CALIFORNIA COMMUNITY COLLEGES
AND
PERALTA
COMMUNITY COLLEGE DISTRICT

#87-0207

PROJECT TITLE

Development of a Computer-Aided Instructional Methodology (CAI) for Teaching Beginning Algebra to Blind Students

FUNDING CATEGORY & AWARD: Grant = $35,222

ELIGIBLE PROGRAM: A2 --- Individualized Instruction

PROJECT CATEGORY: Curriculum Design

PROJECT PRODUCT: Computer Programs

PROJECT TOPIC #1: CAI

PROJECT TOPIC #2: Disabled Blind Students

ACADEMIC SUBJECT: Mathematics

PROJECT DIRECTOR: Bett Lujan Martinez, Project Director

PROPOSAL DESCRIPTION

The purpose of this proposal is to develop a nontraditional audio-tactile method of instruction in beginning algebra for blind students using personal computers combined with voice synthesizers, as well as tactile adjuncts--braille, raised graphics, hands-on manipulatives--for communicating highly-visual concepts.

Under last year's FII Grant (1986-87), the Vista project team redesigned Modules 1-3 of a ten-module CAI tutorial program.

A speech code for mathematics was devised, approved and accepted by our network of advisors and resource persons. Research has uncovered some tactile materials which are currently used in math instruction, which will be incorporated.

With continuation funding, the project team plans to complete Modules 4-10.
Development of a Computer-Aided Instructional (CAI) Methodology for Teaching Blind Students Beginning Algebra at Vista College

The purpose of this project is to develop a non-traditional audio-tactile method of instruction in beginning algebra for blind students, using personal computers combined with voice synthesizers, as well as tactile adjuncts - braille, raised graphics, hands-on manipulative - for communicating highly visual concepts. Blind students will then be tested in a manner which will allow them to demonstrate competence in basic skills in algebra on a comparable basis with their sighted peers (Basic Agenda Addendum #1, Excellence, and Title 5, Section 56026).

Under last year's FII Grant ('86-'87), the Vista project team redesigned Modules 1-3 of a ten-module CAI tutorial program developed by Dr. Herb Garrett at Long Beach City College (LBCC). We met with Dr. Garrett, reviewed the program, and converted it from Apple to IBM-PC. Our blind math specialist found the program to be highly visual, and a blind programmer/analyst was hired to redesign it. A speech code for mathematics was devised, approved and accepted by our network of advisors and resource persons (See Appendix I). Research has uncovered some tactile materials which are currently used in math instruction. which will be incorporated.

With continuation funding, the project team plans to complete Modules 4-10. Due to extensive modifications necessitated, our advisors have recommended the addition of a math textwriter to our staff. Resource persons will aid us in developing a condensed Nemeth (math) code format for algebraic symbols, to allow braille users to make notes and computations. Additional tactile adjuncts will be reviewed and integrated as appropriate, to make visual concepts accessible to both braille and non-braille users.

As each Module is developed, evaluations will be made by blind math specialists, educators and programmers, as well as educators of the blind, then tested by students for comprehensibility.

With the new CAI algebra materials developed, students will be able to sit down at interactive microcomputers, receive both audio and tactile instruction, work through algebraic concepts at their own pace, and demonstrate competence in tests designed to be compatible with the tutorial.
The population to be served includes high school students; older re-entry students, many of them clients of the Department of Rehabilitation seeking to complete the GED; and blind college students preparing to transfer to four-year colleges.

In the course of our research, educators throughout the country have acknowledged that, with the advent of mainstreaming, algebra has proven a stumbling block to blind students. [Appendix II] If the cooperation generated in the course of developing this breakthrough project is any indication, the completed algebra tutorial may well be accepted nationwide.

This project adds to the unique program offerings for the blind at Vista College, including a computer laboratory which gives blind students the opportunity to function independently. Forty totally blind and 40 visually impaired students have been referred from throughout the Greater Bay Area. Bev Hammer, Counselor-Enabler of Disabled Students, herself blind, is active in many organizations of and for the blind; thus, information about the program will be disseminated throughout the state.
Development of a Computer-Aided Instructional (CAI) Methodology for Teaching Blind Students Beginning Algebra at Vista College

1. Specific Educational Program Being Addressed

Vista College Algebra Project
Educational Program or Services Addressed
1. The purpose of this project is to devise a non-traditional method of instruction for teaching algebra which will address the special learning needs of the increasing number of blind students who are seeking employment in areas of technology where a solid mathematical background is necessary. The methodology to be devised will improve and expand the traditional algebra instruction now available in community colleges. The project will develop and evaluate a technique for presenting algebraic material which will interact with the blind student more effectively than the traditional classroom mode, by using IBM-Personal Computers, raised graphics and hands-on manipulatives.

2. The algebra project is redeveloping the Computer-Aided Instructional auto-tutorial program developed by Dr. Herb Garrett at Long Beach Community College (LBCC). (See Appendix III). This program was funded by FII.

3. Although we have met with Dr. Garrett, and continue to consult with him, this project is not a consortium effort.

4. The project staff continues to consult with the network of advisors and resource persons already developed (See Appendix I & II). Evaluators include Jay Yi, Anmin Qi, Don Queen, Tom Kellis, Dr. Steve Smith, and Dr. Carol Gothelf. David and Navy Halladay, as well as Jay Yi, will assist in the development of a condensed format of Nemeth, the Braille code specifically designed for math, which will incorporate the algebraic symbols utilized in the tutorial, in order that braille users may take notes and do computations. Tom Kellis will help us to contact organizations manufacturing and utilizing raised graphics in Math Instruction. We will review Mordenson math, a system of hands-on manipulatives for algebra, and will be visiting the company in Chatsworth,
CA., for the purpose of adapting these materials for use by blind students. We will be contacting former instructors from Fremont School for the Blind (now serving only multiply handicapped blind students) as well as the Hadley School in Winnetka, Ill., to review their methods of teaching algebra, in order to adapt what may be useful for our tutorial program.

Basic Agenda Addendum

In accordance with the Board of Governor's Basic Agenda Addendum, 1987, this project will address Goal #1, Excellence. In the development of non-traditional methodology of instruction for beginning algebra, the project director will work with math teachers at Vista as well as district and state specialists to improve academic quality by insuring that the tutorial meets all operational definitions of basic skills instruction in algebra, including development of tests which are compatible with the tutorial and adapted to the disabled needs of blind students (Title V. Section 56026. Special Services (h) ).
2. Specific Problems Being Addressed

Specific Problems

1. Most blind students fall within the purview of Title V and AB 1173 in that they are educationally disadvantaged. This is true largely because of the tremendous impact of transferring blind children with no other handicaps from residential to public school programs. As in any abrupt transition, many blind students were victims of inadequately trained teachers and of curricula offered in traditional ways, which they were often unable to grasp as thoroughly as would sighted students of comparable intelligence. A typical example is the difficulty that many blind people have with beginning algebra because the symbology is almost exclusively pictorially represented in the classroom, and they are unable to review the formulas visually in the way sighted people do.

Vista College currently offers a mathematics laboratory which is self-paced. Each student is given an evaluation at the outset of the course to determine his/her placement level. Many blind students have enrolled in this lab, but no blind student has ever completely succeeded in mastering elementary algebra. These students are provided with readers and brailled or taped texts, according to their preference, but even this support does not appear sufficient to help them through.

2. The desired outcome of this project is an audio-tactile CAI methodology for communicating algebraic concepts successfully to blind students to be made available as a self-paced tutorial in Vista's self-paced computer center; also, development of a testing procedure which is compatible with the tutorial program and which will allow blind students to demonstrate competence within the operational definition of basic skills instruction in algebra on an equal and comparable basis to their sighted peers. (See section on Basic Agenda Addendum below.)

3. Current practice: Vista College has in its computer center a unique and successful laboratory program for blind students, taught by two blind instructors. Courses include programming in Basic, data-base management, and word processing. Blind students may work independently in the computer center with the aid of voice synthesizers, a braille printer, taped and brailled texts. Vista has the only program of this kind in Northern California and students are referred here from throughout the Greater Bay Area. This program provides a solid base for the algebra project.

The project itself is breaking new ground and there is no existing literature. Our research has included contact with schools for the blind (Hadley, in Winnetka, Ill., and California School for the Blind in Fremont, CA.), colleges (e.g. Baruch and Boston College) with specialized training programs, and organizations of and for the blind (e.g. California Council of the Blind, Jewish Guild for the Blind, N.Y.C.), as well as companies manufacturing devices for the blind (e.g. V-Tek and Computer Aids, Inc. Springfield, Md) and including blind educators (e.g. Sally Mangold of S.F. State). All applaud our efforts as "breaking ground in a much needed area".
Prior to the inception of this project, there was no commonly accepted speech code-for mathematics which could be read by a voice synthesizer using any of the currently available speech software programs. An example, the visual symbols "+" and "-" could be verbalized as either "plus" and "minus" or "positive" and "negative", depending on the context. These difficulties have been resolved by our project team in a manner that has been approved and accepted by our evaluators.

Braille, on the other hand, has devised a code specifically designed for math symbols, Nemeth code. The project team, with the assistance of our resource persons, plans to develop a format specific to Algebra, which can be learned by any braille reader, without the cumbersome necessity of mastering the entire Nemeth code.

Since the project is so innovative, several publications have expressed interest in our findings, including Technological Horizons in Education (T.H.E.) Journal, and Personal Computer News, and "The Catalyst" journal of the Western Center for Micro-Computers in Special Education, Inc.
3. Population To Be Served

Population Served

Currently, Vista has 40 totally blind and 40 visually impaired students referred to Vista's unique computer programs from throughout the Peralta College District. Bev Hammer, Counselor/Enabler for the Disabled Students Program at Vista, has regular contact with organizations of and for the blind throughout the state. She will publicize the program to recruit students, including older working adults who are re-entering and wish to upgrade their skills, as well as high school students who do not have these computer resources available within their own schools.

The Disabled Students Program also has excellent working relationships with counselors for the blind in Department of Rehabilitation Offices throughout the East Bay and in San Francisco, who will make referrals, particularly of client/students needing to complete the GED. The Orientation Center for the Blind will provide referrals. Increasing numbers of disabled students are eager to transfer to four-year colleges and need algebra as a prerequisite.

Currently, there are about 4,200 children registered in public schools in Northern California who are listed as blind or visually impaired, according to the California State Clearing House Depository for the Blind. The majority of these children will be required to study algebra in mainstream classes in the course of their education, and numbers of them will fail for reasons given previously. Added to this figure is the number of adults, 18 and over, who take beginning algebra in college or as a requirement for completing the GED. Berkeley is known for its sizable population of disabled individuals, including the blind. The teacher is Vista's computer lab currently has a waiting list of 20 students for her classes.

Moreover, although the CAI algebra program will be designed for use by blind students, it will also be available as a tutorial through Vista's Math Lab to students with learning disabilities such as dyslexia, since these students also typically tend to have difficulty in comprehending visual concepts and pictorial symbology.
4. Objectives

Objectives

The proposed project will have five objectives:

1. By October 15, the project team will write, program and evaluate Modules 4 and 5. These modules will be evaluated first by a blind math specialist (B.A. UC-Berkeley, Applied Math), math educators for the blind and blind educators, as well as blind programmers (See Appendix, Advisors and Resource Persons).

   COST TO COMPLETE THE OBJECTIVE: $8,600

2. By December 15, the project team will complete an evaluation of tactile adjuncts in preparation for Modules 6 and 7, which are highly visual and graphic. Research will include: consultation with schools for the blind throughout the U.S., with braille specialists, with manufacturers and users of raised graphics and hands-on manipulative materials for math instruction.

   COST TO COMPLETE THE OBJECTIVE: $5,575

3. By January 30, the project team will complete Modules 6 and 7, Linear Systems and Graphing Linear Equations, which present the greatest barriers to the blind in comprehending algebra. Tactile materials will be incorporated as appropriate. The modules will be presented to professional and student evaluators and modified according to their reactions. A mid-term progress report will be submitted.

   COST TO COMPLETE THE OBJECTIVE: $7,982

4. By May 15, the project team will write, program and evaluate Modules 8, 9, and 10.

   COST TO COMPLETE THE OBJECTIVE: $10,502

5. By June 30, the project team will complete the algebra tutorial materials, and work with Vista’s math lab, as well as district and state-wide specialists to ensure that the tutorial and test materials as integrated in Vista’s program, will be comparable for blind students to have the equal opportunity to demonstrate competence on a comparable basis with their sighted peers. Evaluation and documentation of the program will be completed and dissemination materials will be packaged and distributed.

   COST TO COMPLETE THE OBJECTIVE: $8,681
5. Workplan Narrative

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

Expected Impact and Transferability
Flipper Software employed in the development of this project will be purchased by Vista College for the use of blind students in the computer lab.

1. The project team plans to apply for continuation funding in order to transfer and adapt the methodology developed by the algebra project to the teaching of accounting "spread sheets" for blind students. Of the major vocationally-oriented computer courses currently offered at Vista College, spread sheets (such as Lotus 1-2-3) is the only course totally inaccessible to blind students.

2. After the expiration of the grant, Vista College will need no additional personnel for continuation of the project. Project material will be housed in the computer lab where it will be available to blind students under the supervision of the Disabled Student Center personnel.

   The Disabled Student Center personnel will work with the Department of Instruction and the math instructors to incorporate the materials developed by this project into the mainstream algebra class.

3. After the initial stumbling block to the comprehension of algebraic concepts is removed via the project methodology, blind students who complete beginning algebra should be able to continue intermediate algebra successfully in mainstream classes, with traditional supports.

Since the requirement of completing algebra is nearly universal in the educational system, the CAI program will benefit any blind student, from seventh grade through university, who is having difficulty in mainstream math classes.

Organizations of the blind throughout California are becoming increasingly concerned about the quality of education of blind students. Once this methodology is devised, the Disabled Student Center at Vista College will solicit the support and advocacy of these organizations to ensure the use of project materials by California schools and colleges. In the course of research conducted in the development of this project, sufficient interest has been expressed to indicate that the successful development of this project will have national impact on the education of blind students.

The Counselor/Enabler at Vista College will meet with Ed Roberts, Director of the World Institute on Disability, whose offices are located in Berkeley, to discuss the international impact of this project.
7. Evaluation Plan

Evaluation Plan

1. The coordinator of the Disabled Student Services of the Peralta Community College District will select two appropriate District personnel to meet quarterly with the project team and to serve on the final evaluation committee.

   Vista’s Disabled Student Center personnel will work with the Office of Instruction to include one Vista math instructor and math specialists from the District and the State in quarterly meetings with the project team to ensure compatibility with the current Vista math program, as well as operational definitions of basic skills instruction in algebra.

2. In accordance with recognized procedures in software development, the project director, program analyst and textwriter will submit each module to a critical evaluation - first by our math specialist, Jay Yi, then by math resources specialist Tom Kellis, who will test the modules on a newly blinded algebra student; next, the module will be critiqued by Don Queen, a blind programmer; then by three Vista students. Arrangements are being made for additional evaluations under the auspices of the Jewish Guild for the Blind, as well as Baruch College and possibly Boston College.

   Each critique will be recorded by the clerical assistant. In case of any questions about the advisability or feasibility of adjusting the program, a meeting will be held of local advisors, and the problems will be presented and discussed until an agreement is reached. Each module will then be modified by the textwriter and programmer until it satisfies the evaluators and is deemed comprehensible by the students. Final approval will be reserved until the following year, as it is integrated into the math lab at Vista, and other schools.

3. As the project is completed and finalized (in June, 1988), the algebra tutorial will be publicized locally and published in the Vista Catalog Recruitment will begin for Fall, 1988.
8. Dissemination Plan

Information for Dissemination

In addition to the semi-annual reports required by the State, the project director will:

1. Prepare an information packet on the project and disseminate to community colleges, other appropriate schools and organizations of and for the blind, offering the materials developed by the project at cost to any interested institution.

2. Prepare an article on the project for journal publication, e.g. "T.H.E." and the district and community college Publications.

3. Be available, along with the project team, for presentations to conferences, schools and organizations concerned with disability, computers and education.

4. Prepare an abstract for the League for Innovation in Community Colleges.

5. Make the program available, as a demonstration, to Carl Brown, of the Hi-Tech Center in the Chancellor’s office.
9. Budget Narrative

[NO "BUDGET NARRATIVE" ACCOMPANIES THIS DOCUMENT.]