different discipline related teaching techniques and viewpoints;
3) receive more personalized assistance, i.e. two instructors are available to provide help; and
4) develop a multi-logical perspective on their disciplines and their relationship to complex realities.

c. Emphasize the importance of logic as a means to improving one's critical thinking ability. This course will stress the active, self-conscious, interrelationship of several languages and logics from several disciplines. Students will be taught to think in:

1) college English;
2) computer English;
3) syllogistic logic and statement calculus English; and
4) digital logic as it applies to digital-based systems.

They will also be taught to transfer back and forth among these languages. And, by teaching students to creatively and critically interrelate the results of thinking from these different frames of reference, they will be better able to transfer these skills to other classes and to their own lives.
3. Population To Be Served

Population Served

This course will satisfy the General Education requirement for critical thinking skills and will thus serve students completing the requirements to transfer or receive an Associate of Arts degree. It is expected that this course will especially appeal to science and technology majors completing their general education requirements and to humanities and philosophy majors. Special efforts will be made to recruit diverse students including those with English as a second language who will be able to benefit from the various teaching strategies that will be incorporated into the class. Faculty will also encourage enrollment of vocational students who need reinforcement in theory and abstract systems, and other students who are having difficulty laying a basic skills/learning foundation because they cannot translate between various frames of reference.
4. Objectives

Proposed Objectives

a) To develop a logic course that is interdisciplinary, computer based and combines various learning strategies to improve diverse students’ critical thinking ability.

b) To pilot test, revise and institutionalize the course by presenting it to a diverse group of students.

c) By developing and offering this new logic course, improve the retention of students in the logic course (compared to past semesters) by 25% and improve students’ reasoning/critical thinking abilities by 5%, and measured by a standardized reasoning test.

d) To disseminate the curriculum, support materials and other pertinent information to other interested faculty and organizations.
5. Workplan Narrative

[NO “WORKPLAN” ACCOMPANIES THIS DOCUMENT.]
6. Expected Outcomes

Expected Outcomes

a. Objectives

1) Development of an interdisciplinary course in Elementary Logic -
By developing this course, the college will have a course that shows the relationship between the humanities and science and technology while improving students' ability to think logically and critically in all of their studies. The course will be developed using models from student success, classroom based research which emphasizes multiple learning strategies which eliminate cultural and gender bias from the curriculum.

2) Pilot testing of the logic course -
Extensive pilot testing and revision of the course, the course materials and the adopted software programs will ensure that this course effectively meets the needs of students and achieves the desired outcomes. These outcomes include, a course that is culture/gender bias free, has built in components to improve student success, meets the general education requirements for critical thinking, improves critical thinking ability, is transferable, and shows the relationship between the humanities and the sciences.

3) Improving the retention of students in the course and their reasoning ability -
The goal of this course, in measurable terms, is to significantly increase the persistence of students toward the completion of the logic course by presenting it in a manner that incorporates different students' learning styles. The completion rate of students in this class will be compared to semesters when the course was taught solely within the discipline of philosophy and before computers were used. A 25% increase in the successful completion of the course is planned.

In addition, the instructors will attempt to improve students reasoning ability, as measured by a standardized reasoning test, by an average of 5%. This no amount is considered very significant because improving a person's ability to reason and showing an increase on a standardized test, is similar to improving an individual's intelligence, and showing an increase on an intelligence quotient test.

4) Dissemination of the curriculum and project results -
The project faculty plan to develop a unique program for introducing the concepts of logic and improving the critical thinking ability of both liberal arts and science/technology oriented students. The resultant curriculum and report should be of significant interest to other community college faculty. Toward the end of the project, and beyond the funding period, the project faculty will disseminate the written materials to other interested institutions. In addition, they will make presentation to at least two educational organizations.

b. Impact of the Project
In an era characterized by diversity and change, this course will incorporate many of the theories and practices that are proving to positively impact the success of students. New technologies allow faculty members to design courses, programs and classroom strategies tailored to a full spectrum of cognitive styles. Presenting traditional courses in a non-traditional manner, such as through team teaching and the use of an interdisciplinary approach, gives students a broader perspective on the subject matter by showing the relationship of the subject to other disciplines. This is especially important for a class, such as logic, which is meant to be a building block which increases students' ability to reason in all of their other courses as well as in their own lives.

c. Potential for Continued Support

Once the appropriate equipment is purchased and the curriculum developed, this project will require no additional external support. The course will be institutionalized by the college and will become a regularly offered course. The curriculum will be presented to the appropriate articulation councils for approval by four year colleges and universities as a transferable course.

d. Potential for Adaptation

With the appropriate faculty, equipment and software, and the curriculum designed by these faculty members, could be incorporated into the curriculum of any California community college. The information needed to establish this course at other institutions will be made available through the dissemination process.
7. Evaluation Plan

Evaluation Plan

a. Formative Evaluation

The following milestones will be used to evaluate the development of this project.

1) Project staff will meet the target dates as outlined in the Work Statement.
2) The curriculum that is developed will be approved by the Diversity Resources Specialist.
3) The curriculum that is developed will be approved by the Gender equity Coordinator.
4) The curriculum that is developed will be approved by the Curriculum Council.
5) The curriculum will be successfully articulated to appropriate colleges and universities.

b. Summative Evaluation

The evaluation of the outcomes of this project will be measured by the following:

1) An increase in retention of students in the class by 25% as compared to retention levels of students in the logic course before it was interdisciplinary and computer based. This will be accomplished by the completion of the second round of pilot testing.

2) An average increase of 5% on the adopted standardized reasoning test based on a pre- and post-testing of students in the class. This will be accomplished by the completion of the second round of pilot testing.

3) An average 7% increase in score from the pre-class writing sample to the post-class writing sample. This will be accomplished by the completion of the second round of pilot testing.

4) Above average student evaluations of the course.
8. Dissemination Plan

Dissemination Plan

The curriculum, support materials and a report on the outcomes of the project will be developed by the project staff. This report will be distributed, upon request, to the Chancellor's Office, other community college faculty, and university faculty.

In addition, project staff will make at least two presentations at educational conferences. These may include the State Academic Senate Conference, the Critical Thinking Conference at Sonoma State College, the CCCCTIN, the California Vocational Association of Community Colleges.

Finally, the project staff will make a presentation to faculty and staff at Rancho Santiago College as a staff development activity.
91-0020

9. Budget Narrative

[NO “BUDGET NARRATIVE” ACCOMPANIES THIS DOCUMENT.]