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ABSTRACT

This publication describes awards made in the National Science Foundation's Division of Science Education Development and Research in FY 1980, FY 1979, and in earlier years. Two indices are contained in the first section. The first index is a rotated title index to every award in the publication. Every significant word in each title is an entry point into the index. The second index is a standard keyword/phrase index for FY 1980 awards only, using ERIC descriptors as well as proper names. All projects awarded in FY 1980 in the Development in Science Education (DISE) and Research in Science Education (RISE) programs are listed in the second section. A summary description of each project is provided, along with the names and addresses of principal investigators, amount of funding, duration of the project, discipline, target audience, and descriptors. Projects are listed alphabetically by state and institution within each program, RISE and DISE. Titles and principal investigators of RISE and DISE projects funded in FY 1979 are provided (alphabetically by state and institution) in the third section. Separate lists of principal investigators by state and institution for 1979 and 1980 and an alphabetical list of principal investigators are provided in appendices. (Author/JN)

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Source Book of Projects Science Education Development and Research

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Fiscal Year 1980
With References to Earlier Years

NATIONAL SCIENCE FOUNDATION
Directorate for Science and Engineering Education
Division of Science Education
Development and Research

SE 80-81

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EO39579

This publication presents a description of awards given by the Division of Science Education Development and Research (SEDR) during Fiscal Year 1980, including award amounts. All references made in this document to actual award amounts are subject to adjustment by financial statements prepared by NSF at the close of Fiscal Year 1980.

Division-initiated funding actions excluded from this report are:

Purchase Orders
Funds for Personnel (Intergovernmental Personnel Act)
International Travel Awards

Awards which received support from organizations within or outside the Division show the source of that support.

The following definitions apply:

"Award" refers to financial support given in the form of a grant, contract, or other arrangement, depending upon the nature of the research or development work to be completed and the terms of performance.

"Principal Investigator" refers to the individual designated by the awardee (and approved by NSF) who is responsible for the scientific or technical direction of the project.

"Institution" refers to any college, university, public or private laboratory, industry, or other organization, whether operating for profit or on a non-profit basis, as well as State and local governments and Federal organizations.

NOTE: Data for this report were taken from program records and therefore may differ from official National Science Foundation source documents which are generated from the Management Information System data base containing different inclusions/exclusions.

The reader is reminded the primary source of further information on a project is the Principal Investigator in each instance, who may be reached at the academic address given.

CONTENTS

FOREWORD

The National Science Foundation's Science and Engineering Education Directorate has the responsibility for enhancing the vitality of all levels of science and engineering instruction across the Nation. The two major goals of the Directorate are:

- To assure a stable flow of the most talented students into careers in the sciences, with particular reference to increasing the participation of minorities and women; and
- To help all citizens increase their basic understanding of science and its contributions to the quality of life.

Science education research and development support are two of the principal mechanisms the Foundation uses to implement the goals. The aim of this support is to develop new knowledge and new means for improving science and engineering education. Innovation, transferability, and potential for widespread impact are especially characteristic of development projects, while usable results are important to the research program.

The purpose of this document is to promote awareness of and interest in recent activities in science and engineering education development and research. We hope it is useful to a variety of groups including developers and researchers, future proposers to the Foundation, and teachers of science at all levels.

Walter L. Gillespie
Acting Assistant Director
for Science and
Engineering Education

INTRODUCTION

The objectives of the Division of Science Education Development and Research (SEDR) are to develop new means for improving science education at all levels, and to further basic understanding of science teaching and learning. Progress is sought by:

- Developing innovative technologies, instructional materials, methods of instruction, and ways to increase participation in science; and
- Generating new knowledge and theory as a basis for improvements in science education.

The quality of life increasingly depends on science and its related technology. The health of science, in turn, depends on the quality of science education. Due to rapid changes in science and society, science education must be continually modified through development and research. Both are needed to introduce new knowledge of the educational process, to prepare people for new science-related tasks and problems, to translate scientific knowledge into a form that can be understood and learned, and to capitalize upon new insights into the way we learn. Both development and research in science education are needed to assure that people will be able to cope with and enjoy the benefits of our technologically based society.

The Science Education Development and Research Division in fiscal year 1980 and fiscal year 1981 is targeting several areas of emphasis which relate directly to the goals stated in the Foreword for the Foundation's Directorate for Science and Engineering Education.

For both development and research these areas of emphasis include:

- Science Literacy—and the Relation of Science to Society—To assist all citizens in coping with and enjoying both our technological society and the natural world, and to understand the relationships at the interface of science and society.
- Career Access - With special concern for participation of minorities, women, and the physically handicapped, to assure a stable flow of talented individuals into science careers, and to maintain their effectiveness through continuing education.

- Technology in Science Education - To exploit the potential of the rapidly advancing information technologies for improving science (especially mathematics) learning, and to help people use these technologies effectively.

- Early Adolescence - This age group is also highlighted in the above three areas of emphasis because of the importance and past neglect of junior high school science instruction. It is at this age that most U.S. children receive their last formal science instruction.

Also pervading both development and research activities is an increasing concern with efforts to disseminate knowledge generated by these activities to those responsible for science and engineering education. This document is made available as one response to this concern. It is expected that the information it contains will be interesting to a spectrum of persons concerned with science and engineering education at all levels.

Joseph I. Lipson
Division Director

USING PUBLICATION SE 81-80

This publication describes awards made in the National Science Foundation's Division of Science Education Development and Research in Fiscal Year 1980, in Fiscal Year 1979, and in earlier years.

Section I. *Indexes.*

This section contains two indexes. The first index is a rotated title index to every award in this publication. Every significant word in each title is an entry point into the index. For example, the title "Factors Influencing Mathematics Participation of Highly Able Mexican-American Adolescents" would appear eight times in the index, once at each of the meaningful words. This index gives subject access to the awards through their title words, and unlike usual subject indexes, supplies the reader with the key word in context.

The second index is a standard key-word/phrase index for FY 1980 awards only. The FY 1980 awards contained in Section II have been assigned key words and phrases from the *Thesaurus of ERIC Descriptors*, as well as some additional terms, such as proper names.

The indexes are keyed to descriptions of related projects contained in Sections II and III. It should be noted that summary descriptions are provided of projects awarded in FY 1980 (Section II), but only titles are shown of projects awarded in FY 1979 and earlier (Section III).

Section II. *Projects awarded in Fiscal Year 1980 in the Development in Science Education (DISE) Program and the Research in Science Education (RISE) Program.*

A summary description of each project is provided, along with the name and address of the Principal Investigator, the amount of funding, and the duration of the project. DISE Program project descriptions begin on page 39; RISE Program project descriptions begin on page 114. Projects appear alphabetically by State and Institution within each program, RISE and DISE.

Section III. *Projects awarded in Fiscal Year 1979 and in earlier years in the Development in Science Education (DISE) Program and the Research in Science Education (RISE) Program.*

The title of the project and the name and address of the Principal Investigator are provided.

DISE Program project titles begin on page 161; RISE Program project titles begin on page 186. Projects appear alphabetically by State and Institution within each program.

Appendix A. *Fiscal Year 1980 Awards, Principal Investigators by State and Institution.*

This appendix is provided as an index to location of projects. It is an alphabetical listing of States, and under each State are given the Institutions and Principal Investigators whose projects were awarded during FY 1980.

Page references direct the reader to summary descriptions of projects contained in Section II.

Appendix B. *Fiscal Year 1979 and Earlier Years' Awards, Principal Investigators by State and Institution.*

Like Appendix A, this appendix is provided as an index to location of projects. It is an alphabetical listing of States and under each State are given the Institutions and Principal Investigators whose projects were awarded during FY 1979 and earlier years, under the DISE and RISE Programs.

Page references direct the reader to titles of projects contained in Section III.

Appendix C. *Principal Investigators, Alphabetically.*

This section is provided as an additional index to projects awarded in FY 1980, in FY 1979, and in earlier years.

Section I

Rotated Title Index
Fiscal Year 1980 and Earlier Years' Awards

Key Word/Phrase Index
Fiscal Year 1980 only

Rotated Title Index FY 1980 and Earlier Years

Rotated Title Index FY 1980 and Earlier Years

Rotated Title Index FY 1980 and Earlier Years

Rotated Title Index FY 1980 and Earlier Years

Rotated Title Index FY 1980 and Earlier Years

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Rotated Title Index FY 1980 and Earlier Years

Key Word/Phrase Index
Fiscal Year 1980 only

Key Word / Phrase Index FY 1980 Awards

Key Word / Phrase Index FY 1980 Awards

Section II

FY 1980 Awards

Project Descriptions and Principal Investigators by Program, and State and Institution

Early Learning (Grades 2-3) of Geometry and Logic, Using Microcomputers

Ann Piestrup
Advanced Learning Technology
13800 Skyline Boulevard
Woodside, CA 94062

Young children can learn mathematics in a playful, interactive manner using today's microcomputers. Games, inquiry learning sequences, and puzzles can be programmed on a low-cost, powerful computer with color graphics, natural sounding speech, music, and a variety of input devices. Children can use a joystick, a graphics tablet, a light pen, and a special children's keyboard to explore mathematics concepts.

The project will develop microcomputer software which will enable children aged 7 and 8 to discover geometry concepts and to develop logical thinking. The microcomputer programs will be paced and sequenced to provide a dynamic learning environment for young children.

Some computer programs will be prepared in three versions: with standard English, Black standard English, and Spanish voice prompts. Teachers' manuals for each program will be written in Spanish and English. The programs will be designed for gifted children as prototypes of a mathematics enrichment curriculum on microcomputers. Commercial publication will be sought.

AMOUNT: $130,000*
AWARDED: 709-10-80
TERMINATES: 02-28-82

AWARD NUMBER: SED80-12510
NSF PROGRAM MANAGER: Mary Ann Ryan
PROGRAM: Development in Science Education

DISCIPLINE: Software Systems/Computer Science; Mathematics Education
TARGET AUDIENCE: Grades 2-3
DESCRIPTORS: Elementary School Mathematics; Mathematics Curriculum; Mathematics Instruction; Computer Assisted Instruction; Microcomputers; Instructional Technology; Educational Games; Computer Graphics; Logical Thinking; Geometry; Multilingualism; Questioning Techniques

* Funded in part by the National Institute of Education.

Science Intervention Programs for Girls: Follow-up Study and Evaluation Kit

Sheila Humphreys
Mills College
Math/Science Network
Oakland, CA 94613

The project is composed of development and research components related to evaluation of the effectiveness of intervention programs designed to increase girls' science interest and participation. The project will be carried out in conjunction with the Expanding Your Horizons conference program sponsored by the Bay Area Math/Science Network. The program is now in its fifth year of operation.

The research component of the project will consist of a study of conference participants' attitudes, follow-up activities, and career and educational plans. The study will be conducted by means of a post-conference mail questionnaire. Participants will be surveyed either 6 or 9 months after attendance at the conference (two samples). Approximately 25-30 percent of 4,000 expected participants will be surveyed.

The development component will consist of the development, evaluation, and dissemination of an evaluation kit for organizers of similar intervention programs. The kit will contain information, instrument samples, and a model for implementing effective program evaluation.

AMOUNT: $90,200*
AWARDED: 08-08-80
TERMINATES: 02-28-83

AWARD NUMBER: SED80-16785
NSF PROGRAM MANAGER: Gregg Edwards
PROGRAM: Development in Science Education

DISCIPLINE: Multidisciplinary Sciences
Mathematics, General/Mathematical Sciences
TARGET AUDIENCE: Females; Grades 5-12
DESCRIPTORS: Females; Womens Education; Science Interests; Evaluation; Intervention; Science Careers; Surveys; Questionnaires; Evaluation Methods; Student Attitudes; Longitudinal Studies

* Funded in part by the Research in Science Education (RISE) Program.

ComputerTown, USA - Bringing Computer Literacy to the Entire Community

Ramon M. Zamora
People's Computer Company
P.O. Box E
1263 El Camino Real
Menlo Park, CA 94025

A computer literacy project, ComputerTown USA, was developed in 1979 to give 27,000 residents of the Menlo Park, California community an opportunity to have direct experience with a microcomputer. The effort to date has been a grass roots, low-cost, volunteer-based project to bring technology to both children and adults. It utilizes the resources of the public library, recreation center, local business locations, and donated hardware and software. In the next three years the project intends to expand its goals to encourage computer literacy beyond the Menlo Park community. Plans include the following: (1) continued publication and distribution of a monthly bulletin; (2) an expanded set of courses and workshops for children and adults; (3) establishment of computer literacy experiences in community locations outside the public library; (4) presentations of papers and workshops on the project at major library and education conferences; and (5) development of a descriptive model to encourage other communities to establish their own versions of the project. Evaluation plans involve quarterly examinations of community residents and statistics on user publication. The model will be assembled as an implementation package which will be disseminated through community centers. Monthly bulletins and implementation packages will be forwarded to 500 libraries nationwide.

AMOUNT: $224,100
AWARDED: 09-10-80
TERMINATES: 02-29-84

AWARD NUMBER: SED80-15964
NSF PROGRAM MANAGER:
Dorothy K. Deringer
PROGRAM: Development in
Science Education

DISCIPLINE: Computer Science
TARGET AUDIENCE: Children; Adults; General Public
DESCRIPTORS: Computers; Computer Science Education; Computer Literacy; Public Libraries; Community Programs; Adult Education; Community Services; Microcomputers

Visual Geometry and Mathematics Cognition for Beginning College Science Students

Kristina Hooper
University of California at Santa Cruz
1156 High Street
Santa Cruz, CA 95064

Mastery of basic concepts in mathematics is essential to gain access to the scientific and technical professions. But many students—especially women, re-entry, and minority students—enter higher education with math deficiencies. Skills in visualization and translating between visual and verbal forms (critical prerequisites to much of math cognition) often are ignored in traditional, verbally dominated math instruction. These skills can be strengthened by using computers to present the visual aspects of math through interactive graphics and to provide training in visualizing patterns and then transforming them to symbolic forms.

This project will develop prototype materials for a precalculus-level course in Visual Geometry at the introductory college level. As preparation for materials development, the project will perform the following: (1) analyze the current difficulties and attitudes of students interested in science careers but without the normal self-confidence and preparation; (2) develop techniques for evaluating and improving skills in spatial visualization and visual-verbal translations; (3) collect and characterize the impact on students of current materials in visual problem solving and geometry; (4) assay the introductory science curriculum of UCSC for the demands placed on math understanding; and (5) develop specifications for computer equipment needed for interactive visual instruction. Expected outcomes include documented techniques for a "new generation" of learning materials, example materials, and insights into the role of visual modes of representation in math cognition and in overcoming problems some students have in beginning science college courses.

AMOUNT: $235,174
AWARDED: 06-13-80
TERMINATES: 12-31-82

AWARD NUMBER: SED79-19778
NSF PROGRAM MANAGER: Gregg Edwards
PROGRAM: Development in Science Education

DISCIPLINE: Geometry/Mathematical Sciences

TARGET AUDIENCE: College Freshmen; Females; Minorities

DESCRIPTORS: Mathematics Instruction; Mathematics Materials; Skill Development; Undergraduate Study; Geometry; Cognitive Processes; Visualization; Problem Solving; Computer Graphics; Computer Assisted Instruction

Mathematics Network Curriculum Project for Middle School Teachers and Students

Diane Resek
San Francisco State University
1640 Holloway Avenue
San Francisco, CA 94132

This project, for the introduction of microcomputers into the middle school mathematics curriculum, has three objectives: the development of seven curriculum prototypes (Units), a model for the teachers, and the development/implementation of a computer communications system (Network) to bring together the separate classrooms. The computer activities will stem from classroom activities that utilize the manipulation of real objects and/or the activities of the students themselves. Each Unit incorporates five elements: games; simulations; classroom activities; data storage, retrieval and processing; and interclassroom interaction. Dynamic software will be developed to provide both structure and freedom for student manipulation of data and interaction with the mathematical content and concepts. The Network will provide for interaction of students and classrooms with each other, teachers with each other, and all of these with the university data base. The interaction will enhance participation and motivation of both students and teachers. The project will disseminate information at professional meetings and will explore the possibilities of commercial publication of the materials.

AMOUNT: $130,811*
AWARDED: 09-17-80
TERMINATES: 02-28-83

AWARD NUMBER: SED80-12465
NSF PROGRAM MANAGER:
Dorothy K. Deringer
PROGRAM: Development in Science Education/National Institute of Education

DISCIPLINE: Software Systems/Computer Science
Mathematics Education
TARGET AUDIENCE: Grades 5-9
DESCRIPTORS: Mathematics Curriculum; Middle Schools; Data Bases; Teacher Education; Computer Programs; Interaction; Educational Technology; Games; Simulation; Information Processing; Mathematics Materials; Microcomputers

* Funded in part by the National Institute of Education.

A Science Course for Youth in Informal Settings: Learning to Experiment

Alan J. Friedman
University of California at Berkeley
Lawrence Hall of Science
Berkeley, CA 94720

This project will develop a compact science program for use in non-school settings (e.g., camps, scout troops, youth groups, parks, and museums). The program is designed to teach early adolescents to understand controlled experiments. The science program includes an eight-lesson class for children aged 10-14, along with written materials for the student *(Experimenter's Guide)*, for the leader *(Leader's Guide)*, and for the training of new leaders *(One-Day Workshop Guide)*. In addition, project staff will refine evaluation instruments developed during the pilot study that will provide a measure of change in students' understanding of controlled experiments.

The user of these materials will be able to present a course entitled *Learning to Experiment* and to evaluate its effects upon student understanding of controlled experiments. In addition, the written materials will enable users to conduct a one-day workshop for the training of new leaders who do not have a formal science education background.

Formative evaluation of the curriculum materials will be conducted throughout the development process of the three-year project. Summary evaluation will examine the effectiveness of the written materials for students and leaders.

The experiments used in the project all involve model rockets.

AMOUNT: $120,640
AWARDED: 03-18-80
TERMINATES: 12-31-83

AWARD NUMBER: SED79-18976
NSF PROGRAM MANAGER:
Carl J. Naegele
PROGRAM: Development in
Science Education

DISCIPLINE: Problem Solving/Education
Aeronautical Engineering
TARGET AUDIENCE: Grades 7-9
DESCRIPTORS: Science Experiments; After School Education; Youth Agencies; Science Materials; Scientific Methodology; Nonschool Educational Programs.

Modules for the Development of Reasoning in Mathematics (Grades 7-9)

Robert Karplus
University of California at Berkeley
Lawrence Hall of Science
Berkeley, CA 94720

This 18-month project will develop and test four two- to three-week modules that will enhance mathematical reasoning of early adolescent students. The modules will concentrate on aspects of mathematics which require the following reasoning skills: problem solving, estimation, graphing, relations among variables, data interpretation, and probability. These skills have little emphasis in currently used junior high school mathematics programs. The design and teaching approach will be in accord with developmental principles of learning that emphasize active participation by the learners. The modules are intended to increase mathematical literacy, produce a more favorable attitude toward mathematics, and prepare students more effectively for high school algebra courses. Formative evaluation from female students and members of minority ethnic groups will receive special attention so that the modules will address the needs of these students without being aimed exclusively at them.

This project is the first phase of a planned two-phase program to develop 15 modules. In the second phase, 11 additional modules would be written, and all 15 modules would be field tested nationwide. Commercial publication of the materials will be sought.

AMOUNT: $238,600
AWARDED: 06-02-80
TERMINATES: 09-30-82

AWARD NUMBER: SED79-26662
NSF PROGRAM MANAGER:
Raymond J. Hannapel
PROGRAM: Development in
Science Education

DISCIPLINE: Mathematics, General/Mathematical Sciences
TARGET AUDIENCE: Grades 7-9
DESCRIPTORS: Mathematics; Junior High School Students; Skill Development; Mathematics Instruction; Instructional Materials; Problem Solving; Curriculum Enrichment; Student Participation; Attitude Change

Elementary Mathematics Concepts with Calculators: Microcomputer-Based Modules for Teachers, Parents and the Public

John David Miller
University of California at Berkeley
Lawrence Hall of Science
Berkeley, CA 94720

This project will develop a pilot instructional program designed to promote the use of hand calculators in fourth, fifth, and sixth grade mathematics. The delivery system will consist of three highly interactive microcomputer-based programs to be used with a microcomputer located in the school where it is accessible to teachers and the public. This program will enable teachers to begin using many kinds of calculators together with any regular mathematics text. A subset of this instruction will explain to parents and the general public the uses of calculators in the classroom and will enlist their support for the program. The module will be tested with 12 teachers in two schools and at a museum exhibit where it will be used by the general public. The evaluation will be formative with emphasis on teacher feed-back. Information will be collected on content, necessary supporting material, time and frequency of use of the module, and impact of the modules on classroom use of the calculator. The principal product of this pilot project will be demonstration of the viability of the concept. Dissemination will occur through professional groups, the State Department of Education, and an NSF program for dissemination of information in science.

AMOUNT: $98,027
AWARDED: 04-29-80
TERMINATES: 04-30-82

AWARD NUMBER: SED79-19000
NSF PROGRAM MANAGER: Harold J. Stolberg
PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 4-6
DESCRIPTORS: Computer Assisted Instruction; Elementary School Mathematics; Mathematics Curriculum; Instructional Technology; Educational Technology; Computers; Hand Calculators; Microcomputers

Role Models for Adolescent Girls in Science and Mathematics

Jane Permaul
University of California at Los Angeles
405 Hilgard Avenue
Los Angeles, CA 90024

The goal of this project is to develop, test, and disseminate information about an easily replicable model program that will increase science/math career awareness among junior high school girls, especially girls from schools with large ethnic minority populations.

Twenty-four female UCLA undergraduate science majors (including a high proportion of minority women) will be selected and trained to offer themselves as role models in junior high schools. After receiving 20 hours of training, the students will form five teams, and each team will lead science career workshops for girls at four schools. Each undergraduate will give 24 additional hours of service in appropriate formats, such as participation at science club meetings or work with the school guidance counselor. The project will be formally evaluated.

Project results will be documented and disseminated through the production and distribution of a descriptive booklet, a tape-slide presentation, conference presentations, and publication in professional journals.

AMOUNT: $30,690*
AWARDED: 08-08-79
TERMINATES: 02-28-81

AWARD NUMBER: SED79-19023
NSF PROGRAM MANAGER: Mary Ann Ryan
PROGRAM: Development in Science Education

DISCIPLINE: Science Education
TARGET AUDIENCE: Grades 7-9; Females; Minorities
DESCRIPTORS: Adolescents; Females; Womens Education; Role Models; Role Perception; Career Awareness; Information Dissemination; Science Careers; Science Interests

* Cumulative amount. Fiscal Year 1980 award: $2,790.

An Instructional Model in Human Genetics for High School Students

Faith M. Hickman
Biological Sciences Curriculum Study Company
P.O. Box 930
Boulder, CO 80306

The goal of this project is to design, develop, evaluate, and disseminate a module in human genetics for high school students. This module will be a self-contained curriculum that has the flexibility to provide from four to six weeks to a full semester of integrated classroom instruction.

The proposed module will introduce students to both the problems and the potentials of human genetics as illustrated through extant mechanisms of prenatal diagnosis, genetic counseling, genetic screening, family planning, and treatment of heritable disorders. The module will be interdisciplinary, allowing it to be integrated into the existing curriculum. It will replace more traditional plant and animal genetics in the science curriculum and provide timely social/value issues for analysis in the social and behavioral sciences.

Content will be communicated through a variety of instructional strategies including transparencies, study card sets, a filmstrip or sound-slide program, and instructional games. Foremost will be discussion and laboratory investigations. Readings for the module will be presented in a "magazine" format. Teachers' materials will provide detailed day-by-day "lesson plans" and strategies for presenting each activity, for individualizing the instruction, and for facilitating student learning.

Extensive review and field testing of materials will involve a wide variety of subject matter specialists, teachers, and parents. Commercial publication is planned as the primary means of dissemination.

AMOUNT: $212,911
AWARDED: 05-21-80
TERMINATES: 11-30-82

AWARD NUMBER: SED79-18983
NSF PROGRAM MANAGER:
Raymond J. Hannapel
PROGRAM: Development in Science Education

DISCIPLINE: Genetics/Life and Medical Sciences
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Curriculum Development; Genetics; Human Development; High School Students; Biology; Discussion (Teaching Technique); Heredity; Science Materials

Development of Problem Solving Skills in Physics/Electrostatics

Neil Ashby
University of Colorado
Boulder, CO 80309

Instructional materials for solving electrostatics problems in introductory physics courses at the college level will be developed. These materials will teach how experts and good students go about solving problems—how they come up with possible approaches to solutions, and how they reject early approaches which don't seem to be working. During the first year, some recent experimental methods developed by researchers of the psychology of problem solving will be applied to describe the skills and ideas that experts and good students use in thinking about specific problems. These include the following: analogies used to analyze each type of electrostatic problem; what particular cues are looked for to confirm or reject the usefulness of those analogies; and which background concepts of physics are used for what type of problems. During the second year, sample instructional materials will be developed and used with beginning students to teach these skills. A few lessons will be programmed in the BASIC language for use with an inexpensive microcomputer to evaluate the effectiveness of computer-aided instruction in scientific problem solving.

AMOUNT: $72,935
AWARDED: 04-15-80
TERMINATES: 11-30-82

AWARD NUMBER: SED79-19012
NSF PROGRAM MANAGER: Gregg Edwards
PROGRAM: Development in Science Education

DISCIPLINE: Solid State Physics
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Instructional Materials; Physics Instruction; Computer Assisted Instruction; Material Development; Problem Solving; Scientific Methodology; Microcomputers

Personal Computers and Cross-Age Instruction

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University of Colorado
School of Education
Boulder, CO 80309

Cross-age tutoring and the use of personal computers will be combined to enhance the level of basic mathematics skills of low-achieving sixth graders and to increase the number of students enrolling in high school math and science courses. The project will evaluate the use of microcomputers as instructional tools and develop effective applications in education. The plan includes identification of 60 low-achieving sixth grade students and 60 non-math/science oriented, able tenth grade students. Half of each group will be randomly assigned to control groups. During the first semester of the program, 30 tenth graders will study specific areas of math weakness of 30 sixth graders and will develop microcomputer courseware for them. Each tenth grader will tutor one sixth grader during the second semester, using and further developing courseware. A tested instructional strategy, a curriculum for high school students, and computer software will be produced. Interviews with students, tutors, and teachers will be conducted as part of the evaluation process. Program effectiveness will be measured by achievement tests for sixth graders, problem solving tests for sixth and tenth graders, and change in enrollment in 11th grade science and math courses. Dissemination of results will take place at national conferences and in professional journals. Computer software will be available for publication.

AMOUNT: $84,917
AWARDED: 05-08-80
TERMINATES: 02-28-83

AWARD NUMBER: SED79-18974
NSF PROGRAM MANAGER:
Dorothy K. Deringer
PROGRAM: Development in
Science Education

DISCIPLINE: Mathematics Education; Software Systems/
Computer Science
TARGET AUDIENCE: Grades 6-10
DESCRIPTORS: Mathematics Instruction; Mathematics Materials; Computer Assisted Instruction; Cross Age Teaching; Curriculum Development; Low Achievement; Elementary School Students

Teaching Materials in Microbiology for Community and Junior Colleges

Helen L. Bishop
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Washington, DC 20006

The rapid increase in student enrollment and the growth of academic programs in community and junior colleges have created a need for instructional materials in microbiology. The American Society for Microbiology (ASM) Board of Education and Training, through its Committee on Undergraduate and Graduate Education, will organize bodies of microbiological knowledge so that teachers in community and junior colleges can extract and use portions according to their needs. Four units will be developed: Introductory Microbiology, Medical Microbiology, Microbial Physiology, and Microbial Genetics. Each unit is to be organized into topic outlines followed by essential laboratory and enrichment information.

In the first phase, a steering committee composed of teachers from community and junior colleges and from degreegranting institutions established guidelines for the project. In the second phase, two drafts of the actual units were produced by four study groups selected by the steering committee. The study groups were composed of community and junior college teachers currently teaching microbiology, content specialists, and an education expert. The draft units were reviewed by a large group of content specialists and teachers identified by the steering committee.

In this, the third phase, the units will be revised to final form, edited, printed, and made available for purchase as individual publications--in accordance with the approved dissemination plan.

AMOUNT: $159,130*
AWARDED: 09-08-77
TERMINATES: 06-30-81

AWARD NUMBER: SED77-18459
NSF PROGRAM MANAGER: Raymond J. Hannapel
PROGRAM: Development in Science Education

DISCIPLINE: Microbiology/Life and Medical Sciences
TARGET AUDIENCE: Two Year College Students
DESCRIPTORS: Microbiology; Physiology; Genetics; Instructional Materials; Teaching Methods; Curriculum Guides; Teaching Guides

* Cumulative amount. Fiscal Year 1980 award: $82,800.

Mathematics in Society: Multimedia Materials for 8th-10th Grade Students

John Jobe
The Mathematical Association of America, Inc.
1529 Eighteenth Street, NW
Washington, DC 20036

The project will develop and disseminate multimedia materials to inform eighth to tenth grade students about careers involving mathematics and the limitations on career options which result from math avoidance. The materials, to be entitled "Mathematics at Work in Society (MAWIS)," will include four videocassettes, each covering a different career area, and a student workbook. The videotapes will provide specific illustrations of careers which require substantial use of mathematics. The workbook will contain information on other careers, suggested activities related to the contents of the videotapes, and a direct discussion of "math avoidance." A major goal and focus of the MAWIS materials will be to convince adolescents, especially young women and minority students, that they can and should study mathematics appropriate for their intended careers; in short, to combat mathematics anxiety and avoidance.

The materials will be disseminated through existing MAA secondary school lectureship programs and through 29 regional MAA offices.

AMOUNT: $118,400
AWARDED: 08-11-80
TERMINATES: 05-31-82

AWARD NUMBER: SED80-08438
NSF PROGRAM MANAGER: Harold J. Stolberg
PROGRAM: Development in Science Education

DISCIPLINE: Mathematics, General/Mathematical Sciences
TARGET AUDIENCE: Grades 8-10
DESCRIPTORS: Mathematics; Womens Education; Careers; Multimedia Instruction; Career Education; Career Choice; Secondary School Mathematics; Adolescents; Minority Groups; Career Planning; Mathematics Anxiety

ERIC

A Strategy/Action Program for Re-Entry of Women in Science

Bernard J. Bulkin
Polytechnic Institute
of New York
333 Jay Street
Brooklyn, NY 11201

This is a project to train colleges and universities to implement successful strategies for facilitating retraining of post-baccalaureate women and their re-entry into science and engineering careers. The project collects and builds on findings of several NSF-supported projects that explored the re-entry of women into science careers. It provides a variety of forms of assistance to other institutions interested in developing their own re-entry programs.

A consortium of three institutions (Polytechnic Inst. of NY, Univ. of Dayton, CA State Univ. at Northridge) will be formed. This consortium will conduct three Regional Re-entry Training Seminars for 30-100 colleges and universities. A paradigm for recruiting student participants, designing curricula, building counseling and support services, and developing a plan for placement of the students will be presented at each seminar. In designing the seminars, the project will employ the latest research findings on effective diffusion and on the adaptation of innovative strategies, and test this research on a new problem under conditions which will allow careful evaluation of the results.

A number of small ($1,000-$3,000) "incentive awards" will be given to stimulate and facilitate initiation of locally appropriate re-entry programs.

The proposal addresses the DISE mandate of increasing access to science careers for women and of disseminating successful models.

The project will be jointly supported by FIPSE and NSF.

AMOUNT: $124,415*
AWARDED: 09-17-80
TERMINATES: 08-31-82

AWARD NUMBER: SED80-20923
NSF PROGRAM MANAGER:
Mary Ann Ryan
PROGRAM: Development in
Science Education

DISCIPLINE: Engineering Education; Science Education
TARGET AUDIENCE: Minorities; Handicapped; Females

DESCRIPTORS: Physical Disabilities; Womens Education; Females; Postsecondary Education; Minority Groups; Engineering Education; Science Education; Career Choice; Information Dissemination; Science Careers

•Funded through award to Fund for Improvement of Post-Secondary Education (FIPSE) of the Department of Education.

Instruction for Problem Solving Using the Microcomputer in High School Mathematics

Mary Grace Kantowski
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College of Education
360 Norman Hall
Gainesville, FL 32611

This project will develop a body of prototype instructional materials (computer programs plus supplementary printed materials) for use with a microcomputer to teach non-routine and "real world" problem solving in high school mathematics courses. The effectiveness of these materials in promoting growth in the problem solving ability of students will be studied.

The content emphasis in the mathematical problems will be on geometry, so that the graphics capability of the microcomputer will be used to advantage, and on number theory to capitalize on its iterative capability and the powerful calculator mode. Active participation by interaction with the computer will be emphasized. It will be possible, for example, to generate diagrams or to alter or manipulate existing figures and to select from among several possible paths to a solution. Hints or cues will be given to problem solvers who begin along a path but are unable to continue.

Materials will be submitted to consultants for critical evaluation. The final programs will be demonstrated at professional meetings of mathematics teachers. Progress reports and materials will be disseminated initially to the mathematics education community.

AMOUNT: $110,322
AWARDED: 07-18-80
TERMINATES: 10-31-82

AWARD NUMBER: SED80-12466
NSF PROGRAM MANAGER: Mary Ann Ryan
PROGRAM: Development in Science Education

DISCIPLINE: Mathematics, General/Mathematical Sciences
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Problem Solving; Geometry; Number Concepts; Mathematics Instruction; Computer Assisted Instruction; Computer Graphics; Secondary School Mathematics; Microcomputers

A Prototype System to Deliver Continuing Education to Engineers

J. David Waugh
Association for Media-Based Continuing Education for Engineers (AMCEE)
Georgia Institute of Technology
Savant Building, Room 212
Atlanta, GA 30332

AMCEE, a consortium of 21 engineering universities, was formed to provide off-campus graduate and continuing education in engineering through the media of television and videotape. The organization is non-profit and operates on a national level. Services include distribution of videotape courses from member institutions, production (with private funds) and distribution of videotape short courses, conferences and symposia developed by AMCEE, and a computer-based information service on continuing education programs from a wide variety of sources. Continuation of organizational support is sought until revenue from these services enables AMCEE to be selfsustaining.

An information service, sponsored by AMCEE, will provide practicing engineers with data on "live" short courses and media-based "packaged" courses collected from universities, technical societies, trade associations, industrial and proprietary firms, video-publishing houses, and State and Federal Government agencies. The data collection is maintained in a word-processing computer, and information can be retrieved through a computer search. Satellite delivery is also being considered. Guidelines for program evaluation and production of ITV instruction in studio classrooms are being prepared by the AMCEE Industrial Research Committee in a two-year study.

AMOUNT: $316,620
AWARDED: 07-30-80
TERMINATES: 01-31-84

AWARD NUMBER: SED80-14211
NSF PROGRAM MANAGER: Harold J. Stolberg
PROGRAM: Development in Science Education

DISCIPLINE: Engineering Education
TARGET AUDIENCE: Scientists; Engineers
DESCRIPTORS: Engineering Education; Professional Continuing Education; Professional Education; Educational Technology; Television; Videotape Recordings; Information Services; Consortia; Graduate Education; Information Dissemination; Information Processing

Microcomputer-Based Strategies for Mathematics in Junior High and High School

Les A. Karlovitz
Georgia Institute of Technology
School of Mathematics
225 North Avenue
Atlanta, GA 30332

This project will develop computer programs called IDPs (interactive demonstration programs) for use on microcomputers capable of generating high resolution video graphics to treat key topics in traditional junior high and high school mathematics courses—primarily general mathematics, algebra, geometry, and calculus. The programs will apply the technology to the tasks of computation, graphical display, and simulation in order to clarify and explain the subject matter. The classroom component of the project is complemented by a laboratory component in which students experiment individually with the programs and carry on related activities.

The primary product of the project will be the demonstration of a teaching model which makes use of computer programs for classroom demonstration and laboratory use in mathematics courses. The programs themselves, which will be available when the project is completed, will be designed to achieve many goals: (1) bring ideas and numbers together more effectively for the understanding of mathematical concepts and procedures; (2) promote classroom participation by virtue of the interactive nature of the programs; (3) provide multiple viewpoints and contexts for the treatment of the given topic; and (4) allow for a useful redistribution of the teachers' time. Teachers from the Atlanta public school system will be actively involved in the planning and development of the IDPs to ensure the quality and effectiveness of the programs. A distribution network for the materials will be provided by the Southeastern Consortium for Minorities in Engineering. The project is designed for future expansion to other courses and grades and to a large geographical area.

AMOUNT: $88,800*
AWARDED: 07-14-80
TERMINATES: 10-31-82

AWARD NUMBER: SED80-12649
NSF PROGRAM MANAGER: Mary Ann Ryan
PROGRAM: Development in Science Education

DISCIPLINE: Mathematics, General/Mathematical Sciences
Software Systems/Computer Science
TARGET AUDIENCE: Grades 7-12; Minorities

DESCRIPTORS: Mathematics Education; Computer Assisted Instruction; Educational Technology; Teaching Techniques; Programmed Instructional Materials; Microcomputers; Secondary School Mathematics; Junior High School Students; Computer Graphics

* Funded in part by the National Institute of Education.

Space-Centered Activity Kit for Junior High Science Instruction

Thomas C. Campbell
Illinois Central College
Peoria, IL 61635

The project will develop and field test a science curriculum kit for junior high schools featuring four or five physical science lessons. Each lesson will relate to a different single-concept Skylab film, from a series of 12 films produced and marketed by the American Association of Physics Teachers.

The physical science lessons, designed for use either with existing science curriculum materials or alone, will incorporate the learning concepts of Jean Piaget. The complete teaching kit is scheduled to become available concurrently with NASA plans to implement the Space Shuttle Program; renewed interest in space travel is foreseen as providing impetus for children to learn the basic physical science principles applied in the kit. Cited here are examples of titles of films on which the lessons will be based: *Human Momenta, Games Astronauts Play, Human Mass Measurement* and *Gyroscopes*. Films are available in the Super 8mm silent technicolor cartridge format and are of proven classroom use.

Formative evaluation of the curriculum materials will be conducted throughout the development process of the two-year project. Summary evaluation will assess the project's impact on content mastery, student motivation, and development of reasoning. Commercial production and distribution of the project will be sought for 1981.

AMOUNT: $25,700
AWARDED: 02-06-80
TERMINATES: 01-31-83

AWARD NUMBER: SED79-18986
NSF PROGRAM MANAGER:
Carl J. Naegele
PROGRAM: Development in
Science Education

DISCIPLINE: Science Education; Space Physics
TARGET AUDIENCE: Grades 7-9
DESCRIPTORS: Physical Sciences; Science Education; Space Sciences; Curriculum Design; Instructional Films; Piaget

Computer Graphics Technology as a Visualization Tool for Teaching Modern Optical Theory in High School and College Physics

Raymond G. Wilson
Illinois Wesleyan University
Bloomington, IL 61701

The technology of computer graphics is to be applied to make the predictions of modern optical theory—Fourier Optics—visually comprehensible and conceptually understandable to high school and college physics students. Using a dedicated small desktop computer and plotter, a collection of three-dimensional diagrams illustrating all the phenomena associated with wave radiation as it interacts with surfaces or passes through optical systems will be produced. Examples will be chosen which are applicable across the disciplinary lines of physical sciences, biomedical science, and engineering. Detailed tutorial and pedagogical text materials also will be provided. They will be developed with the particular user in mind and will be systematically keyed, where appropriate, to the user's discipline, level, work, and background.

Substantive input from potential users and experts will be actively sought. Satisfactory test materials can be photo-reproduced, and information regarding the products will be disseminated through physics, electrical engineering, mathematics, biological, and certain medical journals. The project is designed to produce materials for commercial distribution.

AMOUNT: $38,600
AWARDED: 07-23-80
TERMINATES: 01-31-83

AWARD NUMBER: SED80-21473
NSF PROGRAM MANAGER:
Carl J. Naegele
PROGRAM: Development in
Science Education

DISCIPLINE: Optics/Physics
Software Systems/Computer Science
TARGET AUDIENCE: Grades 9-12; Graduate Students; Undergraduates
DESCRIPTORS: Computer Graphics; Computer Assisted Instruction; Optics; Physics Instruction; College Students; Secondary School Students; Instructional Materials; Curriculum Enrichment; Fourier Optics

Prototype Microcomputer Courseware for Teaching High School Algebra

Sharon Dugdale
University of Illinois
Urbana, IL 61801

This project will develop microcomputer courseware to teach basic algebra concepts to secondary students (grades 9-12). Materials will be developed to teach recognition of general functional relationships and graphing of linear and quadratic equations. The materials will use an "intrinsic models" approach. This approach uses motivating activities which are direct expressions of the underlying mathematics, such as games based on the mathematical principles involved.

The materials will be designed for and tested on a color graphics microprocessor-based system which uses a standard color television set and a floppy disk for program storage. This hardware has capabilities which can be expected to be widely available within a few years.

AMOUNT: $111,300
AWARDED: 07-23-80
TERMINATES: 06-30-82

AWARD NUMBER: SED80-12449
NSF PROGRAM MANAGER: Harold J. Stolberg
PROGRAM: Development in Science Education

DISCIPLINE: Algebra or Number Theory/Mathematical Sciences; Software Systems/Computer Science
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Algebra; High School Students; Mathematics Materials; Mathematics Curriculum; Secondary School Mathematics; Computer Assisted Instruction; Programmed Instruction; Mathematical Models; Computer Graphics; Motivation Techniques

Engineering Education Materials for Computer Aided Manufacturing (ECAM)

Randall P. Sadowski
Purdue University
Department of Industrial Engineering
West Lafayette, IN 47907

This project will lay the foundations of an ongoing system of instructional materials on the principles and methods of computer-aided manufacturing for university students, educators, and practicing professionals in industrial, mechanical, and manufacturing engineering.

The project will perform the following: develop a taxonomy of basic concepts in the computer-aided manufacturing area; enlist broad university, industrial, and technical society participation; establish participant incentives; establish a national steering committee and task forces for preparation of materials; define curricular areas and delivery modes materials developed; develop formal evaluation methods; begin and maintain an educational journal for publication of materials; develop approximately 300 lecture units of materials; test materials in classroom and continuing education environments; and evaluate the material andoverall impact of the project.

The project builds on the work of a previous and similar project at Purdue which has produced (in draft) instructional materials covering about 200 introductory lectures on the concepts in manufacturing engineering. These materials will be revised and combined into the new system.

Future phases, depending on satisfactory progress and review of a new proposal, will enlarge and disseminate the system being developed in prototype in this phase.

AMOUNT: $263,722
AWARDED: 08-27-80
TERMINATES: 03-31-83

AWARD NUMBER: SED80-20447
NSF PROGRAM MANAGER:
Gregg Edwards
PROGRAM: Development in
Science Education

DISCIPLINE: Computer Systems Design; Industrial Engineering
TARGET AUDIENCE: Undergraduates; Graduate Students; Professional Continuing Education Students
DESCRIPTORS: Engineering Education; Instructional Materials; Manufacturing; Computer Oriented Programs; Educational Technology; Information Dissemination; Curriculum Evaluation; Engineering Technology

Demonstrations in Experimental Psychology for Junior High Schools

Fred L. Yaffe
Washburn University of Topeka
Department of Psychology
Topeka, KS 66621

The major objective of the project is to provide a cost-effective system for presenting scientifically based psychology education programs to junior high students by developing a model program. The first phase of the program is the development of an "itinerant psychology fair." The psychology fair model is intended to generate an interest in the science of psychology through an experimental, hands-on medium. The "Fair" will be taken to junior high schools and youth organizations in the 20-county area in Northeast Kansas.

The principal investigator and his assistants will develop demonstrations which will exemplify various areas of experimental psychology such as the following: sensory processes; perception; learning; motivation and emotion; human learning and memory; animal learning; developmental and abnormal psychology; personality and intelligence assessment; and physiological psychology.

AMOUNT: $118,648
AWARDED: 05-08-80
TERMINATES: 11-30-82

AWARD NUMBER: SED79-18967
NSF PROGRAM MANAGER:
Raymond J. Hannapel
PROGRAM: Development in Science Education

DISCIPLINE: Experimental Psychology
TARGET AUDIENCE: Grades 7-9
DESCRIPTORS: Expositions; Experimental Psychology; Junior High Schools; Demonstration Programs; Demonstration Projects; Exhibits; Science Fairs

Development of a Microcomputer Network and Courseware for Teaching Chemical Engineering Design

Brice Carnahan
CACHE Corporation
77 Massachusetts Avenue
Cambridge, MA 02139

Chemical engineering greatly impacts on the productivity of our society because of its high technology content; exploitation of this content depends on the (now computer-aided) design of semi-automated plants. In this project, a nonprofit consortium of academic and industrial chemical engineering groups will use the rapidly expanding technology of the personal computer as a vehicle for more efficiently teaching chemical engineering design. Three kinds of products are anticipated: (1) 10 prototypic, interactive, personal computer programs and associated educational materials that focus on engineering design and problem solving; (2) an instructional monitoring system, used on the student's computer, which keeps track of student progress and difficulties, poses questions and retains the answers for the instructor's analysis, and also provides information that will guide revision of the instructional materials; and (3) a network of software developers which will make possible a means to share future development costs and electronically distribute new programs and data.

These products will be field tested in graduate, undergraduate, and continuing education settings in order to develop materials that will be widely useful.

The products will be compared for cost effectiveness to alternative approaches of software development and exchange. It is expected that this project may serve as a model for the development and exchange of computer courseware in other fields of science and engineering.

AMOUNT: $127,940
AWARDED: 06-18-80
TERMINATES: 11-30-82

AWARD NUMBER: SED79-19609
NSF PROGRAM MANAGER: Gregg Edwards
PROGRAM: Development in Science Education

DISCIPLINE: Chemical Engineering; Software Systems/Computer Science
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Programmed Instructional Materials; Curriculum Development; Computer Programs; Engineering Education; Information Dissemination; Microcomputers; Chemical Engineering

Technology and the Individual - A School TV Series for Adolescents

Minaruth Galey
Eastern Regional Council for Educational Television
131 Clarendon Street
Boston, MA 02116

A curriculum for teaching the interrelationships of science, technology, and society will be developed for 4.5 million pupils in grades 7-12 and their 137,000 teachers in eastern states. Designed to help secondary pupils become effective citizens, the project will focus on the following: (1) the development of a technical literacy; (2) the impact of technology on the individual and on society; and (3) the effects of social factors and actions on technology. The curriculum will consist of an instructional television series of 12 videotaped 20-minute programs and instructional materials for teachers. Program topics will cover consumerism, displaced workers, automation, fuel alternatives, health, population patterns, food technology, communication, Western and Eastern cultures, transportation, city growth, and information processing. The series will be designed for teachers of social studies, industrial arts, and other appropriate subjects. Inservice activities will familiarize teachers with the subject and methods of teaching it. Curriculum specialists in each state will plan and conduct evaluation procedures. Dissemination will be through state departments of education and educational television stations. Following final evaluation and revision of the program, national distribution will be initiated.

AMOUNT: $192,700
AWARDED: 09-04-80
TERMINATES: 02-28-82

AWARD NUMBER: SED80-14104
NSF PROGRAM MANAGER: Mary Ann Ryan
PROGRAM: Development in Science Education

DISCIPLINE: Social Science/Education
TARGET AUDIENCE: Grades 7-12
DESCRIPTORS: Curriculum Development; Technological Advancement; Social Responsibility; Social Influences; Scientific Literacy; Citizenship Education

Modules and Monographs in Undergraduate Mathematics and Its Applications Project (UMAP)

Ross L. Finney
Education Development Center, Inc.
55 Chapel Street
Newton, MA 02160

The Undergraduate Mathematics Application Project (UMAP) has two primary goals: (1) develop a system of innovative materials in applications of mathematics; and (2) develop a consortium of individuals who will continue to create and use these materials. The present materials inventory is 273 modules and 24 monographs; approximately 30 modules and three monographs will be added each year. UMAP has a publication contract with Birkhauser Boston, Inc., to publish its materials including the UMAP journal. To facilitate the formation of a community, the UMAP Consortium, composed of more than 2,000 individuals from over 1,000 U.S. institutions interested in teaching applications of mathematics, has been formed. A major task of UMAP over the proposed grant period is to establish this Consortium as an independent, self-supporting organization. This project, which was established in 1976, is an ongoing effort to respond to the increasing application of mathematics in a variety of professional fields.

AMOUNT: $440,404
AWARDED: 09-02-80
TERMINATES: 02-28-83

AWARD NUMBER: SED80-07731
NSF PROGRAM MANAGER:
Dorothy K. Deringer
PROGRAM: Development in
Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Consortia; Educational Cooperation; Interinstitutional Cooperation; Mathematics Instruction; Mathematics Materials; Mathematical Applications; Instructional Innovation

Administrative Activities Related to NSF-Supported Curriculum Materials

Jerry D. Murphy
Education Development Center, Inc.
55 Chapel Street
Newton, MA 02160

The distribution of more than 100 titles of text materials and over 600 films developed by EDC with NSF funding will be administered and managed. NSF-imposed accounting activities will be followed and appropriate reporting procedures carried out with respect to royalty income. An itemized analysis of cost of administration and income anticipated will be prepared. Categories of support include contract and publication administration and administration of film materials.

In addition, the project will complete a cost/benefit analysis for administration of NSF-supported EDC curricular materials and prepare a plan for decontrol and divestiture of interest in projects whose continued administration is no longer of public benefit.

AMOUNT: $238,582*

AWARDED: 10-19-78
TERMINATES: 04-30-82

AWARD NUMBER: SED78-20121.A01, A02
NSF PROGRAM MANAGER: Raymond J. Hannapel
PROGRAM: Development in Science Education

DISCIPLINE: Science Education
TARGET AUDIENCE: National Science Foundation
DESCRIPTORS: Program Administration; Information Dissemination; Textbook Publication; Instructional Films; Copyrights; Contracts; Instructional Materials; Cost Effectiveness

* Cumulative amount. Fiscal Year 1980 award, amendments 01 and 02: $157,144.

Application of Dimensional Analysis to Middle School Mathematics Using Microcomputer and Print Materials

Judah L. Schwartz
Education Development Center, Inc.
55 Chapel Street
Newton, MA 02160

This project will develop a collection of tested mathematical word problems which will be available both in printed form with graphics and in the form of interactive computer programs for use with a microcomputer. The problems will be set in contexts that are interesting to junior high school students. The approach to problem solving will be based on the technique of dimensional (semantic) analysis commonly used in university-level physics and engineering.

A core group of six to ten teachers in the Boston area will collaborate closely with project staff in the development of materials and will test materials initially. A larger group of 50 teachers with access to microcomputers in several urban areas around the country will then receive all materials and have complete discretion as to their use. Evaluation will be based on the extent to which these teachers voluntarily use the materials provided and the responses of the teachers and their students after using them. The project will also produce a report presenting insights gained on the following issues in the course of developing and testing the materials: (1) the generation of a computer-based curriculum in mathematics and other subjects; (2) the interaction of printed and computer-based materials; (3) computer-generated printed materials custom tailored to particular student interests; (4) the attitudes of teachers toward the present and future roles of computers in education; and (5) the training of teachers to use computers for their own ends, both as professional teachers and as functioning adults in society.

AMOUNT: $156,101
AWARDED: 08-18-80
TERMINATES: 09-30-82

AWARD NUMBER: SED80-12611
NSF PROGRAM MANAGER: Mary Ann Ryan
PROGRAM: Development in Science Education

DISCIPLINE: Mathematics/Mathematical Sciences
TARGET AUDIENCE: Grades 7-9

DESCRIPTORS: Mathematics; Computer Graphics; Educational Technology; Computer Assisted Instruction; Microcomputers; Secondary School Mathematics; Mathematics Curriculum; Teacher Attitudes; Curriculum Development; Junior High School Students; Problem Solving; Teacher Response

LOGO (A Computer Language) Methods in Science Education Using Low Cost Home Computers

Seymour A. Papert
Massachusetts Institute of Technology
77 Massachusetts Avenue
Cambridge, MA 02139

Previous research and development work has created a computer language and a computer based learning environment that allow children to learn computer programming while acquiring skills in mathematics, science, and problem solving. This work has been tested under realistic conditions in public schools and demonstrated to be accessible to students of low academic achievement and of anti-mathematical turn of mind as well as providing a new challenge to the mathematically successful.

This project will adapt these methods to new computers and develop teaching materials which will allow widespread use of these methods. Features of the new computers will be taken advantage of to expand the range of content of the learning units to include more physics and biology in addition to the mathematics emphasized in the last round of work with students.

The project will accomplish the following tasks: (1) develop and adapt new activities from the current LOGO educational environment based on high resolution to the present generation of low-cost home computers making use of lower resolution video-based graphics; (2) develop and revise activities in the areas of physics and biology—both as initial projects for beginners and as "advanced topics" for junior high school students who have had an introduction to LOGO programming; (3) prepare teachers' guides, background information, and student booklets, covering both introductory and advanced topics; and (4) provide a full implementation of a mini-LOGO for at least one presently available low-cost computer. In addition, a manual will be provided for the adaptation of subsets of LOGO to any presently available low-cost computer.

AMOUNT: $200,600
AWARDED: 10-29-79
TERMINATES: 04-30-82

AWARD NUMBER: SED79-19033
NSF PROGRAM MANAGER:
Dorothy K. Deringer
PROGRAM: Development in
Science Education

DISCIPLINE: Computer Science/Computer Systems Design
Problem Solving/Education

TARGET AUDIENCE: Grades 7-9

DESCRIPTORS: Computer Oriented Programs; Computer Assisted Instruction; Educational Technology; Educational Media; Computer Science Education; Computer Graphics; Interdisciplinary Approach

Interest Worlds: Precollege Mathematics in a Computer Culture

Seymour A. Papert
Massachusetts Institute of Technology
77 Massachusetts Avenue
Cambridge, MA 02139

This project will develop an alternative to the traditional uniform mathematics curriculum. The new model of education will be computer-based "interest worlds." These interest worlds will serve as significant routes into the achievement of "computer literacy" on a broad scale. The project is guided by a key idea: If people have developed a serious interest and significant expertise in some activity and its associated body of knowledge, then it should be possible to design computer systems that help them pursue that activity and at the same time draw on their expertise and emotional attachment to support mathematics learning.

Four interest worlds will be developed: Words World, Games World, Music World, and Animation World. The interest worlds will be tested in a six-week summer program for 24 mid-elementary to junior high school youngsters.

AMOUNT: $165,434*
AWARDED: 07-30-80
TERMINATES: 07-31-82

AWARD NUMBER: SED80-12648
NSF PROGRAM MANAGER:
Dorothy K. Deringer
PROGRAM: Development in
Science Education

DISCIPLINE: Mathematics Education; Computer Systems Design/Computer Science
TARGET AUDIENCE: Grades 4-9
DESCRIPTORS: Computer Assisted Instruction; Computer Science Education; Mathematics Curriculum; Computer Oriented Programs; Instructional Innovation.

*Funded in part by the National Institute of Education.

Reasoning Development: In-Service Training for Middle School Science Teachers

Richard D. Konicek
University of Massachusetts
Amherst Campus
Amherst, MA 01003

This project will develop in-service training for middle or junior high science teachers. Modules which include a manual and a series of training tapes will be produced for the following purposes: (1) to help science teachers in their communication skills with students about observed scientific phenomena; (2) to help teachers gain insights into student thinking styles, information processing and pre concept formation; and (3) to help teachers apply this information toward designing or modifying science curricula and/or improved teaching styles.

The modules, to be developed by teachers and the staff, will employ a video training technique and will focus on elements of curriculum development, communication theory, and adolescent cognitive theory.

A second phase of the project, for which future funding will be requested, is the dissemination of the project to potential users. This phase will include leadership workshop conferences.

AMOUNT: $55,562
AWARDED: 09-8-80
TERMINATES: 06-30-82

AWARD NUMBER: SED80-10776
NSF PROGRAM MANAGER: Carl J. Naegele
PROGRAM: Development in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Teachers; Grades 5-9
DESCRIPTORS: Science Teachers; Science Education; Junior High Schools; Middle Schools; Science Curriculum; Teaching Styles; Videotape Recordings; Concept Formation; Communication Skills; Cognitive Processes; Inservice Teacher Education

Support Centers for Microcomputer Applications in Science Education

Karl E. Zinn
High/Scope Educational Research Foundation
600 North River Street
Ypsilanti, MI 48197

This project will address the needs of science teachers, interested parents, administrators, science museum staff, and developers of science education materials and programs for up-to-date information and person-to-person advice concerning the many applications of microcomputers and related technologies to science education at all levels. The project will develop a series of workshops and instructional materials, computer systems and associated software, and information files necessary to set up a local microcomputer resource center. These materials will be tested in a dozen centers to ensure ease of national replication and should help new centers get started. The local centers will serve their clients through hands-on demonstrations, consultation, and workshops, as well as through a resource library containing computer programs, online catalogs, and audiovisual materials. The content of the resource library will orient and guide users on the general range of uses of computers in science education, programs available for specific course objectives, how to write courseware, how to choose and maintain hardware, and on other sources of help and information. The project will be in ongoing communication with both local and national developers of computer applications and with other information dissemination centers. Information sharing will be facilitated by use of computer teleconferencing. Thus, the project will foster the development of a network of local dissemination centers which could continue after grant funds are spent.

AMOUNT: $199,900
AWARDED: 05-21-80
TERMINATES: 10-31-82

AWARD NUMBER: SED79-20124
NSF PROGRAM MANAGER: Gregg Edwards
PROGRAM: Development in Science Education

DISCIPLINE: Software Systems/Computer Science; Multidisciplinary Sciences
TARGET AUDIENCE: Teachers, Grades K-12; Undergraduates; Graduate Students; College Instructors; Education Administrators

DESCRIPTORS: Computer Assisted Instruction; Resource Centers; Information Dissemination; Microcomputers; Educational Technology; Information Systems; Science Materials; Science Instruction; Data Bases; Information Retrieval; Online Systems

Problem-Oriented College Physics Instruction

Peter Signell
Michigan State University
East Lansing, MI 48824

This project will put the physics curriculum (usually taught in service courses) into a form—often computer-managed—that will allow college students, professional engineers, biology researchers, and others to more quickly isolate and obtain the precise instruction they need for solving specific problems and classes of problems. The new modular form will also allow the instructional materials system to quickly capture new knowledge and new instructional insights and to be easily disseminated electronically to save costs, time, and energy.

The project will link its physics modules to the applied science and mathematics modules being produced by other NSF projects in order to form a comprehensive instructional network for problem solvers.

The project's physics modules will incorporate instruction in problem solving and science learning strategies based on recent research findings. It will incorporate specific materials produced in prior NSF projects, employ recently developed field testing strategies to ensure instructional designs that actually work, and field test the materials at a number of other institutions. Many of these materials will be useful at the high school level.

In a final phase, to follow this one, the project is to be taken over by a user-producer consortium and made self-sustaining.

The project builds on work done in a prior grant which has in draft form some 500 instructional module manuscripts covering most of the undergraduate physics curriculum, and which has developed computer-aided systems for review, revision, and field-management of the modules.

AMOUNT: $482,100
AWARDED: 09-08-80
TERMINATES: 03-31-83

AWARD NUMBER: SED80-20272
NSF PROGRAM MANAGER: Gregg Edwards
PROGRAM: Development in Science Education

DISCIPLINE: Physics, General
TARGET AUDIENCE: Grades 9-12; Undergraduates; Graduate Students

DESCRIPTORS: Physics Curriculum; Computer Assisted Instruction; Programmed Instructional Materials; Problem Solving; Physics Instruction; Curriculum Development; Consortia; Information Dissemination; Educational Technology; College Science; Information Networks

Adaptable Microcomputer Graphics for Undergraduate Life Science Instruction

James D. Spain
Michigan Technological University
College of Sciences and Arts
Department of Biological Sciences
Houghton, MI 49931

This is a project to develop user-adaptable microcomputer graphics software for undergraduate life science instruction. This is the first phase of an overall program to develop, evaluate, and disseminate single-concept interactive graphics packages for instruction in general biology and ecology using a microcomputer. Twenty packages will be developed under this grant; an additional 20 will be proposed for Phase II. In order to encourage broad utilization, each package will deal with a single concept or biological system. This will maximize adaptability of packages to a variety of courses and instruction situations. The adaptability will be further enhanced by writing the programs in BASIC, using a modular structure with each step fully documented. Users' guides will provide theory, learning objectives, program organization, and other information to augment program adaptability and make it possible for instructors to fit their interests and expertise, irrespective of previous programming experience. The interactive graphics strategy uses a mathematical model to generate simulation data that are displayed in an easily understood graphical form.

AMOUNT: $125,484
AWARDED: 05-14-80
TERMINATES: 10-31-82

AWARD NUMBER: SED79-19051
NSF PROGRAM MANAGER: Raymond J. Hannapel
PROGRAM: Development in Science Education

DISCIPLINE: Software Systems/Computer Science
Biology, General/Life and Medical Sciences
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Computer Assisted Instruction; Computer Graphics; Educational Technology; Biology Curriculum Materials; Ecology; Microcomputers; Science Instruction; Learning Modules

Instructional Materials for Computer Literacy

Ronald E. Anderson
Minnesota Educational Computing Consortium
Division of Special Projects
2520 Broadway Drive
St. Paul, MN 55112

Instructional materials will be developed to encourage computer literacy among secondary school students. These materials will consist of 25 individual learning packets which can be integrated into current mathematics, science, and social science programs, or used for separate courses in computer science. Since attitudes, skills, and factual information are considered equally important aspects of computer literacy, the content materials will consider applications and impacts as well as hardware, software, and programming. Each learning packet will contain background material, student activities, text material, and, in some instances, computer-based learning activities. Individual teacher guides and an overall guide to the set for aid in curriculum planning will be included.

Formative evaluation will start with one-on-one testing and interviews followed by pilot tests conducted in 14 classrooms in seven states. Results of student pre- and post-tests and content review by technical experts will be analyzed before final revision and publication. Information will be disseminated through the mailing of 1,200 descriptive brochures, journal articles, and conference presentations.

AMOUNT: $286,175*
AWARDED: 04-18-80
TERMINATES: 03-31-83

AWARD NUMBER: SED79-18987
NSF PROGRAM MANAGER:
Dorothy K. Deringer
PROGRAM: Development in
Science Education

DISCIPLINE: Computer Science/Education
TARGET AUDIENCE: Grades 7-9
DESCRIPTORS: Computer Science Education; Instructional Materials; Curriculum Development; Computer Assisted Instruction; Mathematics Instruction; Science Instruction; Social Sciences; Secondary School Students; Interdisciplinary Approach

*Funded in part by the Research in Science Education (RISE) Program.

Microcomputer Instructional Units (for 11th and 12th Grade Mathematics) Using Simulation of Mathematical Modeling

Lynn Arthur Steen
St. Olaf College
Northfield, MN 55057

Three prototype instructional units will be developed for microcomputers, each using simulation of mathematical modeling as a vehicle with which students can explore the geometrical and physical bases of mathematical relationships. The simulation programs will employ color graphics (with a graphic input pad) to illustrate physical and geometrical processes. Students will use the programs as experiments, trying different parameters and conditions, in order to collect data and formulate conjectures. The program packages will permit students to test their conjectures for consistency with the simulations and will suggest exploration of possible sources of error. The materials will be tested in high school, college, and in adult continuing education classes.

Each program package will be a self-contained instructional tional unit on some topic illustrating mathematics ordinarily encountered in grades 11 and 12. Each will be accompanied by a supplementary pamphlet suggesting problems, projects, and further reading.

AMOUNT: $54,184*
AWARDED: 07-09-80
TERMINATES: 06-30-83

AWARD NUMBER: SED80-12463
NSF PROGRAM MANAGER: Dorothy K. Deringer
PROGRAM: Development in Science Education

DISCIPLINE: Software Systems/Computer Science
TARGET AUDIENCE: Grades 11-12
DESCRIPTORS: Mathematical Models; Mathematics Instruction; Secondary School Mathematics; College Mathematics; Computer Graphics; Computer Assisted Instruction; Educational Technology; Microcomputers; Simulation; Geometric Concepts; Autoinstructional Aids

* Funded in part by the National Institute of Education.

Out of School Science for Pre-Adolescent / Adolescent Children and Their Parents

Eugene D. Gennaro
University of Minnesota
370 Peik Hall
Minneapolis, MN 55455

Five short informal science courses will be developed and evaluated. These courses will be inquiry oriented, designed specifically for middle school children and their parents, and will be taught at community settings such as zoos, museums, planetariums, and nature centers. Parents and children will be provided with home activity packets that they can do together. Course topics will supplement what is being taught in science in the middle and junior high schools.

The project is divided into four phases: (1) developing instructional materials; (2) teaching the courses with suburban participants; (3) revising courses and teaching courses again with urban participants; and (4) final revision of instructional materials and the production of six manuals (an overview manual and five teacher's manuals) and children-parent materials. The overview manual will give strategies for initiating similar informal science courses in other communities. The teacher's manuals will offer examples of instructional materials, including materials and strategies that can be used in other communities.

The courses will be evaluated on the basis of pre- and post-tests of cognitive attainment, attitudinal measures, and student evaluations. Materials will be developed and reviewed by science content experts and curriculum development specialists. After appropriate testing, revision, and evaluation, national distribution through a commercial publisher is planned.

AMOUNT: $158,400
AWARDED: 07-28-80
TERMINATES: 02-28-83

AWARD NUMBER: SED80-07872
NSF PROGRAM MANAGER: Carl J. Naegele
PROGRAM: Development in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Grades 5-8

DESCRIPTORS: Instructional Materials; Curriculum Enrichment; Middle Schools; Intermediate Grades; Junior High Schools; Parent Participation; School Community Programs; Community Involvement; Questioning Techniques; Field Trips; Experiential Learning; Activity Units; Adventure Education; Non-school Educational Programs

Computer Storytelling Mathematics for Pueblo Indian Upper-Elementary Level Students

Judith A. Hakes
All Indian Pueblo Council
1015 Indian School Road
Albuquerque, NM 87197

This project will develop an alternative, computer-based learning unit in mathematics and science for upper-elementary level Pueblo Indian students. The project will produce and field test a four- to six-week unit entitled "Pueblo Uses of Energy" which fuses mathematical problem solving with science content related to the daily lives of the Pueblo students. The major mode of instruction will be the microcomputer interfaced with a tape recorder. Instructional programs will be designed to introduce content and skills in a storytelling format which capitalizes on a specific learning style of Pueblo culture.

The project will be accomplished in two six-month phases: (1) design; and (2) field development, revision, and dissemination. The computer programs, audio tapes, and printed materials developed will be disseminated through the Education Division of the All Indian Pueblo Council to Bureau of Indian Affairs schools and other educational programs. Materials will also be available at the American Indian Bilingual Education Center at the University of New Mexico. Results of the project will be presented in journal publications.

AMOUNT: $59,444*
AWARDED: 09-19-80
TERMINATES: 02-28-82

AWARD NUMBER: SED80-12482
NSF PROGRAM MANAGER: Mary Ann Ryan
PROGRAM: Development in Science Education

DISCIPLINE: Mathematics, General/Mathematical Sciences
TARGET AUDIENCE: Grades 4-9
DESCRIPTORS: American Indian Education; Computer Programs; Mathematics; Science; Computer Assisted Instruction; Educational Technology; Instructional Materials; Story Telling; Curriculum Development; Bilingual Education; Biculturalism; Adolescents; Interdisciplinary Approach; Minority Groups; Pueblo Indians

*Funded in part by the National Institute of Education.

Development of Instructional Films in Ethology—"Behavior of the Ring Dove"

Rae Silver
Barnard College
606 West 120th Street
New York, NY 10027

This project will produce three coordinated versions of a teaching film on the behavior of the ring dove, emphasizing the relationship of endocrinal functions to its biological cycles and behavioral patterns. These three versions will be targeted, respectively, toward the following: (1) precollege nature study/biology; (2) undergraduate biology and comparative psychology/graduate level endocrinology and ethology; and (3) a general public environmental education film for TV distribution. With all film footage requirements pre-identified, sufficient film can be exposed in a single trip to the remote location, unused footage being earmarked for national cinematographic archives.

Associated and concurrent studies into improved production and utilization efficiencies include the following: (a) basing the entire plan on a preliminary study by educational film utilization experts who will identify existing related films to prevent unplanned duplication; define the educational needs, teacher attitudes, and target audiences; and pre-plan the educational strategy for the entire complex of films before shooting begins to minimize production costs; (b) coordinating this group's findings with scientific expertise and film-making skills to achieve an ideal mix of scientific accuracy, film quality, and educational impact; (c) experimenting with combinations of strategies to maximize market penetration and improve cost effectiveness; and (d) documenting and evaluating each step in a manner calculated to show how to increase the education returns from investments in teaching films.

AMOUNT: $260,000*
AWARDED: 09-21-77
TERMINATES: 04-30-82

AWARD NUMBER: SED77-12124
NSF PROGRAM MANAGER: Raymond J. Hannapel
PROGRAM: Development in Science Education

DISCIPLINE: Biology, General/Life and Medical Sciences
TARGET AUDIENCE: General Public

DESCRIPTORS: Film Production; Instructional Films; Animal Behavior; Educational Television; Extension Education; Audiovisual Communications; Biology; Ethology

*Cumulative amount. Fiscal Year 1980 award: $67,000.

Professional Competencies Development in the Undergraduate Engineering Curriculum

Jean LeMee
The Cooper Union for the Advancement
of Science and Art
The School of Engineering
Cooper Square
New York, NY 10003

This project will design, develop, and evaluate the first stage of a model curriculum in which engineers are trained to understand and communicate the broad, social-humanistic context in which society's technological problems occur. The goals of this curriculum are based on a two-year planning project in which faculty, academic administrators, and industrial engineers surveyed a wide range of attempts to clearly specify, in the form of competencies, those skills necessary to be an effective practicing engineer.

In the first phase of this project a number of assessment instruments developed by the American College Testing Service were utilized to develop a portion of the proposed curriculum focused on skills in problem solving, ethics and values, and communication. Cooper Union faculty worked with experts in instructional development, competency-based curricula, and educational evaluation to accomplish the following tasks: (1) state competence levels and develop assessment criteria; (2) prepare appropriate learning activities, study guides and teaching materials to enable students to meet competence criteria; (3) train faculty who will use these materials in four existing traditional engineering courses; and (4) develop formative and summary assessment instruments.

During the second project phase, project staff will develop four more courses, evaluate the impact of courses on students, and provide workshops to other engineering institutions which desire to adopt resultant material and/or techniques.

AMOUNT: $259,500*
AWARDED: 08-28-79
TERMINATES: 02-28-83

AWARD NUMBER: SED79-19004
NSF PROGRAM MANAGER:
Gregg Edwards
PROGRAM: Development in
Science Education

DISCIPLINE: Engineering Education
TARGET AUDIENCE: Undergraduates

DESCRIPTORS: Engineering Education; College Science; Science Education; Humanization; Social Values; Technological Advancement; Social Responsibility; Minimum Competencies; Professional Continuing Education

*Cumulative amount. Fiscal Year 1980 award: $142,600.

Microcomputer Courseware to Develop Insight into Arithmetic Using Perceivable Algorithms

Caleb Gattegno
Educational Solutions, Inc.
80 Fifth Avenue
New York, NY 10011

The project presents a new way of using microcomputers for teaching mathematics. The prototype will be field tested with first and second graders and early adolescents (middle school age) in predominantly minority public schools in New York City. The ultimate target audience will be elementary and middle school students. The approach to be used is based on learning through insight rather than drill. The computer is used to generate insight in students by interacting with them in such a way that their attention is focused on mathematical relationships and transformations.

Prototype courseware for generating insight and skill in numeration, addition, and subtraction will be produced, field tested, and refined.

AMOUNT: $52,000
AWARDED: 09-03-80
TERMINATES: 07-31-82

AWARD NUMBER: SED80-12612
NSF PROGRAM MANAGER: Harold J. Stolberg
PROGRAM: Development in Science Education

DISCIPLINE: Mathematics, General/Mathematical Sciences
Software Systems/Computer Science
TARGET AUDIENCE: Grades 1-8
DESCRIPTORS: Computer Assisted Instruction; Elementary School Mathematics; Mathematics Instruction; Arithmetic; Algorithms; Middle Schools; Adolescents; Mathematical Concepts; Microcomputers; Minority Group Children

A Computer Based Annotated List of Laboratory Experiments in College Chemistry

Stanley C. Bunce
Rensselaer Polytechnic Institute
Troy, NY 12181

This project will survey all articles published in the *Journal of Chemical Education* describing laboratory experiments in chemistry, prepare an annotated list of experiments in the form of a computer file, develop a program for searching that file, and make both the list and the computer file and program generally available at cost of reproduction.

A computerized annotated list will be useful to instructors planning or revising laboratory courses in chemistry and to instructors and students searching for experiments of a particular type suited for individual or "project" type experiments. It will make it possible to search quickly and effectively approximately 1,000 articles published in 30 years in the *Journal of Chemical Education* for experiments of a particular type. It will permit calling from a master list all articles with certain combinations of features (for example, all experiments involving kinetic studies of chemical reactions of organic compounds that are suitable for second year students). The annotated list will also state what special apparatus, unusual reagents, or hazards may be involved, and what background is required of the student.

AMOUNT: $14,900
AWARDED: 06-11-80
TERMINATES: 03-31-83

AWARD NUMBER: SED79-23685
NSF PROGRAM MANAGER: Gregg Edwards
PROGRAM: Development in Science Education

DISCIPLINE: Chemistry, General
TARGET AUDIENCE: College Instructors; Undergraduates
DESCRIPTORS: Chemistry; Science Education; Chemistry Instruction; Literature Reviews; Annotated Bibliographies; Computer Programs; Laboratory Experiments; Laboratory Equipment; Science Laboratories; Laboratory Techniques; Data Bases; Information Retrieval; Online Systems

Improving Spatial Skills in Pre-College Mathematics through Computer Graphics

Edith H. Luchins
Rensselaer Polytechnic Institute
Mathematical Sciences Department
Troy, NY 12181

This project will develop and test experimental educational materials intended to improve mathematical problem solving by training students in spatial visualization and orientation. Spatial skills have been shown to be good predictors of mathematical performance and grades in mathematics courses and to be important in certain occupations. Among modern technologies, computer graphics has special potential as a tool in spatial visualization and orientation training. This project will develop and produce software (which will be available at the end of the project) to generate a variety of instructional courseware.

Students will interact with subject matter using individual computer graphics systems. The computer programs will evaluate student responses and adapt the training sequence.

Moreover, this software will enable teachers to design new training experiences without special knowledge of computing. Testing of materials will be done at a public and a private high school. Pre- and post-training testing of spatial and mathematical abilities will be administered to experimental and control subjects. Since sex differences in spatial abilities have been reported widely, the project will compare the changes in spatial skills shown by males and females.

AMOUNT: $124,769*
AWARDED: 08-06-80
TERMINATES: 07-31-82

AWARD NUMBER: SED80-12633
NSF PROGRAM MANAGER:
Mary Ann Ryan
PROGRAM: Development in
Science Education

DISCIPLINE: Software Systems/Computer Science; Mathematics Education
TARGET AUDIENCE: Grades 9-12

DESCRIPTORS: Computer Assisted Instruction; Computer Graphics; Problem Solving; Mathematics Instruction; Mathematical Concepts; Spatial Perception; Orientation

*Funded in part by the National Institute of Education.

A World Model for Undergraduate College Classroom Use

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University of Denver
Graduate School of
International Studies
University Park
Denver, CO 80210

Transferred from:
Case Western Reserve
University
Cleveland, OH

The project focuses on the development of a world model of global development processes suitable for use in undergraduate college classrooms. A computer simulation will be accompanied by a student manual designed to link the model to further study. General objectives of the project are to communicate to students basic information about global development and global interdependence and to motivate students to explore further the interrelatedness of science, technology, and the important social/value issues of the day.

The initial phase of effort now under way (funded by the Cleveland Foundation) involves development of the basic model and preparation of the manual. The second phase consists of refinement of the model and accompanying manual and pilot testing of the total package at several sites.

The final model, the International Forecasting System (IF), includes the following features: (1) representation of the world in nine regions; (2) a population model; (3) an economic model; (4) an agricultural model; (5) an energy model (6) a set of environmental variables; and (7) other variables representing policy choices, technological developments, and other unknown variables.

The manual used for much of the teaching must introduce students to the subject matter, provide basic substantive information and theory, explain how to use the computer model, and motivate students to do further work.

Great care is being taken to ensure portability of the products. The computer software will be designed so it can be used on microcomputers. Dissemination is expected to take place via major computer program distribution centers and by commercial publication.

AMOUNT: $76,100
AWARDED: 07-11-80
TERMINATES: 02-28-82

AWARD NUMBER: SED80-07313
NSF PROGRAM MANAGER:
Raymond J. Hannapel
PROGRAM: Development in
Science Education

DISCIPLINE: Political Science/Social Sciences;
Software Systems/Computer Science
TARGET AUDIENCE: Undergraduates

DESCRIPTORS: Simulation; World Problems; Interdisciplinary Approach; Futures (of Society); Instructional Materials; Computer Assisted Instruction; Global Approach; World Affairs; International Studies

The Use of Microcomputers for Mathematics Instruction in Grades 1-4

William H. Kraus
Wittenberg University
Springfield, OH 45501

This project will develop 10 to 15 computer games to be used as supplements to mathematics instruction in grades one through four. The computer will be used as a learning center in the classroom. The games to be developed are based on typical game strategies used with older students: practice in skills; applications of mathematics; and problem solving. Games will be designed for both small and large group use. The mathematical content of the programs would cover the 10 basic skill areas identified by the National Council of Supervisors of Mathematics. Development of the program would stress the following: (a) appropriateness of mathematical content; (b) ease of program use; and (c) use of color graphics and animation for increased motivation, user involvement, and effectiveness of communication. Elementary teachers will be involved in the development of the programs, and the programs will be field tested in public schools.

AMOUNT: $25,048*
AWARDED: 07-11-80
TERMINATES: 12-31-82

AWARD NUMBER: SED80-12268
NSF PROGRAM MANAGER: Dorothy K. Deringer
PROGRAM: Development in Science Education

DISCIPLINE: Software Systems/Computer Science; Mathematics, Elementary/Mathematical Sciences
TARGET AUDIENCE: Grades 1-4
DESCRIPTORS: Mathematics Instruction; Elementary School Mathematics; Computer Assisted Instruction; Educational Games; Learning Centers; Problem Solving; Basic Skills; Computer Graphics; Microcomputers

*Funded in part by the National Institute of Education.

Pre-College Science Education Materials on Mt. St. Helens' 1980 Eruption

Michael Fiasca
Portland State University
P. O. Box 751
Portland, OR 97207

This project will assemble an exhaustive, immediate, and on-the-spot collection of high-appeal photos (still, movie, and videotape) which record the Mt. St. Helens' eruptions and will prepare materials which describe their ecological, social, and economic sequels in the Pacific Northwest. The most suitable of these materials will be incorporated into an 80-slide/tape presentation for principal use in high school and junior high school classes, but with probable implications for adult audiences also.

Forty sets of trial materials will be field tested under the supervision of the National Association of Geology Teachers. Following necessary revisions, availability of the materials will be announced nationally through the NAGT and through numerous journals read by teachers and the general public. The materials will be distributed at cost through the Division of Continuing Education of the Oregon State System of Higher Education.

In addition, the collected video materials, supporting field notes, and the like (all captured while this enormous event is actually occurring) will be passed on to the staff of the Crustal Evolution Project which will create an additional module on volcanism for use in that series.

The film-tape presentation, while capitalizing on the drama and popular appeal of the eruptions, will put the events into the larger context of crustal tectonics (volcanism, mountain building, the Cascades Range) and the environmental and social impacts of a volcanic eruption in the midst of a populous region.

AMOUNT: $17,637
AWARDED: 07-18-80
TERMINATES: 06-30-81

AWARD NUMBER: SED80-20737
NSF PROGRAM MANAGER: Raymond J. Hannapel
PROGRAM: Development in Science Education

DISCIPLINE: Geology/Earth Sciences
TARGET AUDIENCE: Grades 9-12

DESCRIPTORS: Instructional Materials; Audiovisual Aids; Earth Science; Geology; Secondary School Students; High School Curriculum; Curriculum Enrichment; Films; Photographs; Videotape Recordings; Slides

Computer Graphics in a High School Mathematics Laboratory

John H. Staib
Drexel University
Philadelphia, PA 19104

This project will develop a series of microcomputer-based mathematics experiments designed to accompany a high school course in elementary mathematical functions. The experiments will constitute a laboratory course which will make use of interactive computer graphics as a means for developing mathematical insights and for otherwise motivating and enhancing the learning of mathematics. These experiments will be designed to encourage the use of inductive reasoning processes.

A team of mathematicians, mathematics educators, and computer scientists will design, develop, and field test the laboratory course. The team will produce the necessary software, a student laboratory manual with worksheets, and a teacher's guide. The project will be a cooperative one including the school district of Philadelphia. The school district will contribute personnel and make possible a classroom test of the materials.

Results of the project will be presented at local and national professional meetings. The materials will be demonstrated at in-service courses for teachers in the Philadelphia area and will be made available to other school systems and individual teachers throughout the country.

AMOUNT: $123,000
AWARDED: 08-14-80
TERMINATES: 09-30-82

AWARD NUMBER: SED80-12532
NSF PROGRAM MANAGER: Harold J. Stolberg
PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 11-12
DESCRIPTORS: Mathematics Curriculum; Educational Technology; Computer Graphics; Laboratory Experiments; Curriculum Enrichment; Computer Assisted Instruction; Secondary School Mathematics; Microcomputers; Induction; Mathematical Concepts

A Model Computer-Based Interpretive System for Science Museums

Minda Borun
The Franklin Institute Science
Museum and Planetarium
20th Street & The Parkway
Philadelphia, PA 19103

The Franklin Institute will develop a model computer-based interpretive system for the explanation of participatory science-teaching exhibits. A computer-based interpretive system will be designed to enhance present museum exhibits in energy, transportation or optics. The system, which will contain materials on three different reading levels, will enable visitors to browse through a broad range of current information in an interactive format.

The 18-month pilot project will develop, test, and evaluate a data input and interactive information-retrieval program and public-access system. The hardware configurations, data input, and user programs will be designed with sufficient generality to be directly exportable to other museums for use with data based on their own exhibitions. Plans for further dissemination will be formulated during the course of the project.

AMOUNT: $135,114
AWARDED: 12-12-79
TERMINATES: 12-31-81

AWARD NUMBER: SED79-19003
NSF PROGRAM MANAGER:
Dorothy K. Deringer
PROGRAM: Development in
Science Education

DISCIPLINE: Software Systems/Computer Science; Computer Systems Design
TARGET AUDIENCE: General Public
DESCRIPTORS: Museums; Computer Assisted Instruction; Information Dissemination; Co-curricular Activities; Scientific Concepts; Energy; Optics; Transportation; Information Retrieval; Data Bases

A Microcomputer-Based Laboratory Measurement System for Undergraduate Electrical Engineering Laboratories

Paul T. Hulina
Pennsylvania State University
121 Electrical Engineering East
University Park, PA 16802

Electrical engineering curricula are being affected dramatically by the microelectronics revolution; this is especially true of electrical engineering laboratory courses. Specialized measurement equipment needed to keep abreast of these new developments has placed a severe strain on already tight budgets. As a response to this situation, the project will develop and evaluate a microcomputer-based measurement system for undergraduate engineering laboratories which enriches modern instrumentation techniques and is available at low cost. The effort will result in the design of a general purpose source and detector (for electrical circuits) which would be coupled to a low-cost microcomputer system. Software would be designed using a higher-level language (BASIC) to imitate a variety of modern instruments needed in an undergraduate laboratory. The results of a preliminary effort indicate that a cost effective system can be developed which will allow for meaningful integration and evaluation in an undergraduate laboratory.

AMOUNT: $77,600
AWARDED: 11-08-79
TERMINATES: 01-31-82

AWARD NUMBER: SED79-18985
NSF PROGRAM MANAGER: Dorothy K. Deringer
PROGRAM: Development in Science Education

DISCIPLINE: Computer Science; Engineering Education
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Engineering Education; Measurement Instruments; Measurement Techniques; Cost Effectiveness; Instructional Materials; Computer Assisted Instruction; Microcomputers

Educational Modules for Materials Science and Engineering (EMMSE)

Rustum Roy
Pennsylvania State University
Materials Research Laboratory
University Park, PA 16802

This award is for the third segment of a four-year project to organize a system for the production and dissemination of teaching aids and instructional materials in modular form for Materials Science and Engineering (MSE). During the first two and one-half years, the project has made the following progress: (1) continued the development of five Topic-Area Teams in the major subfields of MSE (these teams have been encouraging the development of materials covering the basic examples of more advanced work as often taught in leading schools); (2) produced and distributed in four volumes 23 peer-reviewed, student-tested instructional modules; (3) started the organization of cognate groups in other countries (the one in Europe has just received its first grant from NATO and will produce materials during the next year); and (4) started up a long-range planning group which will survey past performance, current needs of client groups, and suggest the next steps for system development.

During the next year and a half, the project plans to accomplish the following: (1) continue engaging more of the academics in this field to participate in project activities--especially writing and reviewing materials; (2) produce and distribute another six volumes of modules; (3) continue setting up foreign groups who can contribute instructional modules, especially in those areas in which foreign nationals have superior work; and (4) shift to encouraging individual contributions.

If successful, this project should provide a prototype of a new mode for technology transfer.

AMOUNT: $493,975*
AWARDED: 09-16-77
TERMINATES: 05-31-82

AWARD NUMBER: SED77-14149.A02
NSF PROGRAM MANAGER: Gregg Edwards
PROGRAM: Development in Science Education

DISCIPLINE: Science Education; Engineering Education
TARGET AUDIENCE: Undergraduates; Graduate Students; Engineers; Scientists

DESCRIPTORS: Instructional Materials; Engineering Education; Curriculum Enrichment; Material Development; Foreign Nationals; Workshops; Learning Modules; Information Dissemination

*Cumulative amount. Fiscal Year 1980 award, amendment 02: $197,395.

Educational Modules for Materials Science and Engineering (EMMSE)

Rustum Roy
Pennsylvania State University
Materials Research Laboratory
University Park, PA 16802

This supplemental award is intended to acquire recently developed microcomputer technology to increase the effectiveness of production and distribution of instructional materials for materials science and engineering. Much of the content of this field is presented graphically, and graphical materials have been extremely expensive to prepare. The project will also purchase optical scanning and digitizing equipment to put extant graphical material into electronic form. The project will also purchase a computer and mass storage devices to transform the graphics into formats needed for instruction, and then disseminate the results in digital form (by magnetic tape reels and by telephone lines) to the user audiences. In addition, the new equipment will permit the project to disseminate instructional materials designed for small and highly dispersed, but crucially important, technical specialties—the volume of material, large data bases, and small numbers of students do not make print distribution economical. Several clusters of instructional materials, and associated data, will be prepared and tested in university and industrial continuing education programs.

AMOUNT: $543,384*
AWARDED: 09-16-77
TERMINATES: 05-31-82

AWARD NUMBER: SED77-14149.A03
NSF PROGRAM MANAGER:
Gregg Edwards
PROGRAM: Development in
Science Education

DISCIPLINE: Materials/Engineering
TARGET AUDIENCE: Undergraduates; Graduate Students; Engineers
DESCRIPTORS: Instructional Materials; Engineering Education; Instructional Technology; Computer Assisted Instruction; Professional Continuing Education; Information Dissemination; Computer Storage Devices; Digital Computers; Science Materials; Computer Graphics; Data Bases

*Cumulative amount. Fiscal Year 1980 award, amendment 03: $49,409.

Using a Visual Technique to Teach High School Students the Concept of Variables in Polynomials

Joel Baumeyer
Christian Brothers College
650 E. Parkway South
Memphis, TN 38104

This project will assist students who have difficulty in the manipulation of the basic symbols used in introductory algebra. This difficulty leads to a failure to understand the true nature of a polynomial and precludes the further study of mathematics. Four objectives will be attained: (1) the student will learn to use "polyboxes" in order to understand the concept of a variable in a polynomial (the "polybox" is a visual device that replaces the variable "x" in a way that is visually more obvious than standard notation); (2) software for computer programs will be written to use "polyboxes" with a visual display on an interactive display terminal which includes feedback from a small computer; (3) students will use the software in lessons devised as a module for classroom instruction or self-paced instruction to learn the manipulation of basic polynomials and to obtain a better understanding of the nature of a polynomial; and (4) the module, consisting of five lesson plans including the typical teacher aids of performance objectives and tests and written in a programmed learning self-paced mode, will be prepared and packaged. This project is geared to the 11th and 12th grade student taking algebra and/or the junior college student or college freshman taking introductory college algebra. The evaluation and dissemination will take place in a pilot classroom with students and in a workshop with secondary school teachers of algebra. Teachers will evaluate this project relative to the usefulness of the module in their individual classrooms.

AMOUNT: $34,106
AWARDED: 09-02-80
TERMINATES: 02-28-83

AWARD NUMBER: SED80-12518
NSF PROGRAM MANAGER: Harold J. Stolberg
PROGRAM: Development in Science Education

DISCIPLINE: Software Systems/Computer Science; Algebra or Number Theory/Mathematical Sciences
TARGET AUDIENCE: Grades 11-12; Two-year College Students; College Freshmen

DESCRIPTORS: Computer Assisted Instruction; Undergraduates; Algebra; Instructional Materials; Symbols (Mathematics); Mathematical Concepts; High School Students; Concept Formation; Visual Aids; Visual Stimuli

Curriculum Analysis and Student Interrogation and Information System

Ernest J. Henley
University of Houston
Central Campus
Houston, TX 77004

This project will produce an information system to permit the shifting from a mode of instruction based on courses to one based on selections from a bank of several thousand modules. These modules are single-concept and lecture-length packages of readings, exercises, and computer programs. This shift is intended to provide opportunities for curriculum planning on a highly individualized basis, for course reorganization based on evidence, and for greatly increased opportunities for independent study and self pacing. A key element is nationally accessible computer-based information and management programs designed for the following purposes: (1) to allow sharing of materials by authors in many universities; (2) to indicate needed materials to prospective authors; (3) to advise students on appropriate learning sequences; and (4) to assist teachers in curriculum restructuring. During the first two years some elements of the system have been created: a Data-Based Management System (accessible to universities through telephone links) has been used to enter the abstracts of 154 modules; a computer-based student advising system on course sequencing is under trial at the University of Kansas; the computer-moderated analysis of alternative learning paths based on sequences of key terms is being simulated.

During the third year of this four-year project, the above programs will be integrated on the basis of a larger collection of materials and trial uses.

AMOUNT: $225,960*
AWARDED: 06-01-77
TERMINATES: 03-31-81

AWARD NUMBER: SED76-21950
NSF PROGRAM MANAGER: Gregg Edwards
PROGRAM: Development in Science Education

DISCIPLINE: Software Systems/Computer Science
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Information Networks; Dial Access Information Systems; Planning; Curriculum Planning; Educational Alternatives; Learning Modules; Autoinstructional Aids; Data Bases; Information Retrieval

*Cumulative amount. Fiscal Year 1980 award: $50,000

Using Non-Formal Contexts to Teach Children Science

Howard L. Jones
University of Houston
Central Campus
3800 Calhoun
Houston, TX 77004

To enhance the interest of adolescents in science, this project will develop 11 supplemental physical science miniunits for use in junior and senior high schools. The units will focus on physics and mathematics concepts associated with experiences in amusement parks and playgrounds. Topics covered in the mini-units include motion, acceleration, relativity, forces, gravity, time, graphing, conservation of energy, and frames of references. Each mini-unit will provide interrelated instruction both in the classroom and in amusement park settings. Teachers' and students' guides, audiovisual materials, and inexpensive measuring devices will be developed for use with each of the mini-units. An additional outcome of the project will be a series of research reports that will focus on the impact of amusement park experiences on adolescents' science knowledge and attitudes. The miniunits will be pilot tested in selected classrooms in Houston and other locations. An ethnographic evaluation of classroom interactions will be applied formatively to aid in the development of instructional materials. It is planned that all materials will be made available commercially. Articles will be submitted to appropriate professional journals.

AMOUNT: $293,400
AWARDED: 08-11-80
TERMINATES: 02-29-84

AWARD NUMBER: SED80-16566
NSF PROGRAM MANAGER:
Carl J. Naegele
PROGRAM: Development in
Science Education

DISCIPLINE: Physics, General
Mathematics, General/Mathematical Sciences
TARGET AUDIENCE: Adolescents, Grades 7-12
DESCRIPTORS: Science Activities; Science Materials; Instructional Materials; Supplementary Education; Recreational Facilities; Parks; Recreation; Physics Instruction; Playgrounds; Mathematical Concepts; Field Trips; Experiential Learning; Activity Units; Sensory Experience

Mental Errors in Arithmetic Skills: Their Diagnosis and Remediation in Pre-College Students

C. Victor Bunderson
WICAT, Inc.
Learning Design Laboratories
1160 South State, Suite 10
Orem, UT 84057

This project will study methods of diagnosing consistent mental errors (termed cognitive bugs) exhibited by students in elementary arithmetic, the frequency and stability of such errors, and ways to remediate the errors using a microcomputer. Three populations will be involved in the study: third to fifth graders in Orem, Utah; fourth to sixth graders in Salt Lake City (including students from the middle class, urban poor, and minority groups); and teenaged juvenile delinquents in Salt Lake City alternative schools. The objectives include the following: (1) to develop cognitive diagnostic models and tests in subtraction, multiplication, and addition of fractions; (2) to obtain data to determine the need for computerized diagnostic testing for each of the three areas; (3) to develop, if the cognitive bugs are frequent enough and stable, microcomputer-based diagnostic tests to follow paper and pencil screening tests; and (4) to develop micro- computer-based remediation programs to structure a remedial interchange between a student and tutor.

The diagnostic and remedial programs will be evaluated in field experiments. The materials will be made available to interested parties upon request. Research findings will be disseminated via presentation at national conferences and publication in professional journals.

AMOUNT: $141,544*
AWARDED: 09-09-80
TERMINATES: 08-31-82

AWARD NUMBER: SED80-12500
NSF PROGRAM MANAGER: Dorothy K. Deringer
PROGRAM: Development in Science Education

DISCIPLINE: Mathematics, General/Mathematical Sciences
TARGET AUDIENCE: Grades 1-12

DESCRIPTORS: Error Patterns; Educational Diagnosis; Arithmetic; Learning Problems; Remedial Programs; Remedial Arithmetic; Computer Assisted Instruction; Diagnostic Teaching; Diagnostic Tests; Microcomputers

* Funded in part by the Research in Science Education (RISE) Program.

Computer Literacy Guides for Elementary and Junior High Schools

Beverly Hunter
Human Resources Research Organization (HumRRO)
Eastern Division
300 North Washington Street
Alexandria, VA 22314

This project will enable schools to infuse computer-related skills and knowledge into the traditional curriculum of elementary and junior high school science, social studies, and mathematics. This literacy project will concentrate on the computer, which has become a popular symbol of modern science and technology. The goal is to enable all students, kindergarten through junior high school, to acquire minimal computer-related skills required in their role as citizens in our information-based society.

The project will begin with a national invitational conference coordinated through a related project (SED79-18987) by the Minnesota Educational Computing Consortium (MECC). The conference will further develop course objectives and establish advisory committees.

The MECC project will concentrate on the development of student materials for use as supplementary or course-length modules in middle school or high school. The HumRRO materials are for teachers in grades K-8.

A curriculum kit will be developed and tested. The kit will spell out a developmental sequence of literacy learning outcomes by grade level, subject area, and unit. For each learning outcome, a set of classroom activities and resource materials will be suggested. Guides for equipment planning, teacher training, and implementation of the program will also be developed. The learning outcomes will be defined by a panel of experts. Fifty K-8 teachers and subject specialists will identify scope and sequence. HumRRO staff will prepare the kits. Montgomery County, Maryland, schools will try out the package in the classroom, and monitored field tests will be conducted in two dissimilar school districts. The package will be disseminated through professional societies and will be offered for commercial publication.

AMOUNT: $216,755
AWARDED: 04-18-80
TERMINATES: 09-30-83

AWARD NUMBER: SED79-23684
NSF PROGRAM MANAGER:
Dorothy K. Deringer
PROGRAM: Development in
Science Education

DISCIPLINE:	Science Education Software Systems/Computer Science
TARGET AUDIENCE:	Grades K-8
DESCRIPTORS:	Learning Processes; Learning Activities; Instructional Materials; Curriculum Development; Elementary School Curriculum; Computer Science Education; Computer Oriented Programs; Science Instruction; Mathematics Instruction; Social Studies

Graphing in High School Level Algebra and Trigonometry for Adults

J. Richard Morris
Virginia Commonwealth University
901 West Franklin Street
Richmond, VA 23284

A software package of 15 to 20 graphing lessons intended for use on a computer graphics terminal will be developed by three members of the Mathematical Sciences Department at Virginia Commonwealth University. This package will be used by students on an individual and personalized basis with the help of a qualified teaching assistant. This software will augment existing courses in elementary algebra, intermediate algebra, and trigonometry. The content of these courses is the same as that found at grade levels 10 through 12. Each lesson in the software package will be written so that the student is an active participant in the graphing process.

Appropriate testing will take place at each stage of development to insure the effectiveness of the graphing lessons. When the software is complete, a control group and an experimental group will be selected from among the groups of students of age 25 or over. Both student achievement and attitude will be assessed. Guidelines established by CONDUIT will be used as a basis of project organization and management. The software and the new knowledge which result from the project will be disseminated.

AMOUNT: $55,494*
AWARDED: 07-09-80
TERMINATES: 12-31-82

AWARD NUMBER: SED80-12447
NSF PROGRAM MANAGER: Dorothy K. Deringer
PROGRAM: Development in Science Education

DISCIPLINE: Software Systems/Computer Science; Mathematics, General/Mathematical Sciences
TARGET AUDIENCE: Undergraduates; Continuing Education Students
DESCRIPTORS: Mathematics Education; Algebra; Trigonometry; Computer Assisted Instruction; Adult Students; Computer Graphics; Individual Instruction; Instructional Materials; Graphs; Microcomputers

* Funded in part by the National Institute of Education.

Geometric Visualization: Dynamic Graphics to Develop Mathematical Perception and Intuition in Pre-Calculus Students

Gerald L. Isaacs
Carroll College
100 N. East Avenue
Waukesha, WI 53186

This project is a joint effort between Carroll College and the Waukesha Public School System. Its primary purpose is to improve the teaching of pre-calculus courses through the introduction of Geometric Visualization Techniques using the graphics capabilities of low-cost microcomputers and television displays. The approach will be to promote understanding, using geometric representation and interpretation. An equally important goal is to introduce a prototype for designing graphics software to be used throughout mathematics and science education. This software will be designed in such a way as to be easily transported across hardware, graphics devices, and dialects of BASIC. The project revolves around the concept that there are many topics in mathematics that can be better presented and understood with the aid of dynamic graphics. To insure widest possible use, the software will be designed so that the instructor need only turn on the machine and start the program. The package would then present the material in English with appropriate prompts and a clear indication of the options available at each step. The project will be discussed at national meetings, papers will be submitted to professional journals, and the courseware and documentation will be disseminated initially through Carroll College and CONDUIT.

AMOUNT: $149,327
AWARDED: 08-22-80
TERMINATES: 08-31-82

AWARD NUMBER: SED80-12457
NSF PROGRAM MANAGER: Harold J. Stolberg
PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education; Software Systems/Computer Science
TARGET AUDIENCE: Grades 9-12; Undergraduates
DESCRIPTORS: Programming; Mathematics Instruction; Secondary School Mathematics; Mathematical Concepts; Computer Graphics; Computer Assisted Instruction; Televised Instruction; Instructional Technology; Microcomputers; Geometric Concepts

Factors Influencing Mathematics Participation of Highly Able Mexican-American Adolescents

Linda M. Oldaker
Arizona State University
Tempe, AZ 85281

This study will investigate the social/emotional and cognitive factors influencing decisions of Mexican-American secondary school students to avoid or persist in mathematics training. The team of investigators includes a mathematics educator, a mathematician, and a social scientist. They will design or obtain instruments to measure which factors are influential in a student's decision to persist in mathematics. The study will test the following categories of variables: (1) family-related variables; (2) significant others; (3) career consciousness; (4) attitudes toward mathematics; (5) cognitive styles; and (6) language-related variables. Pertinent demographic and academic data also will be obtained. The sample will consist of 450 students in grades 8, 9, and 10. The data will be analyzed using path analysis techniques to test the degree of influence of decision-related variables. Articles will be prepared for publication in various journals and presented at meetings.

AMOUNT: $148,966
AWARDED: 08-15-80
TERMINATES: 07-31-82

AWARD NUMBER: SED80-17768
NSF PROGRAM MANAGER: Douglas McLeod
PROGRAM: Research in Science Education

DISCIPLINE: Mathematics, General/Mathematical Sciences
TARGET AUDIENCE: Grades 8-10
DESCRIPTORS: Mathematics; Secondary School Mathematics; Minority Groups; Mexican-Americans; Student Attitudes; Racial Attitudes; Social Factors; Instrumentation; Career Planning; Cognitive Processes; Mathematics Anxiety

Research to Promote Science Learning Among Blind Students in Colleges and Universities

Morris Sica
California State University
Fullerton, CA 92634

The intent of this project is to ascertain factors which help and factors which hinder blind students' progress in science at the college level. It will proceed in two phases. In Phase I, five blind persons will be trained to conduct interviews with 90 blind students in California colleges. These interviewers will have had some experience in science. Critical incidents that blind students describe as positive will be probed to determine the attributes of instruction judged to be helpful to learning. Instructional methods which seem to hinder the learning process will be identified. Science instructors who have had blind students in their science classes will also be interviewed with a similar objective; namely, to discover the attributes of successful and unsuccessful strategies. A principal consultant to the project is a blind biology teacher. A content analysis of the critical incidents provided by both students and teachers will be the basis for developing characteristics of successful and less successful conditions for science learning by blind students. One product of this research will be a report that identifies the main factors that need to be considered in teaching science to the blind. Some better understanding of how blind students acquire science concepts is expected to emerge. A set of questions to be investigated under more controlled circumstances will be another product of the study. If the results indicate that the proposed methodology is an effective way to do the research, a more extensive study may be proposed.

AMOUNT: $30,682
AWARDED: 01-18-80
TERMINATES: 03-31-81

AWARD NUMBER: SED79-20597
NSF PROGRAM MANAGER: Kathleen M. Fisher
PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Handicapped; Undergraduates
DESCRIPTORS: Blindness; Disabilities; Cognitive Processes; Scientific Concepts; Science Literacy; Learning Problems; Instructional Improvement; Students; Interviews; Evaluation Methods; Handicapped

Science Education for Women, Minority, and the Physically Handicapped Students in Community Colleges

Arthur M. Cohen
Center for the Study of Community Colleges
1047 Gayley Avenue, Suite 205
Los Angeles, CA 90024

The objective of the project is to describe intervention strategies that will allow colleges to remove barriers and to develop incentives for the participation of minorities, women, and the physically handicapped in science.

This project will study and describe the course-taking patterns, science background, and attitudes toward science of women, minority, and physically handicapped students. It will also examine the institutional patterns that inhibit or enhance science enrollments and analyze the interaction among these variables in the Los Angeles Community College District, which comprises nine colleges with markedly different proportions of ethnic enrollments. As such, this study addresses an important national problem: the underrepresentation of minorities, women, and the physically handicapped in the sciences. Many reasons have been advanced for this situation and many college programs have been developed to remedy this inequity. However, the mechanisms by which college students are attracted to the study of science are not clearly understood.

Data will be gathered through five activities: student surveys; transcript analyses; instructor surveys; tabulation of science course offerings listed in college catalogs and class schedules; and staff interviews. These data will be synthesized through the development of a College Orientation Toward Science index and a Student Orientation Toward Science index.

AMOUNT: $189,546
AWARDED: 10-19-79
TERMINATES: 12-31-82

AWARD NUMBER: SED79-20222
NSF PROGRAM MANAGER: Kathleen M. Fisher
PROGRAM: Research in Science Education

DISCIPLINE: Science Education; Multidisciplinary Sciences
TARGET AUDIENCE: Females; Minorities
DESCRIPTORS: Women's Education; Sex Bias; Educational Attitudes; Social Bias; Ethnicity; Minority Groups; Scientific Attitudes; Learning Motivation; Handicapped Students; Instructional Improvement

A Longitudinal Study of Women and Minorities in Science and Engineering

Rita A. Scherrei
Higher Education Research Institute
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Los Angeles, CA 90024

This is a study of factors which bear on retention of minorities and women in science and technology. The population consists of a national sample of 50,000 persons who as college freshmen in 1971 completed a survey questionnaire at the time of entry. They were re-surveyed in 1979-80. Those who aspired to careers in science, engineering, or mathematics will be the focus of this investigation. In addition, those who later migrated into one of these fields will be studied. An attempt will be made to identify conditions that improve the likelihood of retention and to clarify the conditions which appear to function as barriers. The investigation will show whether the patterns are the same for Blacks and Hispanics and women, or whether there are features unique to each group. To validate the findings from the large data base analyses, a sample of respondents from each segment of the study will be selected for more in-depth interviews. The study is expected to contribute information which will be useful to career counselors and for the planning of continuing education beyond the baccalaureate.

AMOUNT: $49,542
AWARDED: 08-15-80
TERMINATES: 05-31-82

AWARD NUMBER: SED80-17651
NSF PROGRAM MANAGER:
Kathleen M. Fisher
PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Grades 9-12; Undergraduates; Graduate Students; Females; Minorities
DESCRIPTORS: Women's Studies; Minority Groups; Science; Technology; Engineering; Mathematics; Questionnaires; Longitudinal Studies; Continuing Education; Career Change; Career Choice; College Students; Interviews; Career Planning

Learning Science in Bilingual Classrooms: Interaction and Social Status

Elizabeth G. Cohen
Stanford University
School of Education
Stanford, CA 94305

This research applies an established sociological theory, Expectation Theory, to the analysis of the processes of learning cience in bilingual elementary classrooms (grades 2-4). The science program materials are especially developed for bilingual instruction and stress experiential learning. In the context of a predominantly interaction-based science program, the content, nature, and quality of child-child and child-teacher encounters is a salient feature, and hypotheses from Expectation Theory regarding status, engagement in learning, and achievement need to be investigated. If it can be shown that academic status is operating to depress interaction and science learning for poor readers, then responses addressed to this problem can be instituted. Nine schools in five districts are involved in a bilingual science program of 15 weeks' duration. Results of the research will have implications for both theory and practice.

AMOUNT: $78,733
AWARDED: 06-20-80
TERMINATES: 02-28-82

AWARD NUMBER: SED80-14079
NSF PROGRAM MANAGER: Kathleen M. Fisher
PROGRAM: Research in Science Education

DISCIPLINE: Science Literacy/Education
TARGET AUDIENCE: Grades 2-4; Bilingual Students
DESCRIPTORS: Science Education; Bilingual Students; Bilingual Education; Predictor Variables; Group Status; Academic Achievement; Interaction Process Analysis; Ethnic Studies; Social Experience; Experiential Learning

Improving Students' Comprehension of Science Prose

Richard E. Mayer
University of California at Santa Barbara
Santa Barbara, CA 93106

The major goal of this project is to determine how to increase students' understanding of scientific prose by developing presentation formats (such as the use of redundancy or analogy) and training in reading strategies (such as identifying key ideas or restating the relations expressed) that are specific to domains in science. Understanding is defined in terms of a student's ability to use the presented information in problem solving. This project will use the prose analysis techniques of cognitive psychology in order to specify the structure of various domains of science prose. Specific issues are addressed: (1) Are there characteristic prose structures for different domains in science? (2) What do good problem solvers know after reading a text that poor problem solvers do not pick up? (3) Does emphasis on the structure and critical features of a science passage influence subsequent problem solving performance? (4) Does training in specific domain-related reading strategies influence subsequent problem solving performance? This project is directed especially at undergraduate students who normally do not perform well in science.

AMOUNT: $59,252
AWARDED: 08-15-80
TERMINATES: 08-31-83

AWARD NUMBER: SED80-14950
NSF PROGRAM MANAGER:
Erik D. McWilliams
PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Reading Processes; Cognitive Processes; Reading Comprehension; Reading Skills; Prose; Problem Solving; Learning Theories; Science Instruction; Science Materials; Scientific Concepts; Reading Diagnosis; Reading Ability

Logical Competencies and Activity Selection Patterns in Early Adolescents: A Longitudinal Study

James T. Robinson
Biological Sciences Curriculum Study Company
P.O. Box 930
Boulder, CO 80306

The purpose of this project is to make available to researchers evaluation and research data from the Human Sciences Program (HSP). The data base is longitudinal in character and contains information on choice behavior, attitudes, and achievement of adolescent students in human science. The availability of this data source will provide researchers with an opportunity to test hypotheses concerning the contribution of curriculum variables and student variables to growth in biological knowledge, logic, and attitudes toward science.

This project has two parts: (1) to prepare archive data tapes for data collected in conjunction with the development and testing of the HSP modules; and (2) to trial test the tapes and their transferability by running some analyses which would then be subject to peer review. A Statistical Package for the Social Sciences (SPSS) archive file of data collected for nearly 1,000 students who used 15 HSP modules will be prepared. These data include logic test scores, attitude scales, achievement test item responses, activity evaluation ratings, questionnaire responses, and the biographical data. Data are available for 1974 through 1976.

AMOUNT: $126,976
AWARDED: 03-31-80
TERMINATES: 09-30-81

AWARD NUMBER: SED79-19312
NSF PROGRAM MANAGER:
Rita W. Peterson
PROGRAM: Research in Science Education

DISCIPLINE: Biology, General/Life and Medical Sciences
TARGET AUDIENCE: Adolescents
DESCRIPTORS: Data Bases; Longitudinal Studies; Attitudes; Adolescents; Biology; Achievement; Scientific Attitudes; Behavior Patterns; Curriculum Research; Evaluation Methods

The Status of Middle School/Junior High School Science

Paul DeHart Hurd
Biological Sciences Curriculum Study Company
Center for Educational Research and Evaluation
P.O. Box 930
Boulder, CO 80306

The purpose of this project is to analyze and describe the present status of middle school/junior high science instruction in the United States and, from this synthesis, to propose characteristics for effective science instruction for grades 6 to 9 for the 1980s.

The research procedure includes an analysis and synthesis of existing data that describe the condition of middle school/junior high science instruction for two distinctly different periods in science education: 1965-70 and 1975-80. The principal data sources for the earlier period will be science texts and several national surveys of middle school/junior high school science instruction. The primary sources for the later period will be the three NSF-funded status studies of precollege education and data for 13-year-olds of the 1978 National Assessment of Educational Progress science study. Science instruction research data for middle school/junior high for the period 1965-80 will also be synthesized. Interpretations will incorporate the rationale of the middle school and changes and trends in the scientific enterprise that should be considered for effective science instruction at these levels. The results of the study will be presented in a variety of formats for different audiences (middle school/junior high teachers and administrators, the public, the NSF, and science educators). Recommendations for further research will be derived from gaps and discrepancies in the data.

AMOUNT: $119,962
AWARDED: 09-16-80
TERMINATES: 06-30-82

AWARD NUMBER: SED80-15816
NSF PROGRAM MANAGER:
Raymond J. Hannapel
PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Grades 6-9
DESCRIPTORS: Science Programs; Surveys; Middle Schools; Science Instruction; Science Courses; Junior High Schools; Curriculum Planning; Science Curriculum; Synthesis; Comparative Analysis; Evaluation

Research in Science Education: New Questions, New Directions

James T. Robinson
Biological Sciences Curriculum Study Company
Center for Educational Research and Evaluation
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Boulder, CO 80306

An invitational conference for science educators and scientists will explore three new areas of research of potential interest to science educators engaged in training graduate students and science department chairmen interested in teaching and learning. The conference will examine the work of nine researchers, each with different approaches in separate but related fields. These include the analysis of curriculum materials, investigations of contextual factors in science classrooms, and investigations of student understandings of science. New approaches to research in science education will be discussed by small groups in the final symposium of the conference. Topics of discussion concern recent developments in the analysis of text materials with special emphasis on the text, the most used curriculum resource. Other topics addressed include new insights into the interactions of students, teachers, and curriculum materials based on ethnographic, ecological, and case studies in science classrooms. The papers presented at the conference will be published in a conference report to be made available to the science education community.

AMOUNT: $25,628
AWARDED: 08-15-80
TERMINATES: 02-28-82

AWARD NUMBER: SED80-17531
NSF PROGRAM MANAGER: Kathleen M. Fisher
PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Teachers; Scientists; Graduate Students; Education Administrators
DESCRIPTORS: Science Instruction; Science Curriculum; Instructional Materials; Content Analysis; Textbook Research; Classroom Research; Case Studies; Curriculum Research; Conferences; Context Clues; Reading Comprehension

An Expert-Novice Information Processing Study of Problem-Solving in Genetics

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Biological Sciences Curriculum Study Company
Center for Educational Research and Evaluation
P.O. Box 930
Boulder, CO 80306

This is a pilot study of the mental processes and structures used in solving problems in genetics. These processes and structures will be inferred from intensive observations of both experts and novices (in genetics) as they work on such problems. The novices will consist of students from several nearby high schools. Teachers and researchers from the field of genetics will serve as the experts. The resulting descriptive "model" of problem solving, at several levels of expertise, will then be tested and refined with "new" groups of problem solvers. The end result of the research is hoped to be the beginning of a better understanding of human information processing in solving genetics problems. The results eventually could lead to more efficient instruction for students to help them understand the major concepts of genetics and be able to apply these concepts in an efficient manner in solving genetics problems.

AMOUNT: $35,480
AWARDED: 08-22-80
TERMINATES: 02-28-82

AWARD NUMBER: SED80-17671
NSF PROGRAM MANAGER:
Erik D. McWilliams
PROGRAM: Research in Science Education

DISCIPLINE: Genetics/Life and Medical Sciences
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Genetics; Problem Solving; Cognitive Processes; Information Processing; Models; Comparative Analysis; Scientific Literacy; Observation; Science Instruction; Biology Instruction; Science Teachers

Investigation of Critical Barriers to the Understanding of Science

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Mountain View Center for Environmental Education
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Boulder, CO 80309

Experience over the years at the Mountain View Center has uncovered a problem common to children and adults in learning elementary concepts in science and mathematics. Because this type of problem displays a particular set of attributes, the principal investigator has labeled them "critical barrier phenomena." Critical barriers appear to arise because of a person's difficulties in making the transition in thought processes from "common sense views" of natural occurrences to scientific interpretations. When these barriers are overcome, the new understanding has been observed to give a powerful impetus to further learning.

The current investigation will attempt to clarify the concept of critical barriers to the understanding of science by university students within the instructional setting provided by a newly initiated program of interdisciplinary studies at the University of Colorado. The investigation also will include precollege teachers. The project director, a philosopher of science, will be joined by faculty in the natural and behavioral sciences and by staff of the Mountain View Center in research to identify and characterize these critical conceptual barriers. Initial work will concentrate on developing the methodology for documentation and analysis. An interdisciplinary seminar will contribute to theory odevelpment and to planning further empirical studies. Outcomes expected will include the beginning of a taxonomy of critical barriers to understanding science and a related set of instructional techniques to overcome these barriers.

AMOUNT: $180,622
AWARDED: 08-07-80
TERMINATES: 08-31-82

AWARD NUMBER: SED80-08581
NSF PROGRAM MANAGER:
Erik D. McWilliams
PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Preschool; Grades K-12; Undergraduates; Graduate Students; Minorities; Teachers

DESCRIPTORS: Thought Processes; Concept Formation; Learning Processes; Experimental Teaching; Cognitive Development; Scientific Concepts; Scientific Literacy; Interdisciplinary Approach; Mathematics

Analysis (Meta-Analysis) of Major Facets of Science Education

Ronald D. Anderson
University of Colorado
School of Education
Boulder, CO 80309

The purpose of this project is to conduct analyses of a wide range of topics in science education about which sufficient research has been done to produce some generalizations of use to practitioners. Meta-analysis is a statistical procedure for combining the findings of a large number of primary research results. It is an alternative to narrative research reviews that makes it possible to draw generalizations from large bodies of research. A compendium of findings will be prepared in book form. This work will also serve to validate other meta-analyses currently being funded in the RISE program. The research is expected to produce findings which will be useful to both teachers and researchers. For example, it will show in each subject area addressed in the project the relationship between types of teaching (e.g., inquiry vs. didactic; laboratory vs. demonstration) and science achievement, attitudes toward science, and critical thinking. Meta-analysis is a technique which allows one to discover patterns of relationships in what often appear to be a collection of studies with apparently conflicting outcomes. It has proved useful in fields as diverse as medicine and computer instruction for settling controversies and clarifying issues. Thus the research is expected to provide practical advice to teachers and administrators.

AMOUNT: $191,935
AWARDED: 06-20-80
TERMINATES: 01-31-83

AWARD NUMBER: SED80-12310
NSF PROGRAM MANAGER:
Kathleen M. Fisher
PROGRAM: Research in Science Education

DISCIPLINE: Science Education
TARGET AUDIENCE: Grades K-12; Pre-School
DESCRIPTORS: Science Education; Educational Research; Content Analysis; Research Utilization; Statistical Analysis; Teaching Methods; Critical Thinking

Research into Important Factors Influencing Female Selection of First Optional Mathematics Courses

Alma Lantz
University of Denver
Denver Research Institute
Denver, CO 80210

This research has examined the relative impact of relevant variables in the participation in elective mathematics courses within a theoretical framework provided by social psychology (utility, social exchange, cognitive consistency theories). The objectives have been threefold: to determine the relative importance of factors influencing math-related decisions so that the most important conditions may be addressed by future experimental interventions; to conduct a preliminary examination of the role of peer influence in making math-related decisions; and to provide a more sensitive instrument with which to measure the effects of future interventions.

Salient findings were obtained from the following separate rate samples (N=521, N=644, N=253) to date: (1) males and females in these samples did not differ significantly in their intentions or in their actual participation in nonrequired mathematics courses; (2) many factors influenced course taking in nonrequired mathematics—subjective value of mathematics, liking for mathematics, confidence of success in mathematics, and mother's and father's encouragement; and (3) of these, the subjective value (utility of mathematics) was the most important for both sexes. On the whole, few sex differences were observed on these factors.

During this supplemental award period, the existing data will be analyzed to examine differences in participation in optional mathematics courses as a function of race/ethnicity, the level of mathematics currently being taken, and organizational/administrative variables within the school and/or district.

AMOUNT: $69,150*
AWARDED: 09-15-78
TERMINATES: 02-28-81

AWARD NUMBER: SED78-17103
NSF PROGRAM MANAGER: Kathleen M. Fisher
PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 9-12

DESCRIPTORS: Mathematics Instruction; Peer Acceptance; Minority Groups; Ethnic Studies; Cultural Differences; Elective Subjects; Social Psychology; Sex Differences

* Cumulative amount. Fiscal Year 1980 award: $19,860.

Survey of Undergraduate Education in the Mathematical Sciences, 1980-81

Truman A. Botts
Conference Board of the Mathematical Sciences
1500 Massachusetts Avenue, NW, Suite 457-458
Washington, DC 20005

Continuing its series of surveys made in 1965-66, 1970-71 and 1975-76 at five-year intervals, CBMS will make an in-depth survey and trend analysis of undergraduate education in the mathematical sciences in universities, four-year colleges, and two-year colleges. These studies produce detailed trend information on such factors as course enrollments, programs, facilities, and characteristics of faculty. This information is of importance primarily to departments and divisions of mathematical sciences in academic institutions. Also the findings can be used by individuals and industrial, governmental, and professional organizations concerned with the mathematical sciences. Like the earlier ones, this survey will be carried out under the direction of a broadly representative survey committee (eight persons) by an executive secretary and consultants, with technical advice and assistance and staff support at CBMS headquarters. The survey data will come primarily from responses to questionnaires sent to a statistically designed sample of depatments in the mathematical sciences. After reduction and analysis of these data, the results will be published in a report publicized through announcements, articles, and panel discussions. It will be disseminated on a complimentary basis to responding departments in the sample and to others at cost.

AMOUNT: $52,800
AWARDED: 10-24-79
TERMINATES: 05-31-82

AWARD NUMBER: SED79-19946
NSF PROGRAM MANAGER:
Douglas B. McLeod
PROGRAM: Research in Science Education

DISCIPLINE: Mathematics, General/Mathematical Sciences; Mathematics Education
TARGET AUDIENCE: Undergraduates; Graduate Students; Two-Year College Students

DESCRIPTORS: Undergraduate Study; College Mathematics; Mathematics Instruction; Trend Analysis; School Surveys; Colleges; Two-Year Colleges; Data Analysis; State-of-the-Art Reviews; Universities

Support of Certain Aspects of the 1980 International Congress on Mathematical Education

J. K. Goldhaber
National Academy of Sciences
2101 Constitution Avenue, NW
Washington, DC 20418

The project is designed to assist in the financing of the 1980 International Congress of Mathematics Education (ICME-4) held in August 1980 in Berkeley, California. The week-long quadrennial congress is sponsored by the international Commission on Mathematical Instruction. experts from a variety of countries discuss techniques of mathematics instruction. In particular, the congress provides an international forum for communication among researchers in mathematics education, elementary and secondary teachers, professors, technology specialists, curriculum developers, evaluators, and government officials regarding major issues and problems in mathematics education. Approximately 3,500 people attend the congress.

Through this award to the National Academy of Sciences, the financial agent of ICME-4, the National Science Foundation will join with private industry, private donors, and conference participants to help meet the costs of the congress. Primary expenditures involve production and mailing of announcements, program books, and the proceedings of the congress, along with some support for plenary speakers.

AMOUNT: $50,000*
AWARDED: 11-16-79
TERMINATES: 10-31-81

AWARD NUMBER: SED79-20903
NSF PROGRAM MANAGER:
Douglas B. McLeod
PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: College Instructors; Teachers; Educational Researchers
DESCRIPTORS: Mathematics Instruction; Mathematics Curriculum; Mathematics Teachers; Curriculum Development; Public Agencies; Meetings; International Educational Exchange; Financial Report; Private Agencies

* Funded in part by the Information Dissemination for Science Education (IDSE) Program and by the Development in Science Education (DISE) Program.

Effects of Elaboration Procedures on Learning and Retention of Scientific Principles

Robert M. Gagne
Florida State University
College of Education
Tallahassee, FL 32306

A set of interrelated exploratory studies will be undertaken to test the effectiveness of several different kinds of learning elaboration procedures on the retention of scientific principles acquired from the Intermediate Science Curriculum Study (ISCS) and the Individuaized Science instructional System (ISIS) modules and modifications of them. Sixth grade students of local schools will learn selected science principles under conditions which favor the following: (1) the use of images suggested by pictorial diagrams; (2) learner-generated images; and (3) episodes involving imaginal learner participation. The effects of these conditions will be contrasted with verbally directed learning and, when appropriate, with "hands-on" experience. The nature of knowledge to be investigated is procedural rather than declarative (factual). Retention is to be measured by tests previously of application to previously unencountered examples. In addition, a questioning instrument will be developed and tested to reveal differences in forms of mediation employed by the learners. Results are expected to have implications for the design and use of demonstrations and pictures in the learning of scientific scientific principles.

AMOUNT: $82,064
AWARDED: 08-05-80
TERMINATES: 05-31-82

AWARD NUMBER: SED80-11281
NSF PROGRAM MANAGER:
Erik D. McWilliams
PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Grade 6
DESCRIPTORS: Learning Processes; Retention; Cognitive Processes; Evaluation; Figurative Language; Verbal Learning; Visual Learning; Activity Learning; Testing; Scientific Principles; Science Curriculum; Scientific Methodology; Questionnaires

The Microcomputer and Problem Solving Processes in Middle School Mathematics

Mary Grace Kantowski
University of Florida
College of Education
343 Norman Hall
Gainesville, FL 32611

A teaching experiment will examine processes used by middle school and junior high school students during the solution of nonroutine mathematics problems. Self-regulatory behavior (hint selection) is studied as students attempt to solve the problems. The students will be instructed in techniques useful in solving non-routine mathematics problems. Then 12 practice problems will be given on a microcomputer which will be programmed with hints for the solution of the problems. Hints available will include definitions and formulae, plans for solution with a path to follow, diagrams, and action on diagrams. Several additional possible paths to solution will be given for each problem after a student completes the work. Patterns of hint selection as well as preferred paths of solution will be noted. A post-test (without hints) will be administered, and processes used in solutions will be related to patterns of hint selection. Data will be collected from verbal and written protocols of student solutions or attempts to find solutions, and results will be reported in the form of descriptive statistics and anecdotal evidence of observed regularities. If students exhibit successful self-regulated behavior, the microcomputer could serve as a useful tool for reinforcement after initial instruction. Results will be reported at various meetings of mathematics teachers. Articles will be submitted to appropriate publications.

AMOUNT: $140,342
AWARDED: 09-11-80
TERMINATES: 04-30-84

AWARD NUMBER: SED80-16561
NSF PROGRAM MANAGER:
Douglas B. McLeod
PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education;
Software Systems/Computer Science
TARGET AUDIENCE: Grades 5-9
DESCRIPTORS: Problem Solving; Computer Assisted Instruction; Middle Schools; Junior High School; Mathematics Curriculum; Computer Programs; Behavior Development; Adolescents; Congnitive Objectives; Microcomputers; Reinforcement

Analysis of the Child's Construction of Whole Numbers

Leslie P. Steffe
University of Georgia
Athens, GA 30602

This project will use clinical observations to develop theoretical models that explain the acquisition of early number concepts.

This analysis will lead to conceptual models of a child's construction of numerical concepts and operations. These models will provide a solid foundation for the design of a curriculum that is compatible with and builds upon the child's cognitive processes and their natural development. The planned research involves the observation of primary school children during two school years. Teaching experiments will be developed to analyze how children acquire the follings; (1) the concept of numerosity ("manyness") as an attribute of whole numbers; (2) the ability to use counting to determine specific numerosities; (3) the ability to perform operations involving counting; (4) the use of strategies to find sums and differences (as opposed to the rote learning of number facts); and (5) the ability to count with tens and hundreds. In addition, a logical and philosophical analysis of children's construction of number concepts will be conducted.

The work of the project is concentrated on teaching and interviewing individual children to determine how they develop early number concepts and how they use these concepts to solve addition and subtraction problems. Videotapes of the teaching sessions and interviews will constitute the "raw data" for the analysis. Dissemination of the project's work will take place through professional organizations and publications.

AMOUNT: $173,420
AWARDED: 08-06-80
TERMINATES: 02-28-83

AWARD NUMBER: SED80-16562
NSF PROGRAM MANAGER: Douglas B. McLeod
PROGRAM: Research in Science Education

DISCIPLINE: Mathematics, General/Mathematical Sciences
TARGET AUDIENCE: Grades K-4
DESCRIPTORS: Theoretical Models; Concept Formation; Classroom Observation Techniques; Mathematics Curriculum; Arithmetic; Mathematicals Concepts; Mathematics Instruction; Number Concepts Development; Whole Numbers; Primary Education

Applied Problem-Solving in Middle-School Mathematics

Richard Lesh
Northwestern University
Evanston, IL 60201

An iterative series of experimental case studies will investigate the mental and social processes used by students as they solve problems involving substantive mathematical content in realistic situations, working in small groups. A multidisciplinary research team will design the series of problems, and elicit, observe, and explicate the processes that middle school students use to solve them. The problems will be of a "project" nature, involving multiple stages and extending over a substantial interval of time. The mathematical concepts that will be required are those of number, elementary arithmetic, and measurement. The investigators are particularly concerned with identifying problem situation and procedures which will facilitate the learning of mathematics when administered by a classroom teacher. Prior to the end of the project, the effects and hypotheses will be tested on a sizable set of students in order to make predictions concerning the potential value of small group applied mathematics problem solving, and the possibilities for future development as well as research.

AMOUNT: $198,581
AWARDED: 08-04-80
TERMINATES: 09-30-83

AWARD NUMBER: SED80-17771
NSF PROGRAM MANAGER:
Erik D. McWilliams
PROGRAM: Research in Science Education

DISCIPLINE: Mathematics, General/Mathematical Sciences
TARGET AUDIENCE: Grades 5-7; Undergraduates; Graduates;
DESCRIPTORS: Mathematics; Problem Solving; Cognitive Processes; Case Studies; Groups; interdisciplinary Approach; Concept Formation Mathematical Applications; Projects; Learning Processes; Social Factors; Middle Schools

Increasing the Productivity of Science Learning in Early Adolescents

Herbert J. Walberg
University of Illinois at Chicago Circle
College of Education
Box 4348
Chicago, IL 60680

A field study will be conducted to test a generalized causal model of educational achievement applied to science education in early adolescence. The causal model employs educational, psychological, and sociological constructs within a framework of an econometric production function. The research team, with advice from leading science educators, specialists in early adolescence, mass media, and home environment will perform the following: (1) refine th modle of educational productivity by using nine procisionally identified constructs; (2) summarize recent meta-analysis education research on determinants of learning; (3) design a field test to probe the model and provide best estimates of causal effects; (4) develop measures of the constructs; (5) incorporate randomized interventions of the constructs, in seventh grade science classes in the Chicago metropolitan areas; (6) execute a data analysis plan to identify the determinants of science achievement; and (7) develop a series of guidelines for increasing the productivity of science education in the early adolescent years.

AMOUNT: $240,814
AWARDED: 06-18-80
TERMINATES: 07-31-83

AWARD NUMBER: SED80-07804
NSF PROGRAM MANAGER:
Andrew R. Molnar
PROGRAM: Research in Science Education

DISCIPLINE: Science Literacy/Education
TARGET AUDIENCE: Grade 7
DESCRIPTORS: Science Education; Models; Predictor Variables; Academic Achievement; Cognitive Ability; Environmental Influences; Scientific Literacy; Social Factors

A Synthesis of Findings on Sex Differences in Science Education Research

Martin L. Maehr
University of Illinois
Institute for Child Behavioral Development
Urbana, IL 61801

The literature concerning studies of sex differences in pre-college science learning will be reviewed, analyzed, and reported. Special attention will be given to differences across different fields of science, to the effects of prior instruction and abilities, and to the variation in these differences as a function of ages of the students, the date of the study, and the particular experimental designs that were used. Descriptive, empirical models will be developed which attempt to predict sex differences as a function of such variables. The findings are expected to have implications for future research.

AMOUNT: $184,149
AWARDED: 06-26-80
TERMINATES: 12-31-82

AWARD NUMBER: SED80-07857
NSF PROGRAM MANAGER:
Erik D. McWilliams
PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Women; Grades 5-12
DESCRIPTORS: Sex Differences; Women's Studies; Scientific Literacy; Science Instruction; Achievement Rating; Ability Identification; High Schools

Improving Access and Guidance in Engineering: Research into Contributing Factors

William K. LeBold
Purdue University
Engineering Administration Building
West Lafayette, IN 47907

The central purpose of this study is to provide new norms for the engineering scales of the Strong Vocational Interest Inventory (SVII) and the Purdue Interest Questionnaire (PIQ). Originally women and minorities were not included as a substantial factor in development of the engineering scales of these inventories and thus their widespread use in career counseling may be serving to limit access to careers in engineering by women and minorities. This research will supply updated, unbiased valid norms and will identify factors to consider in making effective use of such inventories with women and minorities. Populations in the study include working engineers in five fields. Factors which influence persistence, interest, career choice, and job satisfaction will be studied in order to provide a better basis for engineering counseling.

AMOUNT: $141,426
AWARDED: 06-17-80
TERMINATES: 12-31-82

AWARD NUMBER: SED79-19613
NSF PROGRAM MANAGER:
Kathleen M. Fisher
PROGRAM: Research in Science Education

DISCIPLINE: Engineering/Education
TARGET AUDIENCE: Undergraduates; Minorities; Females; Grades 10-12
DESCRIPTORS: Occupational Guidance; Engineering Education; Interest Scales; Bias; Test Validity; Minority Groups; Womens Education

Computer Biology Simulations for High School Students to Stimulate Scientific Problem Solving

Edward Vockell
Purdue University - Calumet
2233 171st Street
Hammond, IN 46323

Research will be conducted to determine whether computer simulations of scientific problem solving enhance general problem solving skills and creativity among high school biology students. The simulations will be administered under two conditions: (1) no guidance (pure discovery learning); and (2) guidance. In addition, a control group which will receive no simulations will be used for comparison. To ascertain the effectiveness of the simulations in enhancing problem solving and creativity, comparisons of treatment groups and control groups will be made with standard problem solving tasks employed in cognitive psychology, a standardized test of scientific problem solving ability, and a standardized creativity test.

AMOUNT: $74,955
AWARDED: 08-22-80
TERMINATES: 02-28-83

AWARD NUMBER: SED80-18948
NSF PROGRAM MANAGER:
Andrew R. Molnar
PROGRAM: Research in Science Education

DISCIPLINE: Biology, General/Life and Medical Sciences
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Biology; Problem Solving; Computer Assisted Instruction; Creativity; Student Creativity; Discovery Learning; Teacher Guidance; Test Results; High School Students; Simulation

Computer Assisted Data Analysis (CADA) for Teaching Bayesian Stati and Applications for Research in Science Education

Melvin R. Novick
University of Iowa
Iowa City, IA 52242

Computer-Assisted Data Analysis (CADA) is a conversational, interactive computer system that permits educational researchers to manipulate data sets and perform complex statistical analyses under computer guidance using Bayesian statistics.

The purpose of this project is to provide specialized, computer-based capabilities for the following: (1) statistical evaluation of science education programs; (2) construction and use of course-connected, criterion-referenced testing procedures in elementary and secondary schools; (3) direct on line statistical monitoring of scientific experiments; and (4) teaching of more advanced methods of Bayesian statistics relevant to the areas of educational evaluation,evaluation research, and decision making.

Procedures will be made available to handle the following statistical problems, among others: errors of measurement; non-random assignment; multivariate assessment of value; trait-treatment interaction; quantification of prior and collateral information; and formal statistical decisionmaking in the context of criterion-referenced testing. All new procedures will be made available on the CADA monitor. In addition, a greatly enhanced data management facility will be made available for CADA and a microprocessor version of CADA will be prepared.

AMOUNT: $384,234*
AWARDED: 07-21-80
TERMINATES: 09-30-83

AWARD NUMBER: SED80-06357
NSF PROGRAM MANAGER:
Andrew R. Molnar
Dorothy Deringer
PROGRAM: Research in Science Education

DISCIPLINE: Computer Systems Design
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Computer Assisted Instruction; Statistical Analysis; Bayesian Statistics; Computer Science; Evaluation Methods; Educational Assessment; Data Analysis; Testing; Science Education; Educational Researchers

* Funded in part by the Development in Science Education (DISE) Program.

An Inquiry into the Nature and Goals of Scientific Literacy

Stephen R. Graubard
American Academy of Arts and Sciences
Editorial Offices
7 Linden Street
Boston, MA 02101

Personal, social, and vocational need for scientific literacy is increasing in the modern world, yet observation and tests confirm that general education in science is not keeping pace with need.

Through this project, the American Academy of Arts and Sciences (AAAS) will initiate an inquiry into the nature and goals of scientific literacy. Using existing research, the Academy intends to create a new synthesis and conceptualization of scientific and technological literacy for the general public. The results of the effort will be published as a series of essays in DAEDALUS, the journal of AAAS. As has been the case with prior issues of this scholarly journal, the Academy aims to generate discussions that will ultimately influence people—in this case, men and women who make curricula and teach students, who write and publish, who determine what goes out on the television screens of the country, and who run the museums and adult education programs.

AMOUNT: $260,521
AWARDED: 06-20-80
TERMINATES: 11-30-82

AWARD NUMBER: SED80-05975
NSF PROGRAM MANAGER:
Rita W. Peterson
PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Grades 7-12; Undergraduates; Minorities; Females
DESCRIPTORS: Scientific Literacy; Scientific Concepts; College Students; Secondary School Students; Seminars; Adult Education; Public Education

The Development of Quantification Concepts: A Synthesis

Judah L. Schwartz
Massachusetts Institute of Technology
Division for Study and Research in Education
77 Massachusetts Avenue
Cambridge, MA 02139

This project will prepare a critical review and analysis of the literatures of several disciplines on the subject of the representation of quantifiers. The term "quantifier" is used to denote a broader concept of number and its development than is conventionally used by either linguists or mathematics educators. The review will include aspects of quantification which start with the development of children's natural language as they begin to understand quantitative aspects of their environment. Later formal learning at school will be included. A synthesis of theoretical models already suggested in the literature will be based on work related to counting processes and the solution of simple arithmetic problems, as well as other areas. Reaction time studies on the internal representation of numbers also will be included. In particular, the analog and digital models for the internal representation of numbers will be examined and developmental trends ascertained. The project will try to arrive at a unifying theoretical scheme which will account for the existing body of empirical data. Further possible lines of research will be suggested. Results will be reported through journals in mathematics education and psychology.

AMOUNT: $69,586
AWARDED: 08-08-80
TERMINATES: 02-28-82

AWARD NUMBER: SED80-18390
NSF PROGRAM MANAGER: Douglas B. McLeod
PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education; Mathematics, General/Mathematical Sciences
TARGET AUDIENCE: Pre-school; K-12; Undergraduates; Graduates
DESCRIPTORS: Cognitive Processes; Number Concepts; Research Projects; Data Analysis; Mathematics Education; Literature Reviews

A Study Comparing Formal Algebraic Representations with "Natural" Mental Representations

James J. Kaput
Southeastern Massachusetts University
741 State Road
North Dartmouth, MA 02747

Recent research (e.g., Clement and Lochhead, 1979; Kaput, 1980) has documented a very common and resistant misconception of the roles of variables in "simple" algebraic problems, which interferes strongly with algebraic solutions. Even those who have had considerable instruction and experience exhibit the problem. For example, some 25-30 percent of freshman engineering students tested at major universities wrote $6 \cdot S = P$ instead of $S = 6 \cdot P$ as the solution equation for the following problem: "Suppose that at a certain university there are six times as many students as professors. Using "S" as the number of students and "P" as the number of professors, write an equation that gives the relationship between the number of students and the number of professors." Careful interviews revealed that, in general, students understand the numerical relationship between the students and professors but have great difficulty expressing it properly algebraically. Among other things, they think of a symbol such as "S"as representing a student, rather than the number of students.

This project will study the extent and probable causes of this tendency in various contexts and in considerable detail. Contemporary core curricula in undergraduate emathmatics will be surveyed for tasks that seem likely to elicit the error. Experiments will then be conducted to determine the actual extent of the problem in the mathematical tasks which the survey uncovers. The possible relationships between this tendency and more general mental representation phenomena (such as mental imagery) will be explored, with attention to individual differences. These findings will be related to developmental theories of reasoning, and the implications for instruction will be considered.

AMOUNT: $114,085
AWARDED: 08-29-80
TERMINATES: 03-31-83

AWARD NUMBER: SED80-20020
NSF PROGRAM MANAGER:
Erik D. McWilliams
PROGRAM: Research in Science Education

DISCIPLINE: Algebra/Mathematical Sciences
TARGET AUDIENCE: Grades 9-12; Undergraduates
DESCRIPTORS: Mathematics Instruction; Algebra; Concept Formation; Cognitive Objectives; Statistical Analysis; Symbols (Mathematics); Mathematical Concepts; Problem Solving; Cognitive Processes

Program of Applied Research on Scientific Reasoning Processes

Jack Lochhead
University of Massachusetts at Amherst
Amherst, MA 01003

A program will be established which integrates the study of knowledge structures and reasoning processes in the areas of physics and mathematics. The program will bring together research scientists, graduate students, and faculty from physics, cognitive psychology, computer science, mathematics, and education. Emphasis will be placed on processes which are critical to skilled performance in science and engineering but which, at the same time, extend beyond the range of current theories in cognitive science. Major research areas include the following: (1) investigation of reasons for the finding that many science-oriented college students do not fully understand the role that variables play in algebraic equations; and (2) analysis of patterns of non-deductive reasoning in the problem solving of expert scientists. A research cycle of interviewing, analysis, question redesign, and group testing will be used to isolate key misconceptions and reasoning patterns. Findings in these areas will have important implications for education and cognitive theory.

AMOUNT: $382,240
AWARDED: 07-30-80
TERMINATES: 01-31-84

AWARD NUMBER: SED80-16567
NSF PROGRAM MANAGER:
Erik D. McWilliams
PROGRAM: Research in Science Education

DISCIPLINE: Physics, General; Mathematics, General/ Mathematical Sciences
TARGET AUDIENCE: Grades 9-12; Undergraduates
DESCRIPTORS: Physics; Mathematics; Cognitive Processes; Problem Solving; Algebra; Learning Activities; Learning Processes; Testing; Abstract Reasoning; Engineering

Planning and Teaching Middle-School Science

Edward L. Smith
Michigan State University
Science and Mathematics Teaching Center
E-37 McDonel Hall
East Lansing, MI 48825

Mismatches between teachers' planning processes and the content and organization of science program teachers' guides seem to limit the quality of science instruction at the middle school level. The objectives of this project are to test this idea by analyzing existing patterns in teachers' use of science program materials and their effects on instruction, teacher satisfaction and student learning, and analyzing the effects of an environmental intervention designed to promote a "mutual adaptation" process which involves modification of both teachers' guides and teachers' planning processes.

The proposed study addresses this problem in three phases: planning and teaching of science by 20 sixth grade teachers will be observed; student learning and teacher satisfaction will be measured and used to develop an experimental intervention; and four matched pairs of teachers (half of whom receive the intervention) will be studied intensively, using case study methods to document experimental effects on planning, instruction, teacher satisfaction, and learning.

AMOUNT: $61,324
AWARDED: 08-28-80
TERMINATES: 02-28-82

AWARD NUMBER: SED80-20022
NSF PROGRAM MANAGER:
Erik D. McWilliams
PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Grades 5-8
DESCRIPTORS: General Science; Science Curriculum; Teaching Guides; Teacher Role; Instructional Materials; Middle Schools; Case Studies (Education); Curriculum Research; Educational Planning; Intervention

Survey of Science Understanding and Attitudes

Wayne W. Welch
University of Minnesota
2642 University Avenue
St. Paul, MN 55114

This project is a survey of science literacy of 9-, 13-, and 17-year-olds with particular focus on science and society factors. Three theoretical models that relate to schooling and demographic effects on science achievement, attentiveness to science, and attitudes toward science will be tested.

Data collection for the project will be conducted under the direction of the Education Commission of the States (ECS). The analysis of data for purposes of testing the three theoretical formulations will be the responsibility of the research team at the University of Minnesota. While the ECS/University of Minnesota collaboration will contribute to basic research, it will also provide data of great importance for decision making and policy setting purposes since one of the products will be a report on trends in science knowledge and attitudes since the National Assessment of Science in 1976-77. Documented data tapes and user code books will be prepared by ECS so that the data will be available for other researchers to use.

AMOUNT: $140,000
AWARDED: 09-17-80
TERMINATES: 02-28-82

AWARD NUMBER: SED80-22125
NSF PROGRAM MANAGER: Andrew R. Molnar
PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Grades K-4; 9-12
DESCRIPTORS: Scientific Literacy; Theoretical Models; Student Attitudes; Demography; Trend Analysis; Surveys; Evaluation; Social Factors; Social Influences; Decision Making; Test Results; Policy Formation

Geometric Thinking Among Adolescents in Inner City Schools

Dorothy Geddes
Brooklyn College and Research Foundation of CUNY
Bedford Avenue and Avenue H
Brooklyn, NY 11210

This project will investigate how Van Hiele's model of thinking in geometry applies to minority students in early adolescence in grades 6 and 9 and to teachers of students in these grades. Research on Van Hiele, and, more generally, on learning in geometry will be reviewed critically. Current geometry curriculum materials (grades 1-9) will be analyzed in terms of the Van Hiele model. Instructional modules for children, designed for use as research tools in a one-on-one setting and reflecting the levels of thinking of the Van Hiele model, will be developed and validated. In the clinical portion of this study, students engaged in learning experiences provided in the modules will be videotaped. Detailed analysis of the videotapes will provide insight into the level of thinking of students, difficulties at the levels, and thought processes involved. The project will also investigate whether preservice and inservice teachers can be trained to identify levels of geometry thinking of students and curriculum materials, and to select learning tasks accordingly. At the theoretical level, the findings of the project will have implications for further research of student thought processes in geometry as related to Van Hiele's levels of thinking. Implications of the results will be drawn for curriculum development, teacher training, and classroom practices for geometry instruction of early adolescents.

AMOUNT: $192,680
AWARDED: 10-25-79
TERMINATES: 07-31-82

AWARD NUMBER: SED79-20640
NSF PROGRAM MANAGER:
Douglas B. McLeod
PROGRAM: Research in Science Education

DISCIPLINE: Geometry/Mathematical Sciences
TARGET AUDIENCE: Grades 6, 9; Teachers; Minorities
DESCRIPTORS: Geometry; Minorities; Adolescents; Cognitive Measurement; Curriculum Research; Mathematics Curriculum; Geometric Concepts; Cognitive Processes; Urban Schools; Instructional Materials

Children, Television, and Science: A Detailed Description of Formative Research for 3-2-1 CONTACT

Keith W. Mielke
Children's Television Workshop
One Lincoln Plaza
New York, NY 10023

Two years of developmental or formative research preceded the premiere of the television science series 3-2-1 CONTACT. More than 50 studies involving 10,000 children were conducted in the process of preparing the first 65 half-hour shows. This project will provide an exhaustive description of the developmental research. It will identify the factors which seem to affect the appeal and comprehensibility of science materials on TV. The resulting document should be useful both to researchers and curriculum developers.

AMOUNT: $9,420
AWARDED: 09-05-80
TERMINATES: 08-31-81

AWARD NUMBER: SED80-20774
NSF PROGRAM MANAGER: Kathleen M. Fisher
PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Grades K-8
DESCRIPTORS: Media Research; Experimental Programs; Research Utilization; Television Curriculum; Television Programming; Educational Television; Mass Media; Television Research; Scientific Literacy; Science Materials; Children

Factors Related to Life-Long Learning for Scientists and Engineers: A Feasibility Study

Harold G. Kaufman
Polytechnic Institute of New York
Division of Management
333 Jay Street
Brooklyn, NY 11201

This project will examine the feasibility of conducting a large-scale evaluation and synthesis of changes in motivation and thought processes in adults. Also it will investigate how life-long learning among scientists and engineers is affected by such changes. Published studies in developmental and organizational psychology and adult learning will be evaluated in order to identify pertinent findings. The study will determine the adequacy of the data base and analytical methods. Specific sources of data and valid methods for combining and analyzing them will be provided.

AMOUNT: $70,000
AWARDED: 10-22-79
TERMINATES: 10-31-81

AWARD NUMBER: SED79-20376
NSF PROGRAM MANAGER:
Erik D. McWilliams
PROGRAM: Research in Science Education

DISCIPLINE: Developmental Psychology
TARGET AUDIENCE: Scientists; Engineers; Professional Continuing Education Students
DESCRIPTORS: Cognitive Processes; Motivation; Evaluation Methods; Developmental Psychology; Social Science Research; Feasibility Studies; Scientists; Engineers; Learning Motivation; Lifelong Learning

Wait Time and Questioning Skills of Middle School Science Teachers

J. Nathan Swift
State University of New York at Oswego
Oswego, NY 13126

Wait time, the duration of teacher pauses after questions, is an important variable in research on science teaching. This project will investigate the effects of increasing teachers' wait time on both teacher and student behavior. It will also clarify the relationship of wait time to general questioning skills in science teaching. In previous research, the influence of wait time training has been confounded with instruction in general questioning skills, making it difficult to test the hypothesis that increasing the wait time will by itself improve questioning skills. In this project, these variables will be separated through the use of four treatment groups made up of science teachers. One group will receive instruction in wait time using a newly developed electronic feedback device that monitors the duration of teacher and student pauses; a second group will receive instruction in general questioning skills; a third group will receive both types of instruction; and a comparison group will receive no instruction of either type. Audio tape recordings of classroom interaction will be analyzed in terms of teacher questioning behavior (including wait time as well as other variables) and student responses. Student attitudes and science classroom environment factors also will be assessed. Findings will be published in professional journals and presented at professional meetings.

AMOUNT: $72,257
AWARDED: 08-08-80
TERMINATES: 03-31-82

AWARD NUMBER: SED80-15819
NSF PROGRAM MANAGER:
Douglas B. McLeod
PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Grades 5-9
DESCRIPTORS: Questioning Techniques; Middle Schools; Science Instruction; Science Teachers; Interaction; Student Attitudes; Student Behavior; Teacher Behavior; Reaction Time; Response Mode; Teacher Response

Classroom Process Variables in Urban Integrated Junior High School Individualized Science Programs

Ann C. Howe
Vernon Hall
Syracuse University
Department of Science Teaching
Syracuse, NY 13210

This study examines the relationship of race, sex, and classroom process variables to learning in science. It is intended to yield data pertaining to individualized science instruction for minority and female students. Data will be collected by systematic observation of student and teacher behavior in 20 individualized science classes in five racially integrated urban junior high schools. Ten teachers and 160 students (randomly selected but equally divided according to race and sex) will be observed by trained graduate students and advanced undergraduate psychology majors. All teachers will use Intermediate Science Curriculum Study materials.

Topics to be addressed include the following: the use of classroom time by students and teachers; the nature of the interactions among students and between students and teachers; the relationships between these variables and students' characteristics of aptitude, sex, and race; and the relationship of these variables to student achievement.

Evaluation procedures include the administration of two individualized scholastic aptitude tests and a standardized achievement test. Science in-class achievement will be measured by teacher-test evaluations and responses to questions by observers.

Results of the study will be disseminated by presentation of papers at professional meetings, publication of articles in professional journals, and teacher workshops.

AMOUNT: $70,670
AWARDED: 08-06-80
TERMINATES: 05-31-82

AWARD NUMBER: SED80-14209
NSF PROGRAM MANAGER: Kathleen M. Fisher
PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Females; Minorities; Grades 7-9
DESCRIPTORS: Science Instruction; Classroom Communication; Classroom Research; Classroom Observation Techniques; Student Behavior; Teacher Behavior; Evaluation; Interaction; Achievement; Females; Sex Differences; Minority Groups

Structure of Knowledge and Cognitive Processes in Organic Chemistry

John E. Gordon
Kent State University
Kent, OH 44242

This project will investigate organic chemistry (OC) learning at the undergraduate level by conducting a parallel and interrelated set of theoretical, psychometric, and experimental studies. The basis of the current studies is provided by the principal investigator's earlier work on building a theoretical framework of OC learning that melds an analysis of the language of organic chemistry (LOC) with available knowledge from cognitive psychology, linguistics, second language learning, and formal logistic systems.

The *theoretical* study will formalize LOC, resolve its inconsistencies, extend its ability to describe classes of compounds, and identify inference rules used in OC. Among the latter, the logic and learning strategies for constructing chemical analogies will receive particular attention. The *psychometric* work will test intuitive ideas on the abilities needed in learning OC and investigate diagnostic/remedial instruments for the OC course, singling out stereo-chemical learning difficulties for special attention. The *experimental* portion investigates perceptual and learning strategies in four important and recurrent tasks of OC: categorization of structural formulas (SF); judging equivalence of SF; producing SF that satisfy strict formation rules; and use of generic notation for learning and applying chemical-reaction facts for entire classes of SF. Included in the experimentation are comparisons of algorithmic vs. discovery learning, visual vs. verbal strategies, and novice vs. practitioner behavior.

AMOUNT: $291,136
AWARDED: 08-07-80
TERMINATES: 06-30-84

AWARD NUMBER: SED80-20159
NSF PROGRAM MANAGER:
Erik D. McWilliams
PROGRAM: Research in Science Education

DISCIPLINE: Organic Chemistry
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Organic Chemistry; Chemistry Instruction; Discovery Learning; Algorithms; Cognitive Processes; Measurement Instruments; Perception; Verbal Learning; Visual Learning; Student Behavior; Teacher Behavior; Science Curriculum; Curriculum Research

A Study of the Use of Time-Series Designs for Assessing the Development of Science Concepts in Adolescents

Victor J. Mayer
Ohio State University Research Foundation
1314 Kinnear Road
Columbus, OH 43212

Two experimental studies will be undertaken to validate the technique of time-series analysis applied to student achievement and attitudes in science education. One study will assess the effect of varying the frequency of assessment, ranging from daily to once each eight days. The other will assess the sensitivity of the technique to detecting differences in intellectual development. Time-series data will be compared with post-tests and student interview data from junior high school students studying crustal evolution in the classroom. The findings from the studies are expected to have implications for both instruction (in assessing class performance) and research (in assessing the effects of classroom interventions) in science.

AMOUNT: $27,507
AWARDED: 08-11-80
TERMINATES: 02-28-82

AWARD NUMBER: SED80-16589
NSF PROGRAM MANAGER:
Erik D. McWilliams
PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Grades 7-9
DESCRIPTORS: Time Factors (Learning); Achievement; Student Attitudes; Science Education; Evaluation Methods; Junior High School Students; Intervention; Educational Intervention; Science Instruction; Research Methodology

Mathematical Representations of Real-World Knowledge: Physics and Arithmetic Word-Problems

Jill H. Larkin
Carnegie-Mellon University
Pittsburgh, PA 15213

Research will be conducted on human cognitive performance and learning in the domains of elementary and intermediate physics and in the related domain of using elementary arithmetic to describe real-world situations (word problems). The project will begin to provide an integrated theory of learning and of problem understanding in quantitative domains, building upon recent research in modeling problem solving in science and mathematics by computer program. Students at various levels of ability will be observed as they study about and practice solving problems in these three domains. The knowledge inferable from these behaviors will be modeled by computer programs, in order to provide an explicit theory of how such knowledge is developed and used. The project therefore has both theoretical and practical implications.

AMOUNT: $344,401
AWARDED: 09-10-80
TERMINATES: 03-31-83

AWARD NUMBER: SED80-18264
NSF PROGRAM MANAGER:
Erik D. McWilliams
PROGRAM: Research in Science Education

DISCIPLINE: Physics, General; Mathematics Education
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Physics; Cognitive Measurement; Performance; Problem Solving; Academic Achievement; Mathematics; Computer Programs; Scientific Concepts; Cognitive Processes

Factors that Influence the Technical Updating of Engineers

James L. Farr
Pennsylvania State University
University Park, PA 16802

This research is concerned with professional obsolescence among engineers. Factors affecting the technical updating of engineers will be examined from a theoretical perspective of motivation or expectancy theory. The theory models the behavior of engineers as they attempt to remain current in their fields. Organizational factors (policies, supervision, peers, work assignments, climate) are predicted to affect these behaviors, as are individual factors such as needs for achievement and growth. Data will be obtained in a two-year study of 800-1200 engineers and their supervisors employed at eight to 12 large industrial organizations. In one set of questionnaires, engineers will answer questions related to their perceptions of individual and organizational factors and technical updating. In a separate set, supervisors will evaluate the technical performance and updating activities of their subordinate engineers. This information will clarify the relationship among organizational and individual factors and the technical performance and updating of engineers. Within each data collection phase, correlational and regression techniques will be applied. Project results will be disseminated to academic, industrial, and governmental audiences through professional conferences and journals and in separate project publications.

AMOUNT: $154,351
AWARDED: 08-20-80
TERMINATES: 03-31-83

AWARD NUMBER: SED80-19680
NSF PROGRAM MANAGER: Douglas B. McLeod
PROGRAM: Research in Science Education

DISCIPLINE: Engineering Education
TARGET AUDIENCE: Engineers; Professional Continuing Education Students
DESCRIPTORS: Engineers; Cognitive Processes; Professional Continuing Education; Expectation; Motivation; Improvement; Psychological Studies; Technical Education

Semantics of Arithmetic: Teaching Understanding and Computational Skill Via Computer

Lauren B. Resnick
University of Pittsburgh
1028 Cathedral of Learning
Pittsburgh, PA 15261

This project will use small computers to provide basic instruction in arithmetic. The instruction will connect performance of computational algorithms to understanding of the underlying mathematical principles. The instructional program will be based on principles derived from empirical study and theoretical analysis of an important part of elementary school mathematics, i.e., arithmetic procedures that depend upon a knowledge of place value. The program builds understanding of these procedures by helping the child develop detailed correspondences between two systems for representing numbers (using blocks as well as written notation) and arithmetic operations in those systems. The program will provide practical instruction, usable in classrooms at reasonable cost, as well as an opportunity to test the validity of a developing theory of the origin of arithmetic errors and ways of preventing these errors through meaningful instruction.

AMOUNT: $152,256*
AWARDED: 07-09-80
TERMINATES: 08-31-82

AWARD NUMBER: SED80-12511
NSF PROGRAM MANAGER:
Douglas B. McLeod
PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education; Software Systems/ Computer Science
TARGET AUDIENCE: Grades 1-8
DESCRIPTORS: Number Concepts; Learning Difficulties; Algorithms; Addition; Subtraction; Computer Graphics; Computer Assisted Instruction; Instructional Materials; Cognitive Processes; Units of Study (Subject Fields)

* Funded in part by the Development in Science Education (DISE) Program.

Conceptual Understanding of Physics Students and Influencing Factors - Phase II

James A. Minstrell
Mercer Island School District
4160 - 86th Avenue, S.E
Mercer Island, WA 98040

During the first 12 months of this project, originally funded in 1979, the director of this project studied two classroom phenomena: preconceptions which high school students have concerning principles of physics and the degree to which such preconceptions resist change during classroom instruction. Examples of such robust misconceptions which were studied include the following: (1) "Tables support objects, but they don't exert an upward force"; (2) "Air pressure is the cause of gravity"; and (3) "Electricity flows along a wire, and some flows out at each light bulb." The project director, a high school physics teacher, also experimented with instructional techniques to correct such misconceptions.

The additional support provided by this (1980) award will enable the project director to complete the analysis of the observations and disseminate the findings by preparing and publishing reports and making presentations at professional meetings of science teachers and science education researchers.

AMOUNT: $32,503*
AWARDED: 08-15-79
TERMINATES: 08-31-81

AWARD NUMBER: SED79-12824
NSF PROGRAM MANAGER: Erik D. McWilliams
PROGRAM: Research in Science Education

DISCIPLINE: Physics, General
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Scientific Concepts; Physics Curriculum; High School Students; Science Instruction; Instructional Innovation; Secondary School Science; Physics Instruction; Concept Formation

* Cumulative amount. Fiscal Year 1980 award: $8,153.

SECTION III

Fiscal Year 1979 and Earlier Years' Awards Project Titles and Principal Investigators by Program, and State and Institution

DEVELOPMENT IN SCIENCE EDUCATION

The Guided Design Approach to Problem Solving: A Program For Training Junior High School Science Teachers A

Bernard Coyle
San Francisco State University
Frederic Burk Foundation for Education
1640 Holloway Avenue
San Francisco, California 94132

University Level, Computer-Assisted Instruction (CAI) and Computer-Generated Speech in Mathematics B

Patrick Suppes
Stanford University
Stanford, California 94305

Physical Science Activities in Out-of-School Settings for Early Adolescents and Their Families C

Alan J. Friedman
University of California/Berkeley
Berkeley, California 94720

Activity-Based Education Programs for Small- and Medium-Size Planetariums D

Robert Karplus
Lawrence Hall of Science
University of California/Berkeley
Berkeley, California 94720

Development of Pilot Astronomy Activities for Informal Learning E

Robert Karplus
University of California/Berkeley
Berkeley, California 94720

Materials and Strategies to Improve Women's Access to Scientific Careers F

Robert Karplus
University of California/Berkeley
M-11 Wheeler Hall
Berkeley, California 94720

Outdoor Biology Instructional Strategies (OBIS) G

Watson M. Laetsch
University of California/Berkeley
Berkeley, California 94720

Development of Reasoning Skills in Early Adolescence — A

Alfred M. Bork
University of Califonia/Irvine
Irvine, California 92717

Role Models for Adolescent Girls in Science and Math — B

Jane Permaul
University of California/Los Angeles
UCLA Office of Experimental Educational Programs
405 Hilgard Avenue
Los Angeles, California 90024

An Urban Extension Service Model — C

Perry Shapiro
University of California/Santa Barbara
Santa Barbara, California 93106

Human Sciences Program (HSP): A Three-Year Integrated Human Sciences Curriculum for Middle Schools — D

William V. Mayer
Biological Sciences Curriculum Study Company
P.O. Box 930
Boulder, Colorado 80302

Innovations: The Social Consequences of Science and Technology — E

William V. Mayer
Biological Sciences Curriculum Study Company
P.O. Box 930
Boulder, Colorado 80302

Digital System Educational Materials (DISEM Project) — F

Thomas A. Brubaker
Colorado State University
Fort Collins, Colorado 80523

Quantitative Understanding to Enhance Social Science Teaching — G

Irving Morrissett
Educational Resources Center, Inc.
Boulder, Colorado 80302

Decision-Making Modules on Public Policy Issues of Science and Technology A

Irving Morrissett
Social Science Education Consortium, Inc.
855 Broadway
Boulder, Colorado 80302

Science, Society and the Senior Citizen: A Model Educational Program B

Robert Larkin
University of Colorado
Austin Bluffs Parkway
Colorado Springs, Colorado 80907

Secondary School Course in Applications of Mathematics to Science C

Madeline P. Goodstein
Central Connecticut State College
1615 Stanley Street
New Britain, Connecticut 06050

Undergraduate Education Improvement in Political Science: Innovation in Instructional Materials D

Sheilah K. Mann
American Political Science Association
Washington, DC 20036

Outlines in Microbiology for Community and Junior Colleges E

Helen L. Bishop
American Society for Microbiology
Washington, DC 20006

Teaching Materials in Microbiology F

Helen L. Bishop
American Society for Microbiology
Washington, DC 20006

Teaching and Learning in Graduate Geography G

William D. Pattison
Association of American Geographers
Washington, DC 20009

Conservation Classroom Program (Advanced) A

Margaret Rosenberry
National Wildlife Federation
1412 16th Street, NW
Washington, DC 20036

Individualized Science Instructional System B

Ernest Burkman
Florida State University
Tallahassee, Florida 32306

Toward Improved Candid Classroom Instructional Television: Guidelines for Program Evaluation and Production C

Charles Hutchinson
Association for Media-Based Continuing Education for Engineers, Inc.
Georgia Institute of Technology
Atlanta, Georgia 30332

University Consortium to Increase National Effectiveness of Continuing Education for Engineers D

Charles R. Vail
Association for Media-Based Continuing Education for Engineers, Inc.
Georgia Institute of Technology
Atlanta, Georgia 30332

Development of an Interactive Conversational Computer Model for Linear Programming E

John J. Jarvis
Georgia Institute of Technology
Atlanta, Georgia 30332

Family-Involving Science Education for Elementary School Children F

Michael E. Browne
University of Idaho
Moscow, Idaho 83843

Interactive Science Museum Exhibits for Preschool Children G

Theodore Ansbacher
Museum of Science and Industry
57th Street and Lake Shore Drive
Chicago, Illinois 60637

Development and Trial of an Integrated Undergraduate Science Major Program A

Mark Pinsky
Northwestern University
Evanston, Illinois 60201

Arithmetic and Its Applications B

Zalman Usiskin
University of Chicago
Chicago, Illinois 60637

Survey of Recent East European Literature in School and College Mathematics C

Izaak Wirszup
University of Chicago
Department of Mathematics
Chicago, Illinois 60637

Demo-Graphics: Teaching Population Dynamics in a Multi-disciplinary Framework with Interactive Visual Graphics D

Paul Handler
University of Illinois
57 Coordinated Science Laboratory
Urbana, Illinois 61801

Using Microcomputers to Teach Social Science in Junior and Senior High Schools E

Paul Handler
University of Illinois
57 Coordinated Science Laboratory
Urbana, Illinois 61801

A Computer Conferencing System for Peer Evaluation and Commentary on Essay Tests F

Jerome H. Woolpy
Earlham College
Richmond, Indiana 47374

Global Geography Course for the Middle Grades G

Howard D. Mehlinger
Indiana University
Bloomington, Indiana 47401

Development and Distribution of Print Modules for Manufacturing Productivity Education — A

Joseph El Gomayel
Purdue University
West Lafayette, Indiana 47907

Conduit: Consortium for the Dissemination of Computer-Based Curricular Materials — B

James W. Johnson
University of Iowa
Iowa City, Iowa 52242

Use of Microcomputers for Learning Science — C

James W. Johnson
University of Iowa
Iowa City, Iowa 52242

Computer-Assisted Data Analysis — D

Melvin R. Novick
University of Iowa
Iowa City, Iowa 52242

Educational Modules Development for the Nuclear Fuel Cycle — E

N. Dean Eckoff
Kansas State University
Manhattan, Kansas 66506

Career Oriented Modules to Explore Topics in Science (COMETS) — F

Walter S. Smith
University of Kansas
Lawrence, Kansas 66045

Graphic Techniques for Teaching Statistical Concepts and Procedures — G

Marshall J. Graney
Wichita State University
Wichita, Kansas 67208

Diagnostic and Instructional Services for Undergraduate Students of Statistics — A

Jerry A. Warren
University of New Hampshire
Durham, New Hampshire 03824

New Undergraduate Engineering Materials—Computer Models in the Context of Competing Social Values — B

John M. Mulvey
Princeton University
Princeton, New Jersey 08540

Development of Laboratory and Lecture Materials for Oceanography Teaching — C

Harvey M. Sachs
Princeton University
Princeton, New Jersey 08540

Tutorial Review Articles to Update Collegiate Physics Instruction — D

John S. Rigden
American Association of Physics Teachers
Graduate Physics Building
State University of New York
Stony Brook, New York 11794

Issue-Oriented Instructional Modules for Introductory College Physics Classes — E

Arnold A. Strassenburg
American Association of Physics Teachers
Graduate Physics Building
State University of New York
Stony Brook, New York 11794

Societal Issue-Oriented Physics Modules Project — F

Arnold A. Strassenburg
American Association of Physics Teachers
Graduate Physics Building
State University of New York
Stony Brook, New York 11794

Study of Courses in Computer Literacy and the Impact of Computers on Society — G

Richard H. Austing
Association for Computing Machinery, Inc.
1133 Avenue of the Americas
New York, New York 10036

Dissemination of Instructional Materials (History-of-Physics Laboratory) A

Samuel Devons
Barnard College
New York, New York 10027

Development of Instructional Films in Ethology—"Behavior of the Ring Dove" B

Rae Silver
Barnard College
New York, New York 10027

Professional Competence Development in the Undergraduate Engineering Curriculum C

Jean LeMee
Cooper Union
51 Astor Place
New York, New York 10003

On Using Program Verifiers in Elementary Computer Programming Instruction D

Robert L. Constable
Cornell University
Ithaca, New York 14850

Validation of the Continuing Education Achievement of Professional Engineers E

Roy H. Mattson
Institute of Electrical and Electronics Engineers, Inc.
345 East 47th Street
New York, New York 10017

Development of a Cooperative Graduate Program in Engineering and Public Administration F

J.I. Weindling
Polytechnic Institute of New York
Brooklyn, New York 11201

Master of Science Degree in Applied Mathematics G

Richard C. DiPrima
William E. Boyce
Rensselaer Polytechnic Institute
Troy, New York 12181

Computer Graphics in Engineering Education — A

Michael Wozny
Rensselaer Polytechnic Institute
Troy, New York 12181

Development of Selected Undergraduate Course Materials in Applied Mathematical Modeling — B

Edward Beltrami
State University of New York
Stony Brook, New York 11794

Modular Materials on Socio-Technological Problems and Issues — C

Thomas T. Liao
State University of New York
Stony Brook, New York 11794

Self-Instructional In-Service Program in Science Careers: Teachers of Grades 4-9 — D

Iris R. Weiss
Research Triangle Institute
Center for Educational Research and Evaluation
P.O. Box 12194
Research Triangle Park, North Carolina 27709

Development of Teaching Materials for Computer Programming — E

David L. Parnas
University of North Carolina
Chapel Hill, North Carolina 27514

Creation, Testing, and Dissemination of Problem Solving Instructional Material—Final Phase — F

Richard V. Andree
University of Oklahoma
Norman, Oklahoma 73069

Interdisciplinary Master's Programs in Building Studies — G

Volker H. Hartkopf
Carnegie-Mellon University
Pittsburgh, Pennsylvania 15213

XPRT-Experimental Partnership for the Reorientation of Teaching A

Richard E. Woodring
Drexel University
Center for Teaching Innovation
Philadelphia, Pennsylvania 19104

Educational Computer-Based Models for Socio-Economic-Technological Situations (E-COMSETS) B

William E. Schiesser
Lehigh University
Bethlehem, Pennsylvania 18105

Development of Modular Courses in Science, Technology and Society for University Freshmen and Sophomores C

Philip M. Becker
Pennsylvania State University
University Park, Pennsylvania 16802

Educational Modules for Materials Science and Engineering (EMMSE) D

Rustum Roy
Pennsylvania State University
University Park, Pennsylvania 16802

Guidebook for the Implementation and the Use of Computer Generated Graphic Displays in the Undergraduate Mathematics Curriculum E

Gerald J. Porter
University of Pennsylvania
Philadelphia, Pennsylvania 19104

The Interactive Classroom: A Cost-Effective Approach to Inventive Learning F

Thomas A. Dwyer
University of Pittsburgh
1028 Cathedral of Learning
Fifth Avenue
Pittsburgh, Pennsylvania 15260

Development of Curriculum and Instructional Material in Applied Sociology G

Burkart Holzner
University of Pittsburgh
Pittsburgh, Pennsylvania 15260

An Alternative in Higher Education in the Mathematical Sciences — A

Clayton V. Aucoin
Clemson University
Clemson, South Carolina 29631

High School Computer Science Education — B

J.M. Moshell
University of Tennessee
Knoxville, Tennessee 37916

An Associate Degree Curriculum in Solar Engineering Technology - Phase II — C

Arthur C. Meyers
Navarro College
Highway 31 West
P.O. Box 1170
Corsicana, Texas 75110

Curriculum Analysis, Student Interrogation and Information System — D

Ernest J. Henley
College of Engineering
University of Houston
Houston, Texas 77004

The Development of Modules for the Undergraduate Chemical Engineering Curriculum and Continuing Education (CACHE) — E

Ernest J. Henley
College of Engineering
University of Houston
Houston, Texas 77004

Computer-Oriented Teaching Modules in Geochemistry — F

Philip C. Goodell
University of Texas
El Paso, Texas 79968

Continuing Education and College Instructional Modules in Chemical Engineering — G

David M. Himmelblau
(CACHE Corporation, Cambridge, MA)
University of Texas
Austin, Texas 78712

Extension of TVCAI Project to Include Demonstration of Intelligent Videodisc System A

Robert R. Kadesch
University of Utah
Salt Lake City, Utah 84112

An Intelligent Videodisc System: Evaluation in Developmental Biology B

C. Victor Bunderson
WICAT, Incorporated
Learning Design Laboratories
1160 S. State Street, Suite 10
Orem, Utah 84057

Scientific Instrumentation Information Network and Curricula (Project SIINC) C

Frank A. Settle, Jr.
Virginia Military Institute
Lexington, Virginia 24450

Educating Prospective Engineers in Technology-Related Public Policy D

Barry I. Hyman
American Society for Engineering Education
FS-15
Seattle, Washington 98195

Physical Processes in Terrestrial and Aquatic Ecosystems E

Douglas G. Chapman
University of Washington
Seattle, Washington 98195

Preparing Academically Disadvantaged Students in Sciences Through Concept-Based Modules F

Lillian C. McDermott
University of Washington
Seattle, Washington 98195

Service-Oriented Options in Mathematics G

Donald Bushaw
Washington State University
Pullman, Washington 99163

Development of Video Systems for Teaching Meteorology A

Donald R. Johnson
University of Wisconsin
1225 W. Dayton Street
Madison, Wisconsin 53706

Sociotechnical Systems Design Program B

Gerald Nadler
University of Wisconsin
Madison, Wisconsin 53706

CONTINUING EDUCATION FOR SCIENTISTS AND ENGINEERS

Regional Workshop for Continuing Education of Working-Level Scientists and Their Supervisors C

Roger D. Bauer
School of Natural Sciences
California State University
Long Beach, California 90840

Workshop on Continuing Education for Industry, Professional Societies and Universities D

Sonja S. Marchand
California State University
Northridge, California 91330

Impact of Management Practices and Organizational Climate on Motivation of Scientific Engineering Personnel E

William A. Snow
Rockwell International
2230 East Imperial Highway
El Segundo, California 90245

An Evaluation Model for State of the Art Programs for Professional Engineers F

Martha Maxwell
University of California/Berkeley
Berkeley, California 94720

Evaluation of Short Course Method of Instruction for Professionals in Engineering G

Alfred C. Ingersoll
University of California/Los Angeles
Los Angeles, California 90024

An Investigation Into Learning Patterns of Adults in Alternative Modes of Continuing Engineering Education as Compared With Those of Undergraduates and Graduates A

Bernard N. Samers
Cooper and Company
Stamford, Connecticut 06905

Multimedia User-Controlled Modes of Continuing Education in Chemistry B

Moses Passer
American Chemical Society
Washington, DC 20036

University Consortium to Increase National Effectiveness of Continuing Education for Engineers C

Charles R. Vail
Association for Media-Based Continuing Education for Engineers, Inc.
Georgia Institute of Technology
Atlanta, Georgia 30332

U.S. Electronics Industry Continuing Education Effectivity Study D

Robert M. Janowiak
National Engineering Consortium, Inc.
Oak Brook, Illinois 60521

Measurement for Learning Outcomes in Continuing Education for Scientists and Engineers E

David K. Blythe
College of Engineering
University of Kentucky
Lexington, Kentucky 40506

Pilot Study of Continuing Environmental Health Education for Scientists and Engineers F

Dade W. Moeller
School of Public Health
Harvard University
Boston, Massachusetts 02115

New Directors in Continuing Education: Comparative Perspectives of Decision-Making and R & D Personnel G

A. George Schillinger
Industrial Research Institute
Research Corporation
St. Louis, Missouri 63105

Continuing Education Needs of Engineers/Scientists in the Three-State Ozark Region A

John M. Amos
University of Missouri/Rolla
Center for Applied Engineering Management
Rolla, Missouri 65401

Factors Determining the Effectiveness of Continuing Education: Longitudinal Analyses in Engineering Organizations B

Harold G. Kaufman
Polytechnic Institute of New York
Brooklyn, New York 11201

Continuing Education for Scientists and Engineers: Delivery Systems in North Carolina C

Daniel E. Harrell
School of Engineering
North Carolina State University
Raleigh, North Carolina 27650

A Survey of Continuing Education for Nonacademic Scientists and Engineers Provided by Industry and Government D

Girard W. Levy
Battelle Memorial Institute
Columbus, Ohio 43201

Needs Assessment of Continuing Education Delivery Systems for Scientists and Engineers Employed in Small, Geographically Dispersed Plants E

Lawrence G. Welling
Battelle Memorial Institute
Columbus, Ohio 43201

Behavior Anchored Scales - A Method of Identifying Continuing Education Needs of Engineers F

James L. Farr
Pennsylvania State University
University Park, Pennsylvania 16802

Relationships Among Individual Motivation, Work Environment and Updating in Engineering G

James L. Farr
Pennsylvania State University
University Park, Pennsylvania 16802

ASSESSMENT OF SCIENCE EDUCATION IN THE TWO-YEAR COLLEGE

The Next Step: A Computer Facilites Master Plan for Saddleback — A

Dave Campbell
Saddleback College
28000 Marguerite Parkway
Mission Viejo, California 92692

Conference on the Assessment of Science Education in the Two-Year College — B

Richard E. Wilson
American Association of Community & Junior Colleges
Washington, DC 20036

Local Assessment of Science Education in the Two-Year College — C

Billie Ann Rice
DeKalb Community College
Central Campus, Math Department
555 North Indian Creek Drive
Clarkston, Georgia 30021

Local Assessment of Science Education in the Two-Year College — D

Martha T. Hatcher
Gainesville Junior College
Gainesville, Georgia 30501

Assessment of a Change to a Modularized Approach to Science Instruction — E

Faustine Perham
Central YMCA Community College
211 W. Wacker Drive
Chicago, Illinois 60606

Science for the Non-Science Student at Illinois Central College: An Assessment of Science Needs for Community College Students — F

Thomas C. Campbell
Illinois Central College
Box 2400
East Peoria, Illinois 61635

Triton's Comprehensive Self-Assessment of Science Education — G

William Collien
Triton College
2000 Fifth Avenue
River Grove, Illinois 60171

Local Assessment of Science Education in the Two-Year College — A

Robert Ernst
Kirkwood Community College
P.O. Box 2068
Cedar Rapids, Iowa 52406

Assessment of Science Education at Cowley County Community College — B

Mike Watters
Cowley County Community College
125 South Second Street
Arkansas City, Kansas 67005

Local Assessment of Science Education in the Two-Year College — C

William J. Lembeck
Louisiana State University
Eunice, Louisiana 70535

Local Assessment of Science Education in the Two-Year College — D

Robert L. Sawyer
Catonsville Community College
800 South Rolling Road
Catonsville, Maryland 21228

Local Assessment of Science Education in the Two-Year College — E

William F. Hibschman
Harford Community College
401 Thomas Run Road
Bel Air, Maryland 21014

Study of Science Education in Two-Year Colleges — F

Lance Hodes
Westat, Inc.
Rockville, Maryland 20852

Analysis of Student Skills, Needs and Goals — G

Frank E. Truesdale
Bunker Hill Community College
Rutherford Avenue
Charlestown, Massachusetts 02129

Students, Curricula and Laboratories - A Needs Assessment — A

Malcolm Nason
North Shore Community College
Beverly, Massachusetts 01915

Chemistry and Biology Laboratory Facilities and Curricula — B

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Suomi College Science Education Assessment Project — C

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Local Assessment of Science Education in the Two-Year College — D

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Local Assessment of Science Education in the Two-Year College — E

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Assessing the Biological Science Needs of Community College Freshmen — F

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Local Assessment of Science Education in the Two-Year College — G

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Local Assessment of Science Education in the Two-Year College — A

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Assessment of Placement Needs of Students — B

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Local Assessment of Science Education in the Two-Year College — C

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Local Assessment of Science Education in the Two-Year College — D

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Local Assessment of Science Education in the Two-Year College — E

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Local Assessment of Science Education in the Two-Year College — F

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Local Assessment of Science Education in the Two-Year College — G

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Local Assessment of Science Education in the Two-Year College A

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Local Assessment of Science Education in the Two-Year College B

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Evaluation and Needs Assessment for Mathematics Education C

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RESEARCH IN SCIENCE EDUCATION

An Inquiry Into the Graduate Training Needs of Two-Year College Teachers of Mathematics D

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A Study of Science Instructional Programs in Two-Year Colleges E

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Problem-Solving Processes of Upper Elementary and Junior High School Mathematics Students F

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The Role of Cognitive Style in the Learning of Mathematics: A Research Study G

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Expert-Novice Differences in Computer Science Problem Comprehension: Studies in Knowledge Organization — A

Michael E. Atwood
Science Applications, Inc.
1200 Prospect Street
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Sex Differences in Perceptual, Motor and Cognitive Skills as Related to Mathematics and Science — B

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Early Adolescent Student Reasoning in Mathematics — C

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Computer-Assisted Science Exhibits — D

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A Research Evaluation of Scientific Reasoning Ability in Naturalistic and Laboratory Settings — E

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Factors Which Influence Scientific Reasoning Among Adolescents in Natural Settings — F

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Problem Solving in Physics: Models, Experiments, and Instruction — G

Frederick Reif
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Increasing the Meaningfulness of Technical Information for Novices A

Richard E. Mayer
University of California/Santa Barbara
Santa Barbara, California 93106

Social Studies/Social Science Education: Priorities, Practices and Needs B

Irving Morrissett
Social Science Education Consortium, Inc.
855 Broadway
Boulder, Colorado 80302

Project Synthesis: An Interpretive Consolidation of Research Identifying Needs in Precollege Science Education C

Norris Harms
University of Colorado
Boulder, Colorado 80309

Research Into Important Factors Influencing Female Selection of First Optional Mathematics Courses D

Alma E. Lantz
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University of Denver
Denver, Colorado 80208

The Relationship of Learning Styles to the Continuing Education of Graduate Engineers and Scientists E

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Support of the Planning Phase of the 1980 International Congress of Mathematics Education F

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Science Understanding in Adults Through Television G

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The Use of Heuristics in Problem Solving: An Expository Study — A

Mary Grace Kantowski
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Gainesville, Florida 32602

An Analysis of Research on Mathematical Abilities — B

Jeremy Kilpatrick
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Athens, Georgia 32609

Learning and Teaching Whole Numbers: An Interdisciplinary Study of an Experimental Model — C

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University of Georgia
Athens, Georgia 30602

The Role of Manipulative Aids in the Learning of Rational Numbers — D

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Research Studies on the Scientific Literacy of the Attentive Public — E

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The Graduate School
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A Review of Research of Solving Routine Problems in Pre-College Mathematics — F

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The Feasibility of Using the National Assessment Science Data For Secondary Analysis — G

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A Meta-Analysis of Productive Factors in Science Learning in Grades 6 Through 12 — A

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Detailed Description of Mathematical Behaviors That Demonstrate Understanding — B

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Research on Thought Processes Used in 7th to 10th Grade Mathematics — C

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Effects of Topic-Specific Instructional Variables in Eighth Grade Mathematics — D

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Facilitating Problem Solving in High School Chemistry — E

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Analysis and Synthesis of Mathematical Problem-Solving Processes of Early Adolescents — F

Gerald Kulm
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Calculator Use and Problem-Solving Strategies of Early Adolescents — G

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A Research Study of Computer-Based Tutoring of Mathematical and Scientific Knowledge — A

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Assessment and Documentation of a Children's Computer Laboratory — B

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Identifying Different Levels of Understanding Attained by Physics Students — C

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Amherst, Massachusetts 01003

The Ecology of Failure in Ninth Grade General Mathematics: An Ethnographic, Experimental, and Psychometric Inquiry — D

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East Lansing, Michigan 48824

Statistical Analysis of Research Results in College Science Teaching — E

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Center for Research on Learning and Teaching
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Synthesis of Research on Individualized Science Teaching in Secondary Schools — F

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Computer Awareness and Literacy of Adolescent and Early Adolescent Students: An Empirical Assessment — G

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A Study of Computer Use and Literacy in Science Education — A

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Scientific Reasoning: Cognitive Processes in Using and Extending Problem-Solving Skills — B

Paul E. Johnson
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Inventory of Computing Activities and Related Degree Programs in U.S. Higher Education-Dissemination — C

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Effects of Processing Style on Problem Solving in Mathematics — D

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Psychological Problem Space and Motivation in Adolescent Learning: A Study of Information Processing — E

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University of Nebraska
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An Investigation of the Structure and Dynamics of Classroom Communication of Science — F

Jay L. Lemke
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Strategies and Structures in Understanding Geometry — G

Harry Beilin
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Strategies for Learning Emphasizing the Nature and Role of Concepts **A**

Joseph D. Novak
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Expert and Novice Mathematical Problem Solving **B**

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The Relationship Between Continuing Education and Career Development of Scientists and Engineers **C**

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Elementary School Science Processes Program: Meta-Analysis of Evaluation Studies **D**

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School, Family, and Individual Influences on Commitment to and Learning of Science Among Adolescent Students **E**

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Determinants of Student Entry and Performance in the Sciences **F**

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Research Triangle Park, North Carolina 27709

A Study of Priorities in School Mathematics (PRISM) **G**

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Research on Relationship of Spatial Visualization and Confidence to Male/Female Mathematics Achievement in Grades 6 to 8 **A**

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Research on Relationship of Spatial Visualization and Confidence in Male/Female Mathematics Achievement in Grades 6-8, Phase 2 **B**

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Systematic Investigation of the Cognitive Effects of Games on Mathematics Learning **C**

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NATIONAL INSTITUTE OF EDUCATION - NATIONAL SCIENCE FOUNDATION COLLABORATIVE PROGRAM ON RESEARCH ON COGNITIVE PROCESSES AND THE STRUCTURE OF KNOWLEDGE IN SCIENCE AND MATHEMATICS

(Funding and Administration for the following projects provided jointly by the National Institute of Education and by NSF under the above-named research program).

Research on Process Models of Basic Arithmetic Skills **D**

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Underlying Heuristic and Formal Structures of Probabilistic Thought **E**

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University of California/Irvine
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The Representation and Learning of Knowledge Structures in Experimental Psychology **F**

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Normal, Illinois 61761

The Logical, Mathematical, and Psychological Structure of Counting and of Early Number Concepts — A

Karen C. Fuson
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Analysis of the Development of Propositional Reasoning — B

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Worcester, Massachusetts 01610

The Development of Applied Scientific Thinking in Children and Adolescents — C

Robert Louis Selman
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Cambridge, Massachusetts 02138

The Role of Preconceptions & Representational Transformations in Understanding Science and Mathematics — D

Frederick W. Byron, Jr.
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Cognitive Processes and the Structure of Knowledge in Physics and Algebra — E

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Invention and Understanding in the Acquisition of Computation — F

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Pittsburgh, Pennsylvania 15260

Psychology of Equation Solving: An Information Processing Study — G

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Learning From Science and Mathematics Textbooks: Text Structure, Reading Strategies and Comprehension

James Deese
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Charlottesville, Virginia 22901

APPENDIX A

FY 1980 Awards
Principal Investigators
Alphabetically by State and Institution

Appendix A
Fiscal Year 1980
Principal Investigators Alphabetically by State and Institution

APPENDIX B

Fiscal Year 1979 and Earlier Years' Awards
Principal Investigators by State and Institution

APPENDIX B
Fiscal Year 1979 and Earlier Years' Awards
Principal Investigators By State ans Institution

APPENDIX C

Principal Investigators, Alphabetically

Appendix C
Principal Investigators, Alphabetically

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Directorate for Science and Engineering Education
National Science Foundation
DIVISION OF SCIENCE EDUCATION DEVELOPMENT AND RESEARCH

ORGANIZATIONAL UNIT & TITLE

Office of Division Director	Name
Division Director	Dr. Joseph I. Lipson
Deputy Division Director	Dr. Robert F. Watson
Professional Assistant	Mrs. Mary Louise Charles
Program Analyst	Mr. Jack Jones
Information Dissemination Assistant	Mrs. Patricia Babb
Administrative Officer	Vacant
Secretary	Mrs. Jackye Lee
Secretary	Mrs. Anne Keola

Development in Science Education

Program Director	Mr. Alexander J. Barton
Program Manager	Dr. Dorothy Deringer
Program Manager	Dr. Gregg Edwards
Program Manager	Dr. Raymond Hannapel
Program Manager	Dr. Carl Naegele
Program Manager	Dr. Mary Ann Ryan
Program Manager	Dr. Harold Stolberg
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Secretary	Mrs. Mary Jones
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*Secretary	Mrs. Bridget Richardson

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Program Director	Dr. Rita Peterson
Program Associate	Dr. Kathleen Fisher
Program Manager	Dr. Douglas McLeod
Program Manager	Mr. Erik McWilliams
Program Manager	Mr. Andrew Molnar
Secretary	Mrs. Eleanor MacMeekin
Secretary	Mrs. Betty Finch
Secretary	Ms. Hattie Johnson
*Secretary	Ms. Emily Luttrell

*Part-time