DOCUMENT RESUME

ED 222 394 SE 039 600

TITLE Source Book of Projects, Science Education Development and Research. Fiscal Year 1981, with References to Earlier Years.

INSTITUTION National Science Foundation, Washington, D.C. Directorate for Science and Engineering Education.

REPORT NO SE-82-80

PUB DATE 82

CONTRACT NSF-SED-82017

NOTE 225p.; For related documents, see ED 188 907 and SE 039 599.

EDRS PRICE MF01/PC09 Plus Postage.

DESCRIPTORS *Educational Research; Educational Researchers; Elementary Secondary Education; *Engineering Education; Higher Education; *Mathematics Education; *Program Descriptions; Research Directors; *Research Projects; *Science Education; Science Programs

IDENTIFIERS Mathematics Education Research; *Science Education Research

ABSTRACT

This publication describes awards made in the National Science Foundation's Division of Science Education Development and Research in FY 1981, FY 1980, 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 1981 awards only, using ERIC descriptors as well as proper names. All projects awarded in FY 1981 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 are principal investigators only of RISE and DISE projects funded in FY 1980 are provided (alphabetically by state and institution) in the third section. Alphabetical listings of states (and under each state principal investigators and institutions) and principal investigators are provided in appendices. (Author/JN)

NSF/SED-82017

Source Book of Projects Science Education Development and Research

Fiscal Year 1981
With References to Earlier Years

NATIONAL SCIENCE FOUNDATION
Directorate for Science and Engineering Education

This publication presents a description of awards given by the Division of Science Education Development and Research (SEDR) during Fiscal Year 1981, 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 1981.

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 Act of 1950 (P.L. 81-507, as amended) authorizes and directs the Foundation "to initiate and support basic scientific research and programs to strengthen scientific research potential and science education programs at all levels." Two continuing goals of the National Science Foundation's Science and Engineering Education Directorate have been:

- To assure a stable flow of talented students into the science and engineering workforce, with attention given to increasing the participation of minorities and women; and
- To help citizens increase their understanding of science and technology to a level that enables them effectively to meet the requirements of contemporary society.

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

This publication includes references to all projects supported by the National Science Foundation's Division of Science Education Development and Research in fiscal years 1978-1981 inclusive, and to most projects initiated as early as 1975. It is intended as a continuing reference guide to research and development activity of interest to the science and engineering education community.

In any technologically based enterprise, research and development are the cornerstone for long-range strength and growth. For this reason, a science education R&D effort is required to maintain strength and leadership in science and engineering.

The Division of Science Education Development and Research (SEDR) has supported:

- Continuing development and availability of high quality science and engineering instructional materials based on the latest research and technological findings.
- Research that promotes the acquisition, use, structuring, and transfer of knowledge and skills in science, mathematics, and engineering.

SEDR consists of the two component programs: Development in Science Education (DISE) and Research in Science Education (RISE). SEDR supports only projects of national consequence that promise long-term benefits, rather than those solely for immediate, local benefit.

The specific objectives of SEDR have been as follows:

- To assure the rapid movement of current research and technology into instructional materials for undergraduate science and engineering education.
- To support development and research on the incorporation of computing into science and engineering teaching laboratories and instructional materials.
- To support development and research that advances problem solving and reasoning in science, mathematics, and engineering, and to examine technologies that can be utilized in learning at all levels.

SEDR has supported long-range efforts dealing with the difficult task of anticipating problems and opportunities of the future. Many projects are aimed at future conditions five to fifteen years away to ensure that major problems are both identified and treated by the most highly qualified and talented people in the science and engineering communities.

Also pervading both development and research activities has been 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 useful to persons involved in science and engineering education at all levels.

Robert F. Watson
Acting Division Director
Division of Science Education
Development and Research

USING PUBLICATION SE 82-80

This publication describes awards made in the National Science Foundation's Division of Science Education Development and Research in Fiscal Year 1981, in Fiscal Year 1980, 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 1981 awards only. The FY 1981 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 1981 (Section II), but only titles are shown of projects awarded in FY 1980 and earlier (Section III).

Section II. Projects awarded in Fiscal Year 1981 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 47; RISE Program project descriptions begin on page 108. Projects appear alphabetically by State and Institution within each program, RISE and DISE.

Section III. Projects awarded in Fiscal Year 1980 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 149; RISE Program project titles begin on page 181. Projects appear alphabetically by State and Institution within each program.

Appendix A. Fiscal Year 1981 and Earlier Years' 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 1981 and earlier years, under the DISE and RISE Programs.

Page references direct the reader to summary descriptions of projects contained in Section II and to titles and addresses of projects listed in Section III.

Appendix B. Principal Investigators, Alphabetically

This section is provided as an additional index to projects awarded in FY 1981, in FY 1980, and in earlier years.

Section I

Rotated Title Index
Fiscal Year 1981 and Earlier Years' Awards

Key Word/Phrase Index
Fiscal Year 1981 only

Rotated Title Index FY 1981 and Earlier Years

Rotated Title Index FY 1981 and Earlier Years

Rotated Title Index FY 1981 and Earlier Years

Rotated Title Index FY 1981 and Earlier Years

Rotated Title Index FY 1981 and Earlier Years

Rotated Title Index FY 1981 and Earlier Years

ocial Values
ial Values

llege Students

Rotated Title Index FY 1981 and Earlier Years

Rotated Title Index FY 1981 and Earlier Years

Rotated Title Index FY 1981 and Earlier Years

Rotated Title Index FY 1981 and Earlier Years

Rotated Title Index FY 1981 and Earlier Years

Rotated Title Index FY 1981 and Earlier Years

Rotated Title Index FY 1981 and Earlier Years

Rotated Title Index FY 1981 and Earlier Years

Key Word/Phrase Index
Fiscal Year 1981 only

Section II

Fiscal Year 1981 Awards

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

Modules for the Development of Reasoning in Mathematics

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

The "Mathematical Reasoning Improvement Study (MRIS)" project has embarked on an 18-month effort to develop four two- to three-week modules that will enhance the mathematical reasoning of early adolescent students. The purpose of this augmentation is to provide for the simultaneous adaptation and trial of MRIS materials especially suited to the needs of blind and orthopedically disabled students.

These modules will concentrate on aspects of mathematics which require reasoning skills in the areas of problem solving, estimation, graphing, relations among variables, probability, and data interpretation.

The project has plans for the ultimate development of 15 modules which will undergo a national field test prior to commercial publication.

AMOUNT: $278,500*
AWARDED: 09-01-80
TERMINATES: 09-30-82

AWARD NUMBER: SED79-26662

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; Mathematical Reasoning; Reasoning Patterns; Blindness; Handicapped; Visual Impairments

*Cumulative amount. Fiscal Year 1981 award: $39,900.

Development of Reasoning Skills in Early Adolescence

Alfred M. Bork
University of California/Irvine
Department of Physics
Irvine, CA 92717

This project explores potential applications of inexpensive computers to promoting the development of reasoning in students aged 13 to 15. It is based upon two areas of similar work: non-computer materials in physical science for these ages, and computerized materials for beginning college students. Three considerations motivate the project: (1) the increasing availability of powerful, inexpensive computers; (2) the growing perception that many students never develop a comfortable competency in using abstract thought; and (3) the observation that while abstract thought is essential to understanding concrete reality, people at large do not employ it effectively.

The objective over the next two years is to explore the plausibility that the time is now ripe to make significant progress. The objectives of this prototype phase are to (1) create products which will lay out different approaches to the goal of improving general facility in abstract thought, and (2) demonstrate effectiveness of these approaches, and allow better evaluation of whether further steps should be taken, and if so which steps.

Anticipated products include: surveys of computerized materials stemming from various learning and teaching theories for early adolescence, and of computer-aided evaluations of the effectiveness of materials; analyses of how different reasoning skills relate to the curriculum and overall educational goals; and computer programs showing teachers how to use these materials or to generate their own.

AMOUNT: $207,000*
AWARDED: 08-30-79
TERMINATES: 12-31-82

AWARD NUMBER: SED79-19021

PROGRAM: Development in Science Education

DISCIPLINE: Software Systems/Computer Science
TARGET AUDIENCE: Grades 6-9
DESCRIPTORS: Computer Assisted Instruction; Abstract Reasoning; Learning Theories; Individualized Curriculum

*Cumulative amount. Fiscal Year 1981 award: $28,000.

Network for Educating Teachers of Science in Applying Computers to Precollege Instruction

Alfred M. Bork
University of California/Irvine
Department of Physics
Irvine, CA 92717

This project will set up a network of universities and professional associations providing teacher training workshops on the applications of microcomputers to teaching science. The network will provide a mechanism for the exchange, review, and field testing of computer-based materials designed for use in such workshops. Most of the work during the funded portion of the project will be to adapt, and revise on the basis of field trials, materials which have been generated. The initial computer materials have been generated at Irvine under a series of NSF grants. The teacher workshop materials will in large part come from the experience at three colleges of education which are starting the network. The project will result in computer-readable discs containing exemplary programs for use in instruction. One disc will contain programs primarily from the physical sciences, the second will concentrate on measurement and mathematical concepts, and the third will consist of programs emphasizing scientific reasoning. These discs will be menu driven with additional tutorial assistance for teachers.

The project will produce a written handbook for teachers and a series of "software tools" so that teachers can write their own programs or adapt programs from other sources, plus a guide to various strategies for using and producing computer-based teaching materials.

AMOUNT: $51,128
AWARDED: 01-01-82
TERMINATES: 06-30-84

AWARD NUMBER: SED81-11227

PROGRAM: Development in Science Education

DISCIPLINE: Computer Science
TARGET AUDIENCE: Teachers (Grades 6-12)
DESCRIPTORS: Teacher Education; Teacher Workshops; Teaching Skills; Programmed Instruction; Computer Assisted Instruction; Microcomputers; Programmed Instructional Materials; Information Networks; Science Instruction; Science Teachers

Intensive Computer-Based Mathematics Training for Re-entry Women

Marvin Marcus
University of California/Santa Barbara
University Extension
Santa Barbara, CA 93106

This project will develop a computer-based mathematics curriculum for women who wish to upgrade skills needed for continuing education or re-entering the technical job market. The project will design and implement a graded sequence of instructional units--covering such topics as real and complex numbers, functions, linear systems and probability--for two intensive summer short courses and subsequent home-study/microcomputer laboratory phases, using low-cost, stand alone, commercially available microcomputers located on the Santa Barbara campus.

One hundred women between the ages of 25 and 55 will be selected for the program, taking into account commitment, career goals, demographic mix, and need. Participants will be randomly assigned to control and treatment groups. Only those women in the treatment group will receive the intensive mathematical training, but both groups will be tested regularly, throughout the length of the program, to determine the effectiveness of the intervention.

The project will develop and disseminate: (1) written instructional units covering the pertinent mathematics, and microcomputer-based "discovery" exercises; (2) intelligible manuals for learning a computer language and simple machine operating techniques; (3) a "how-to" manual on setting up an inexpensive microcomputer laboratory to work effectively with non-traditional students; (4) videotapes of the lectures; and (5) a newsletter, published every three months to disseminate the project's results. The materials and course design will be made suitable for easy transfer to other institutions.

AMOUNT: $192,012
AWARDED: 03-01-81
TERMINATES: 10-31-83

AWARD NUMBER: SED80-20411

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics; Computer Science
TARGET AUDIENCE: Females; Minorities
DESCRIPTORS: Mathematics Curriculum; Curriculum Development; Instructional Materials; Mathematics Anxiety; Computer Assisted Instruction; Programming; Microcomputers; Continuing Education; Women's Education; Hispanic Americans; Re-entry Women; Videotapes; Newsletters; Females

Microcomputer and Video-Based Mathematics Modules for High School Women and Minority Students

Edward M. Landesman
University of California/Santa Cruz
Department of Mathematics
Santa Cruz, CA 95064

This project will develop six learning modules which will make use of a combination of media (microcomputers, videotape, and printed workbooks) to assist minority and women students in learning high school mathematics. The proposed approach is based on social learning theory, which synthesizes cognitive and behavioral perspectives. The modules will be designed to aid learners in mastering key concepts, strengthening needed skills, and reducing feelings of learned helplessness or anxiety in mathematics so that the necessary preparation may be acquired to pursue postsecondary studies in science and technical fields.

Interactive computing will be combined with video sequences and printed workbooks to provide the learner with a powerful mix of learning activities based on task analyses and learning objectives. This combination of media is particularly useful in relating mathematical concepts to their applications, demonstrating the importance of mathematics in life and careers, and providing self-paced, interactive rehearsals in generalizing concepts and mastering skills. The proposed work will use equipment that is already available in many high schools, and will provide a foundation for future uses of intelligent videodisc technology.

The project team includes senior academic and professional staff having expertise in mathematics, educational psychology, graphic arts, and computer-assisted instructional techniques. The team also includes high school teachers of mathematics.

AMOUNT: $176,444
AWARDED: 04-01-81
TERMINATES: 03-31-83

AWARD NUMBER: SED80-24701

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Females; Minorities
DESCRIPTORS: Microcomputers; Mathematics Instruction; Females; Minorities; Women's Education; Instructional Materials; Computer Assisted Instruction; Secondary School Students; Videotape Cassettes

Middle School Microcomputer Statistics Laboratory

Ronald Saltinski
Dixie School District
Miller Creek School
380 Nova Albion Way
San Rafael, CA 94903

The primary objective of the project is to create an environment in which middle school students will have the opportunity to develop a sense of statistical reasoning as an integral component of problem solving in science and mathematics. A statistics laboratory will be created in which students will receive instruction in statistics and assistance in applying statistical techniques in science, social studies, and other areas of study. The microcomputer will be used as a tool to solve these statistics problems. The project will generate a low-cost model with supporting courseware, competency statements, and guidelines for instruction and evaluation of hardware and software. Commercial publication of the materials produced in the project will be sought.

AMOUNT: $10,035*
AWARDED: 05-15-81
TERMINATES: 04-30-83

AWARD NUMBER: SED80-24417

PROGRAM: Development in Science Education

DISCIPLINE: Problem Solving/Education
TARGET AUDIENCE: Grades 5-8
DESCRIPTORS: Microcomputers; Middle Schools; Mathematics Instruction; Mathematical Applications; Statistics; Computer Assisted Instruction; Problem Solving; Science Instruction

*Funded in part by the National Institute of Education

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

Robert P. Larkin
University of Colorado
Austin Bluffs Parkway
Colorado Springs, CO 80907

This project involves the design, development, and dissemination of a model educational program which has two primary goals: (1) in the short term, to give older students an experience of science-based interdisciplinary study, stressing the relatedness of scientific ideas and social values, and (2) in the long term, to involve older people in the mainstream of higher education in science.

In the first phase, a group of teacher/counselors--physical, biological, and social scientists, and humanists--from the University of Colorado at Colorado Springs and Colorado College, developed a varied program of educational activities in the area of science and society. Starting out on the senior citizens' home ground, they gradually introduced the older students to the academic programs of the two institutions.

In this phase, the primary emphasis will be on evaluation and dissemination of the model to other locations. A rigorous evaluation component will measure the changes in skills and attitudes on the part of older people toward science education as a result of the program. Twenty people will attend two workshops and receive the ongoing assistance of the principal investigator to establish similar programs at their own institutions at a variety of locations. A "how-to" booklet with an accompanying video presentation will be pilot tested by workshop participants. This program appeals to those large numbers of older people who want very much to understand more about science, but who don't know how or are afraid to begin.

AMOUNT: $188,964*
AWARDED: 08-31-79
TERMINATES: 03-31-83

AWARD NUMBER: SED79-19031

PROGRAM: Development in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Elderly; Older Students

DESCRIPTORS: Higher Education; Nontraditional Students; College Programs; Scientific Literacy; Science Programs; Science Education; Older Adults; Attitude Change; Instructional Materials

*Cumulative amount. Fiscal Year 1981 award: $53,758.

A College-Level Introduction to Computing Principles Through Text Processing

William S. Dorn
University of Denver
College of Arts and Sciences
Department of Mathematics and Computer Science
Denver, CO 80208

This is a project to design a course to teach the fundamental principles of computing by using a text processing language rather than a programming language. The primary audience for the course will be students who are not science majors. The course will be based on real-life case studies that have little or no connection with mathematics or business. For example, students will write and edit a non-technical article comparing various home energy sources: windmills, solar heating, wood-burning stoves, etc. As another example, they will customize a letter so that it appears to be completely individualized when, in fact, the letter was pieced together from standard paragraphs.

Students will have the opportunity (a) to learn to use a text processing system for their work, e.g., writing term papers; (b) to learn the basic principles behind computers and computer programming; and (c) to improve their ability to follow and to create a logical argument.

The experimental course will be given in a classroom in which every two students will have a terminal. The professor will have a terminal whose output will be displayed on a large screen visible to all of the students.

The principal products of this project will be the development of the course materials, the evaluation of the course and the top-down design of the software packages (with programmer and user documentation) in a form suitable for implementation on another system (pseudo-code). Articles about the project will be submitted to the appropriate journals and presentations will be made to the National Educational Computing Conference and the Small College Computing Symposium.

AMOUNT: $95,538
AWARDED: 01-01-82
TERMINATES: 06-30-84

AWARD NUMBER: SED80-25788

PROGRAM: Development in Science Education

DISCIPLINE: Software Systems/Computer Science
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Material Development; Computer Science Education; Programming; Computer Oriented Programs; Microcomputers; Career Development; Problem Solving; Technological Advancement; Text Processing Language; Non-science Majors

A World Model for Classroom Use

Barry B. Hughes
University of Denver
Graduate School of International Studies
University Park
Denver, CO 80208

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. The project aims to communicate to students basic information about global development and global interdependence, and to motivate students to explore further the interrelatedness between science, technology and the important social/value issues of the day.

The initial phase of effort (funded by the Cleveland Foundation) involved development of the basic model and preparation of the manual. The second phase will consist 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.

Great care is being taken to assure 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: $85,598*
AWARDED: 12-01-80
TERMINATES: 05-31-82

AWARD NUMBER: SED81-02303

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); World Affairs; Instructional Materials; Computer Programs; Computer Assisted Instruction; International Relations; Science/Society Interactions; Computer Models; Interactive Computer Programs; Global Interdependence

*Funds for this project were deobligated from the FY 1980 budget (SED80-07313) and obligated under the FY 1981 budget.

A Modular Computer-Based Approach to Improving High School Mathematics Instruction

Clifford W. Sloyer
University of Delaware
Department of Mathematical Sciences
Newark, DE 19711

This project will develop secondary school-level materials that introduce new applied mathematics techniques into the school curriculum. Five instructional modules, to be developed over a 20-month period, will cover the following topics: (1) Dynamic Programming, (2) Queuing Theory, (3) Graph Theory, (4) Glyphs and Algoglyphs, and (5) Applications of Mathematics to Medicine. The modules will be available both as printed monographs adaptable to numerous computer configurations, and as interactive lessons to be used with the widely available PLATO computer system. In addition, an introductory module will be developed to motivate and guide students to the other five lessons.

The project will evaluate the impact of offering these modules to secondary students as well as to high school mathematics and science teachers. Printed materials and parallel computer-based materials will be evaluated independently to obtain measures of their effectiveness. The evaluation will focus also on teacher attitudes and readiness to incorporate these materials into the secondary school curriculum.

AMOUNT: $204,865
AWARDED: 08-15-81
TERMINATES: 09-30-83

AWARD NUMBER: SED80-25787

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 9-12; Teachers
DESCRIPTORS: Mathematics Instruction; Material Development; Computer Assisted Instruction; Secondary School Students; Motivation Techniques; Mathematics Teachers; Secondary School Mathematics; Mathematical Applications; Teacher Attitudes; Science Teachers; Student Attitudes; PLATO Computer System; Glyphs; Algoglyphs; Queuing Theory; Graph Theory; Dynamic Programming

Chemistry in the Community: A Problem-Focused Course for High Schools

William T. Lippincott
American Chemical Society
1155 Sixteenth Street, NW
Washington, DC 20036

This project will develop, field-test, and disseminate six modules comprising a new one-semester high school science course entitled, "Chemistry in the Community" (ChemCom). The course will teach chemical concepts which help students to understand and to seek solutions for technology-related problems of today. Major goals of the program are to enhance the scientific literacy of general students, and to broaden the social and technological perspectives of future scientists.

Each module will be an independent learning unit focused on a chemicals-related societal issue. The modules will be designed for use by chemistry teachers either as an alternative curriculum or to enrich more traditional courses. Written materials will help students (a) identify a problem; (b) learn the chemical concepts involved; (c) describe or propose solutions; and (d) anticipate new problems resulting from proposed solutions.

Materials will be developed and tested at three university centers, Temple University and the Universities of Maryland and Western Washington. A steering committee will oversee the project, act as consultants, and assist the staff in developing materials that are sound in content and teachability. The project staff and steering committee combine the talents of chemists, experts in science education, high school chemistry teachers, social scientists, and science writers. A commercial publisher will be sought to produce and distribute the materials.

AMOUNT: $193,201
AWARDED: 09-01-81
TERMINATES: 02-28-85

AWARD NUMBER: SED81-15424

PROGRAM: Development in Science Education

DISCIPLINE: Chemistry, Community Oriented; Science Literacy/Education
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Chemistry; Science Instruction; Scientific Literacy; High School Students; Curriculum Enrichment; Material Development; Concept Formation; Concept Teaching; Learning Modules; Technology; Community Involvement; Problem Solving

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

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

The project will develop and disseminate multimedia materials to inform 8th to 10th grade students about careers involving mathematics and the limitations to career options which result from math avoidance. The materials, to be titled "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: $129,300*
AWARDED: 08-15-80
TERMINATES: 05-31-82

AWARD NUMBER: SED80-08438

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics, General/Mathematical Sciences
TARGET AUDIENCE: Grades 8-10
DESCRIPTORS: Mathematics; Women's Education; Careers; Multimedia Materials; Career Education; Career Choice; Secondary School Mathematics; Adolescents; Minority Groups; Career Planning; MAWIS (Mathematics at Work in Society); Females

*Cumulative amount. Fiscal Year 1981 award: $10,900.

Spanish Translation and Feasibility Study of Ranger Rick's Nature Magazine

E. Gerald Bishop
National Wildlife Federation
1412 Sixteenth Street, NW
Washington, DC 20036

An issue of RANGER RICK's NATURE MAGAZINE and its accompanying Activity Guide will be translated into Spanish for classroom use in schools with Hispanic populations. The primary purpose is to increase Hispanic students' understanding and appreciation of science by arousing their interest in natural phenomena. Emphasis will be placed on providing first-hand science activities involving the student's own life and surroundings, rather than memorization of facts. It is hoped that the effort also will improve the reading ability of Spanish speaking students. Because of differences in Spanish American groups in the United States, the Spanish translation will consist of a text and glossary responsive to the various dialects. Activity issues with a guide for teachers will be distributed to schools nationwide.

A feasibility study, including both field and market testing, will evaluate the acceptance and effectiveness of the Spanish edition and determine whether a Spanish language edition of the magazine could be self-sustaining. Results of the study will guide the National Wildlife Federation in launching a continuing Spanish edition of RANGER RICK, and will inform publishers of other popular science-related periodicals of the advantages of this approach.

AMOUNT: $78,538
AWARDED: 12-01-80
TERMINATES: 03-31-82

AWARD NUMBER: SED80-19334

PROGRAM: Development in Science Education

DISCIPLINE: Biology, General/Life & Medical Sciences
TARGET AUDIENCE: Minorities; Grades 3-8
DESCRIPTORS: Hispanic Americans; Minority Groups; Scientific Literacy; Zoology; Biology; Translation; Spanish Speaking; Elementary Education; Feasibility Studies; Ranger Rick's Nature Magazine

Science Activities for Informal Learning (SAIL) (Age 11-14)

John H. Falk
Smithsonian Institution
Chesapeake Bay Center for Environmental Studies
Washington, DC 20560

The Smithsonian Institution's Chesapeake Bay Center for Environmental Studies will develop, evaluate, and disseminate a set of materials and activities to be used for science learning in informal educational settings. Called "Science Activities for Informal Learning" (SAIL), these materials will be designed specifically for early adolescents (11-14 year olds), particularly young women. A major goal of this project is to develop materials that help improve attitudes toward science in this age group and increase their motivation to explore science and science-related topics further. Another major goal of this project is to interweave career information into the SAIL materials in order to enhance career awareness.

The project will produce sets of paperback books and related activity-oriented materials designed to give maximum flexibility to a diverse set of users. In this pilot project, two units will be developed, one focusing on the general area of food science and the other on pets and domestic animals. These topics were selected to represent areas of basic interest to early adolescents. They contain important scientific principles and concepts. All units will be multidisciplinary and include biological, physical, and social science aspects of a topic, as well as historical and aesthetic considerations. All materials will be designed for high interest and relevance to early adolescents since a "noncaptive" audience is being targeted. Field testing by museums, youth groups, and science clubs will guide the developers in assuring that the goals of cognitive appropriateness, subject interest, career awareness, and high motivation generation are achieved. This project constitutes the first phase of a planned two-phase project to produce materials on ten different topics.

AMOUNT: $197,800
AWARDED: 05-01-81
TERMINATES: 04-30-83

AWARD NUMBER: SED80-12307

PROGRAM: Development in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Grades 5-8; Females
DESCRIPTORS: Science Programs; Science Activities; Scientific Literacy; Out of School Science Materials; Foods Instruction; Adolescents; Scientific Attitudes; Motivation Techniques; Career Planning; Informal Learning; Science Activities for Informal Learning (SAIL); Pets

Science Education for Families in Informal Learning Settings

Judith White
Smithsonian Institution
National Zoological Park
Washington, DC 20008

A core set of five or more self-contained multi-modal learning packages will be developed for families to use to learn about zoology in the informal learning setting of a zoo. The characteristics of a family zoo visit, including its social and recreational aspects and the varied ages and interests of family members, will be considered in designing the materials. Visitor participation and interactive learning will be fostered by providing specially designed packages that will include objects to handle, animals to examine, and animal displays to manipulate.

Prototype materials will be developed at the National Zoological Park, based upon its reptile and amphibian collection. During the project's second year, prototype materials will be field tested at zoo sites in Washington, D.C.; Philadelphia, Pennsylvania; and Grand Rapids, Michigan. After field testing, evaluation results will be applied toward revising the materials for use in a variety of zoos.

Results of the project, including the materials it develops, will be disseminated to other zoos through workshops and reports in an effort to foster the development of innovative educational approaches for family learning at other zoos across the country. The project will have the active cooperation of the American Association of Zoological Parks and Aquariums during its testing and distribution stages.

AMOUNT: $223,735
AWARDED: 02-13-81
TERMINATES: 07-31-84

AWARD NUMBER: SED80-20621

PROGRAM: Development in Science Education

DISCIPLINE: Zoology/Life & Medical Sciences
TARGET AUDIENCE: Families
DESCRIPTORS: Zoology; Animal Life; Zoos; Family Involvement; Instructional Materials; Participation; Interaction; Material Development; Reptiles; Amphibians

Survey of Recent East European Mathematical Literature

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

The "Survey of Recent East European Mathematical Literature" was initiated in 1956 with a grant from the National Science Foundation. The general aim of the survey is to analyze and provide information on current Soviet and other East European mathematical literature and mathematics education, and to make available to American researchers, educators, and students, some of the best materials from these sources. To realize these goals the Survey is continuing to publish, on a reduced scale, translated and adapted exceptional expositions for teacher training programs, the new school mathematics curriculum, extracurricular school mathematics, and special secondary schools for mathematically gifted students. It is proceeding further with the publication of its series of translations of selected papers and monographs on Soviet research and psychology and the methods of learning and teaching mathematics. The Survey is expanding its information and publishing activities to cover alternatives in Soviet education--in particular, the curricula and educational literature in newly developed training programs for middle- and higher-level specialists in the computer and information sciences, in cybernetics, and in other applied mathematics disciplines. Finally, it will develop a program on the achievements in mathematics education in the more advanced of the other East European countries.

AMOUNT: $296,200*
AWARDED: 09-30-76
TERMINATES: 09-30-82

AWARD NUMBER: SED76-80599

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education; Mathematics, General
TARGET AUDIENCE: Mathematics Educators
DESCRIPTORS: Mathematics Curriculum; Mathematics Education; Foreign Countries; International Programs; Comparative Education; Surveys; Computer Science Education; Information Science; Cybernetics; Soviet Union; East-European Nations

*Cumulative amount. Fiscal Year 1981 award: $25,000.

Females' Acquisition of 8th Grade Geometry Concepts via Non-Verbal Microcomputer Graphics

Gary W. Tubb
Illinois State University
344 DeGarmo Hall
Normal, IL 61761

This project is designed to: (1) improve the acquisition of geometry concepts of 8th grade females; (2) produce software in a working model format that clearly illustrates the utility of microcomputers in geometry and is easily modifiable by educators; and (3) produce a non-verbal symbol-based geometry model using microcomputer graphics. This project is based on research that indicates that females develop spatial abilities differently as well as later than males.

This project will result in: (1) 19 non-verbal, 15-minute interactive instructional modules for a microcomputer which demonstrate at the 8th grade level translation, reflection, rotation, congruence, symmetry, invariance, triangles (SSS, ASA, SAS, AAS), sum of angles, corresponding and alternate angles; (2) identifying the stages of spatial acquisition of the above geometry concepts by sex and by age; and (3) determining the adequacy of a graphics pad in the acquisition of geometry concepts via microcomputer. This project has attracted the interest of a computer vendor who will support the equipment. These modules will be discussed at national meetings and will be offered for commercial publication.

AMOUNT: $55,500
AWARDED: 09-15-81
TERMINATES: 02-29-84

AWARD NUMBER: SED80-24507

PROGRAM: Development in Science Education

DISCIPLINE: Geometry/Mathematical Sciences
TARGET AUDIENCE: Grade 8; Females
DESCRIPTORS: Geometric Concepts; Concept Formation; Geometry; Females; Computer Graphics; Microcomputers; Spatial Perception; Sex Differences; Computer Assisted Instruction; Learning Modules; Programmed Instruction

Microcomputer Applications of Mathematics in High School Management Science

Bernadette H. Perham
Ball State University
Department of Mathematical Sciences
2000 University Avenue
Muncie, IN 47306

This project will develop high school level microcomputer-based curriculum materials for teaching the mathematics used for decision making in the management sciences. The products will be five independent modules on the topics of matrix theory, game theory, linear programming, network theory, and Markov chains. The modules will contain computer programs to be used in problem solving, student and instructor manuals, a book of problem sets based on the mathematics used in decision theory, and tests for evaluating student achievement. The modular nature of the materials will make them suitable for incorporation into existing high school mathematics courses, for collective use as a one-semester course on decision theory, or for use in independent study projects.

The development of these materials addresses the need expressed by mathematics educators for high school courses which stress problem-solving strategies, applications, and the skilled use of computer technology. The increasing availability of microcomputers in the high school makes possible the presentation of mathematical problems arising from real business-world situations for which solution by conventional means would involve tedious computations.

AMOUNT: $79,482
AWARDED: 08-01-81
TERMINATES: 07-31-83

AWARD NUMBER: SED80-24418

PROGRAM: Development in Science Education

DISCIPLINE: Applications of Mathematics/Mathematical Sciences
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Material Development; Computer Assisted Instruction; Microcomputers; Decision Making; Mathematical Applications; Problem Solving; Mathematics Instruction; Secondary School Mathematics; Management Development; Game Theory; Linear Programming; Markov Chains; Matrix Theory; Network Theory

Global Studies in Geography for the Middle Grades

Howard Mehlinger
Indiana University
Social Studies Development Center
Bloomington, IN 47401

This project will develop, test, and disseminate instructional materials for a world geography course that incorporates a global studies perspective, for use in grade 7 social studies classrooms. The instructional materials will consist of a textbook and teacher's guide. The course will be designed for use as a complete two-semester offering and give local schools a new alternative to existing geography and area studies programs at the junior high/middle school level.

A global studies perspective may be defined as one that: (1) emphasizes interdependence among people and places because of resource and technological differences among them; (2) emphasizes the trend toward similarity among people and places because of the rapid spread of ideas; and (3) emphasizes the local, regional, and global impact of people on places because of decisions they make. This project will provide young adolescents with sound social science instruction that emphasizes the impact of science and technology on society. Commercial publication of these instructional materials is planned.

AMOUNT: $407,056*
AWARDED: 09-15-79
TERMINATES: 12-31-82

AWARD NUMBER: SED79-18988

PROGRAM: Development in Science Education

DISCIPLINE: Social Science/Education
TARGET AUDIENCE: Grade 7
DESCRIPTORS: Geography Instruction; World Geography; Thematic Approach; Global Perspective; Science, Technology, and Society Interaction

*Cumulative amount. Fiscal Year 1981 award: $191,356.

Engineering Education Materials for Computer-Aided Manufacturing

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: 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 for 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 and overall impact of the project.

The project builds on the work of a previous and similar project at Purdue which has produced drafts of 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 envision enlargement and dissemination of the system being developed in prototype in this phase.

AMOUNT: $307,318*
AWARDED: 10-01-80
TERMINATES: 03-31-83

AWARD NUMBER: SED80-20447

PROGRAM: Development in Science Education

DISCIPLINE: Computer Systems Design; Industrial Engineering
TARGET AUDIENCE: Undergraduates; Graduates; Professional Continuing Education Students; Engineers
DESCRIPTORS: Engineering Education; Instructional Materials; Manufacturing; Computer Assisted Instruction; Computer Oriented Programs; Educational Technology; Curriculum Development; Information Dissemination; Curriculum Evaluation; College Curriculum; Manufacturing Engineering; ECAM

*Cumulative amount. Fiscal Year 1981 award: $43,596.

Graphic Biology Laboratory Modules for the Blind

Austin E. Brooks
Wabash College
Department of Biology
Crawfordsville, IN. 47933

This project is designed to improve the biology laboratory experience for blind and visually impaired high school and college students through the development of raised-line graphic laboratory materials. Two technologies, largely untapped for educational purposes, will be explored. In the first method, screens will be prepared using large format contact positives of photo-micrographs of biological materials. Prints will be made using heat-polymerizable paints. The second method will make use of a technology from the rubber stamp industry. Large format negatives of images will be used to expose photo-polymerizable flexographic plates. Both methods involve the production of raised-line facsimiles of microscopic images. Based on costs and formative evaluations, one of the methods will be chosen to produce six graphic laboratory supplements including the topics of mitosis, meiosis, algae and fungi, plant structures, and protozoans. Each supplement will contain the raised-line reproductions, an audio tape, instructions in Braille, and a teacher's guide. Revisions will be made following summative evaluations involving high school and college students in both a mainstream environment and a school for the blind. Dissemination plans include publications, oral presentations, and videotaped cassettes.

AMOUNT: $19,940
AWARDED: 01-15-81
TERMINATES: 06-30-82

AWARD NUMBER: SED80-22031

PROGRAM: Development in Science Education

DISCIPLINE: Biology, General Life and Medical Sciences
TARGET AUDIENCE: Handicapped; Undergraduates; Grades 9-12
DESCRIPTORS: Biological Sciences; Biology; Science Instruction; Graphic Arts; Visual Impairments; Blindness; Disabilities; Instructional Materials; Models; Simulation; Photoscreening; Photomicrographs; Raised-line Reproductions; Handicapped

COMETS II — Career-Oriented Science Topics for Elementary and Middle Schools

Walter S. Smith
University of Kansas
Department of Education
Lawrence, KS 66045

The purpose of the second phase of the COMETS project is to accomplish the national testing/dissemination and the further evaluation of materials developed in the first phase. The COMETS (Career Oriented Modules to Explore Topics in Science) materials consist of two packages of instructional materials, one for science and the other for science-centered language arts, to be used in grades 5-9. The packages focus on the use of science role models, particularly women, to encourage students to consider careers in science and related fields. The purpose of the materials is to dispel the young adolescent girls' perception of lack of utility and relevance of math and science courses, and both boys' and girls' stereotypes of science as a career primarily for men.

Each of the 24 science modules developed in Phase I contains directions for classroom activities which allow a science resource person, serving as role model, to participate with students in an interesting science exploration; to relate the underlying science concept to its use in a particular career; and to talk with students about that career. A teacher's guide for the entire package provides general directions for using the modules and includes a rationale for making particular efforts to bring women resource people into the classroom. The package to be used in language arts classes contains 25 profiles of contemporary women who either work in science or whose careers require some background in science or mathematics.

The availability of the materials at cost will be made widely known via advertisements in national publications for teachers, direct mailings to state teacher associations and science supervisors, presentations, and workshops on the materials at regional/national professional meetings by the Project Director and at local meetings by selected teachers who have used the materials in their classrooms. Commercial publication will be sought at the conclusion of the Phase II testing and revision.

AMOUNT: $149,765*
AWARDED: 10-01-79
TERMINATES: 03-31-84

AWARD NUMBER: SED79-19006

PROGRAM: Development in Science Education

DISCIPLINE: Science-Elementary/Education; Science-Secondary/Education
TARGET AUDIENCE: Grades 5-9; Females

DESCRIPTORS: Career Awareness; Prevocational Education; Science Careers; Role Models; Career Education; Student Interests; Science Interests; Sex Stereotypes; Student Attitudes; Women's Education; Females; Role Perception; Language Arts

*Cumulative amount. Fiscal Year 1981 award: $30,000.

Fundamental Mathematics Concepts for Physically Handicapped Students

Frank L. Franks
American Printing House for the Blind
Department of Educational Research
1839 Frankfort Avenue
Louisville, KY 40206

This project will develop, test and disseminate a curriculum-based instructional package containing fundamental conceptual information in mathematics for legally blind students in grades K-12. Project results should provide improved access to careers in technological, scientific, and mathematics-related vocations for this population. Tactile aids, which are essential for blind students, will also have utility as hands-on and visual-support aids for other physically handicapped students whose learning is facilitated by a multisensory approach.

The package of instructional materials will include: (1) a teacher's manual of sequenced student-use activities; (2) a set of hands-on manipulatives, including common objects and shapes; (3) a checklist with behavioral objectives and activities; and 4) record sheets for recording student responses, assessment information, and student performance. Content areas that have been identified include classification, seriation, numeration, whole numbers, measurement, geometry, problem solving, and applications.

Evaluation of materials will include reviews by experts, evaluation by teachers who use the materials with students, and the collection of empirical data to assess the effectiveness of tactile materials. Completed materials should be appropriate for residential, institutional, or mainstream programs. Publication and dissemination will be carried out through the American Printing House for the Blind.

AMOUNT: $162,565
AWARDED: 09-01-81
TERMINATES: 02-28-85

AWARD NUMBER: SED81-09074

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades K-12; Handicapped
DESCRIPTORS: Material Development; Blindness; Disabilities; Mathematics Instruction; Career Education; Tactile Adaptation; Manipulative Materials; Concept Formation; Elementary School Mathematics; Secondary School Mathematics; Legally Blind Students; Materials Testing; Handicapped; Visual Impairments

Ethical Uses of Scientific Knowledge: An Instructional TV Unit for High School

Richard deVillers Seymour
University of Southern Maine
Center for Research and Advanced Study
246 Deering Avenue
Portland, ME 04102

This project will develop, produce, test, and disseminate a pilot instructional television film for high school students exploring ethical dilemmas created by the application of scientific knowledge. The film, accompanied by curriculum materials, will present summary information on the scientific methods or principles involved in the topic under consideration and will illustrate the ethical problems inherent in their application. Work done under projects funded by the NSF EVIST (Ethics and Values in Science and Technology) Program will provide a basis for the materials to be developed. The curriculum materials will treat basic ethical theories and present activities and formats to assist students in developing and defending their ethical positions.

A topic will be selected which is of great interest to young adults and which correlates closely with existing high school courses. The project staff will be advised by curriculum and production consultants, a science consultant, and a board of educators, media specialists, and science teachers. The resulting broadcast-quality film will be disseminated nationally through private distributors and/or established educational networks.

AMOUNT: $168,524*
AWARDED: 12-15-80
TERMINATES: 05-31-82

AWARD NUMBER: SED80-15817

PROGRAM: Development in Science Education

DISCIPLINE: Science Literacy/Education
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Instructional Materials; Videotape Recordings; Films; Television; Scientific Enterprise; High School Students; Ethical Instruction; Moral Values; Curriculum Development; Television Films; Ethics and Values in Science and Technology (EVIST)

*Funded in part by the NSF Ethics and Values in Science and Technology Program.

Microelectronic Technology: Implications for Secondary School Mathematics Curricula

James T. Fey
University of Maryland
Department of Mathematics and Secondary Education
College Park, MD 20742

The central concern of this project is how best to employ microelectronic technology in science and mathematics curricula in high schools. Such existing and projected technology permits machine performance of nearly all formal manipulations that students now learn in high school mathematics. However, to date, school curricula have undergone almost no broad change to reflect the emergence of powerful computer-based work environments in science and mathematics.

This project will address three basic questions:

1. What are the best possible projections of mathematical software to be available for use in doing high school level mathematics by 1990?

A prototype of this environment will be designed and implemented to the extent permitted by the evolving state-of-the-art.

2. What mathematical skills and understanding will students need in order to use the new computing power effectively?

An elementary calculus course and introduction to mathematics course will be revised and taught, using the prototype mentioned above.

3. How might appropriate change in school mathematics be initiated, given the complex interrelation of curriculum expectations by students, parents, teachers and college faculty?

An invited conference will be held to explore this question with leaders in the field. Recommendations and proceedings will be published and disseminated.

AMOUNT: $203,558*
AWARDED: 06-15-81
TERMINATES: 05-31-83

AWARD NUMBER: SED80-24425

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education; Software Systems/Computer Science
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Computer Assisted Instruction; Computers; Computer Science; Mathematics Curriculum; Mathematics Education; Technical Education; Microelectronic Technology

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

Development of an Articulate Instructional System for Teaching Elementary School Arithmetic Procedures

Wallace Feurzeig
Bolt, Beranek and Newman, Inc.
50 Moulton Street
Cambridge, MA 02138

A computer-based instructional system with advanced capabilities for teaching arithmetic algorithms and elementary mathematical procedures will be developed. Whole number computation will be emphasized and synthesized speech will be used extensively with visual displays. In demonstration mode, the system explains the detailed execution of a procedure to the student as it shows its work on a display. In guided practice mode, the student works through a procedure and the system diagnoses his work. The system is articulate and diagnostic. Its explanations and error evaluations use computer-generated speech. The prototype design will be tested and evaluated using a variety of instructional strategies and content materials. Although the extensions over conventional tutorial CAI methods are technically straightforward, their qualitative improvements are pedagogically of the highest importance because of the union of synthesized speech and advanced cognitive models of learning.

AMOUNT: $160,343
AWARDED: 08-01-81
TERMINATES: 04-30-83

AWARD NUMBER: SED80-12481

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education; Software Systems/Computer Science
TARGET AUDIENCE: Grades 1-9
DESCRIPTORS: Computer Assisted Instruction; Elementary School Mathematics; Algorithms; Mathematical Applications; Audiovisual Aids; Number Concepts; Computation

Model System for Dissemination of Microcomputer-Based Instructional Materials

John Moore
Eastern Michigan University
College of Arts and Sciences
104 Snow
Ypsilanti, MI 48197

This project will experiment with several forms of electronic distribution to accelerate the inclusion in the chemistry curriculum of computing methods (especially using microcomputers) and of rapidly emerging new content (such as recent advances in polymers and industrial techniques). While primarily directed at upgrading large service courses in chemistry at the undergraduate level, the project also will work with overlapping portions of high school and continuing education courses. After peer review and student testing, professional recognition will be encouraged by (electronic) publication of submitted materials in a journal and by publicity in the Journal of Chemical Education.

The project will conduct nine workshops for potential users, authors, and reviewers, and generate 50 lecture-length instructional modules, half in finished form. The other half, in draft form, would be completed by a volunteer professional group to be organized during the second year.

Three different methods for dissemination will be experimented with and compared. The dominant method will be distribution of both programs and textual materials by floppy discs; the discs will be made available in electronic formats suitable for reading by three widely used microcomputer lines. In addition, the project will make a small-scale experiment of distribution via one of the national dial-up computer utilities. Back-up documentation in print will be available as well.

AMOUNT: $163,350
AWARDED: 01-01-82
TERMINATES: 06-30-84

AWARD NUMBER: SED81-07568

PROGRAM: Development in Science Education

DISCIPLINE: Chemistry, General; Software Systems/Computer Science
TARGET AUDIENCE: Undergraduates; Grades 9-12; Continuing Education Students
DESCRIPTORS: Chemistry; Science Instruction; Computer Assisted Instruction; Programmed Instructional Materials; Dial Access Information Systems; Learning Modules; Workshops; Electronic Equipment; Information Dissemination

Support Centers for Microcomputer Applications in Science Education

Karl 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 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: $224,950*
AWARDED: 05-15-80
TERMINATES: 10-31-82

AWARD NUMBER: SED79-20124

PROGRAM: Development in Science Education

DISCIPLINE: Software Systems/Computer Science; Multidisciplinary Sciences

TARGET AUDIENCE: Teachers; Grades K-12; Undergraduates; Graduates; College Instructors; Education Administrators

DESCRIPTORS: Computer Assisted Instruction; Resource Centers; Information Dissemination; Microcomputers; Educational Technology; Information Systems; Science Materials; Science Instruction; Computer Conferencing

*Cumulative amount. Fiscal Year 1981 award: $25,050.

Impact of Microcomputers on Teaching Math and Science to Junior High School Students

Herman D. Hughes
Michigan State University
Division of Engineering Research
#102 Engineering Building
East Lansing, MI 48824

This two-year project focuses on the development of materials which make use of low-cost microcomputers for teaching basic problem-solving skills in junior high school mathematics and science. Tutorial programs and teacher oriented materials for mathematics and physical science will be developed, tested, evaluated, and documented for use on microcomputers. This project also seeks to establish a mechanism for increasing an awareness of scientific careers among junior high school minorities, girls, and their parents. A pilot group of 40 seventh and eighth grade students (minorities and girls) from four junior high schools in the Lansing area will be chosen to participate in the project. Each participating school will have five microcomputers for its use. Ten students will meet at Michigan State University for one three-hour period each week for a total of 30 weeks. This project also involves the students' math/science teachers, counselors, principals, and parents.

AMOUNT: $127,370*
AWARDED: 09-01-79
TERMINATES: 08-31-82

AWARD NUMBER: SED79-19045

PROGRAM: Development in Science Education

DISCIPLINE: Software Systems/Computer Science; Mathematical Sciences
TARGET AUDIENCE: Grades 7-9; Minorities; Women
DESCRIPTORS: Computer Assisted Instruction; Mathematics Instruction; Physical Sciences; Science Instruction; Minority Group Children; Females; Problem Solving; Microcomputers

*Cumulative amount. Fiscal Year 1981 award: $22,770.

Middle Grades Mathematics Project Emphasizing Problem Solving

Glenda Lappan
Michigan State University
Department of Mathematics
East Lansing, MI 48824

To improve the understanding of mathematical concepts and problem-solving skills of middle grade students, this project will develop a series of six instructional units which progress from concrete to abstract reasoning. Each unit, consisting of a guide for the teacher and a sequence of activities for the students, will be based on a specific challenge. The units will include these characteristics: (1) an integrated collection of concepts, relationships, and skills; (2) a problem-solving atmosphere; (3) concrete manipulative materials such as cubes and computers; (4) instruction aimed at the whole class, allowing time for small group and individual pursuit of problems; (5) provisions for maximum student involvement; and (6) further challenges for abler students. The units will be divided into the following categories: (1) fractions and decimals; (2) divisors and multiples; (3) motions in geometry; (4) number patterns and functions; (5) experimental probability; and (6) special visualization and representation. An instructional model of a previously developed prototype will be used for each unit. Videotapes, produced for dissemination purposes, will be made to demonstrate techniques for the effective teaching of the content.

AMOUNT: $233,387
AWARDED: 01-01-81
TERMINATES: 06-30-83

AWARD NUMBER: SED80-18025

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 5-8
DESCRIPTORS: Mathematics Curriculum; Mathematics Instruction; Problem Solving; Videotapes; Intermediate Grades; Instructional Development; Instructional Materials; Concept Formation

Using Problem Solving in Junior High Mathematics

Randy E. Gross
Waterford School District
6020 Pontiac Lake Road
Waterford, MI 48095

This project uses microcomputers for teaching problem-solving skills in mathematics in grades 7-9. Materials will be developed by experienced teachers who have developed computer software and use microcomputers in their classrooms. The project objectives include developing instructional packages for junior high mathematics, including simulations; inquiry activities; educational games; and programming materials.

The goal of the project is to develop materials which improve students' ability to solve real-life problems, use induction, work with algorithms, and think abstractly.

Commercial publication will be sought for materials produced by this project.

AMOUNT: $71,051*
AWARDED: 06-15-81
TERMINATES: 05-31-83

AWARD NUMBER: SED80-24463

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education; Problem Solving Education
TARGET AUDIENCE: Grades 7-9
DESCRIPTORS: Problem Solving; Junior High School Students; Computer Assisted Instruction; Material Development; Microcomputers; Mathematics Instruction; Abstract Reasoning

*Funded in part by the National Institute of Education.

Computer Enhanced Statistics Modules for the Upper Elementary Grades

John S. Camp
Wayne State University
College of Education
223 Education
Detroit, MI 48202

This project will develop prototype computer-enhanced elementary mathematics curriculum units. It will use computers for simulation, games, information storage and retrieval, and open and guided discovery to introduce upper elementary school students to statistics. A major focus will be the development of students' heuristic problem-solving skills through their command of the computer's capability to simulate experiments, alter values of variables, make tables, draw graphs, present a simpler problem, or present a related problem. The units will include goals, objectives, computer and/or non-computer learning experiences, teachers' guides, and evaluation instruments.

Formative and summative evaluations will be conducted to assess the materials, their usefulness, and student outcomes. The project will also produce a teacher education module for future teachers of the statistics materials.

AMOUNT: $110,442*
AWARDED: 06-01-81
TERMINATES: 05-31-83

AWARD NUMBER: SED80-24223

PROGRAM: Development in Science Education

DISCIPLINE: Problem Solving/Education; Mathematics Education
TARGET AUDIENCE: Grades 4-6
DESCRIPTORS: Mathematics Curriculum; Elementary School Mathematics; Computer Assisted Instruction; Statistics; Problem Solving

*Funded in part by the National Institute of Education.

A Computational Estimation Program for Middle Grades Mathematics

Robert E. Reys
University of Missouri/Columbia
College of Education-Curriculum and Instruction
212 Education Building
Columbia, MO 65211

This project will develop and evaluate a planned, systematic program dealing with computational estimation skills in the middle grades. Instructional materials for grade levels 7 and 8 will be prepared to complement classroom instruction in the areas of whole numbers, fractions, decimals, and percentages. Students will be tested in two different geographical regions to determine the effectiveness of the developed materials. Classroom visits, reports, and interviews will provide further information on the instructional program and its effect on the learning of new estimation skills.

Computational estimation has long been recognized as a basic mathematical skill and is widely used. The following situation represents one common use of estimation: You have only $5 and want to purchase two cartons of milk at $1.79 each and three loaves of bread at 59¢ each. Do you have enough money? This and most day-to-day mathematics problems rely heavily on computational estimation and mental computation. Further, the widespread use of calculators in the classroom has increased the need for diverse estimation skills that should be useful, for example, in checking the results of machine calculations and programs.

Information from this project will be disseminated through publications in professional journals, presentations at professional workshops, and through the nationwide Research and Development Exchanges supported by the National Institute of Education to bring educational researchers and practitioners closer together.

AMOUNT: $185,872
AWARDED: 02-01-82
TERMINATES: 01-31-84

AWARD NUMBER: SED81-13601

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 7-8
DESCRIPTORS: Computation; Mathematics Instruction; Skill Development; Material Development; Instructional Materials; Number Concepts; Intermediate Grades; Evaluation; Problem Solving; Cross Sectional Studies; Estimation

Microcomputer-Based Continuing Education Courses in Control Engineering

Robert A. Mollenkamp
University of Missouri/Rolla
Rolla, MO 65401

The objectives of this project are (1) to adapt, for interactive microcomputer presentation, current Instrument Society of America (ISA) continuing education courses in process and computer control; (2) to evaluate the effectiveness of the hardware and software for continuing education through field testing in seven major centers of the U.S. process industries; and (3) to leave the test units in place at the seven sites as the nucleus of a nationwide, microcomputer-based continuing education delivery system. Seven instructional packages, consisting of interactive computer programs and comprehensive course notes will be developed. They address the following topics: Process Dynamics, Feedback Control Fundamentals; Cascade, Ratio, and Feedforward Control; Interacting Process Control; Computer Control Techniques; Distillation Control; and Chemical Reactor Control. Guides to computer operation and to the software structure will also be developed to accompany the course materials. The use of computer graphics will allow realistic simulation, display, and comparison of process time responses to illustrate the theory presented in the courses. The microcomputer-based courses are intended to provide an efficient, flexible, and cost-effective method of continuing education delivery for practicing scientists and engineers who require training in the design, implementation, and operation of control systems.

Microcomputers and completed course materials will be rotated to selected industrial offices and plants in the test cities so that participants may use them at their places of work. This activity will be coordinated through the ISA. The ISA will also provide for widespread dissemination of project products through its established publication, continuing education, technical conference, and local section activities.

AMOUNT: $245,501
AWARDED: 03-15-81
TERMINATES: 08-31-84

AWARD NUMBER: SED80-20267

PROGRAM: Development in Science Education

DISCIPLINE: Engineering Education
TARGET AUDIENCE: Engineers; Professional Continuing Education Students
DESCRIPTORS: Microcomputers; Continuing Education; Engineering; Computer Graphics; Engineering Education; Professional Education; Computer Assisted Instruction; Course Descriptions; Control Engineering; Computer Control; Interactive Computer Programs; Control Systems

Interactive Videodisc Applications to Elementary Mathematics Education

Isaac I. Bejar
Educational Testing Service
Division of Measurement, Statistics, and Data Analysis Research
Princeton, NJ 08541

This project will design an interactive (computer-controlled) videodisc system for use in teaching the elementary mathematics topics of decimals and fractions. This system will incorporate in a single delivery system the advantages of several instructional techniques: one-way television, computer-assisted instruction, sophisticated measurement designs, analysis of student errors and detailed record keeping.

The system is viewed as a viable mechanism for progress toward equal educational opportunity in a cost-effective manner. The initial effort will concentrate on a self-contained mini-curriculum combining fractions and decimals. Materials will be tested in fourth and fifth grade classrooms. At the conclusion of the project the production handbook, the videodisc, the software for the lessons and the final report will be disseminated.

AMOUNT: $147,918
AWARDED: 05-15-81
TERMINATES: 04-30-83

AWARD NUMBER: SED80-24465

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 4-5
DESCRIPTORS: Elementary School Mathematics; Computer Assisted Instruction; Decimals; Fractions; Videodisc Recordings; Television; Measurement Techniques; Mathematics Instruction

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

John M. Mulvey
Princeton University
School of Engineering and Applied Science
Princeton, NJ 08544

This grant continues the work begun in 1979 on a series of modules on the use of decision models in engineering design, and on the value assumptions implicit in such models. Fourteen case studies have been completed and revised on the basis of teaching experience at Princeton.

The major goals of this 12-month continuation are to (1) pilot test the materials across the country at a variety of engineering schools exchanging instructional materials for computer aided design, including participating schools in the "4C" consortium; (2) determine the course content of potential users; (3) revise and complete the modules based on comments and needs emerging from field tests; (4) prepare the materials for use in and conduct continuing education workshops for engineering professors at professional society meetings; and (5) distribute the materials through the "4C" consortium plus a case-clearinghouse which will serve as a continuing information course on materials of this sort.

AMOUNT: $163,840*
AWARDED: 09-15-79
TERMINATES: 02-28-83

AWARD NUMBER: SED79-18998

PROGRAM: Development in Science Education

DISCIPLINE: Engineering Education
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Engineering Technology; Material Development; Instructional Materials; Computer Assisted Instruction; Professional Continuing Education; Learning Modules; Case Studies; Design Requirements

*Cumulative amount. Fiscal Year 1981 award: $71,840.

Development of Computer-Based Learning Models in Secondary School Science and Mathematics

Ludwig Braun
State University of New York
College of Engineering and Applied Sciences
Stony Brook, NY 11794

This project responds to a national need for quality science and mathematics courseware (computer-based learning units) brought on by the rapidly growing use of microcomputers in secondary schools. Twenty such exemplars covering mathematics, biology, chemistry, and earth/space science will be developed to demonstrate both the structure and content of high quality and effective instructional courseware. Models which enable pre-college level teachers who have very limited computer programming expertise to produce computer-based learning units for their own classes will be created, tested and disseminated. Also to be developed will be: (1) a teacher's guide to assist in modifying exemplars to suit a variety of curricular objectives, and (2) a handbook describing techniques of courseware design along with helpful hints for conversion from one computer to another.

The materials will be tested and evaluated by a large number of teachers and an external advisory/review board comprised of experienced professionals. Dissemination will be carried out through the publication of a newsletter; presentation at national, regional, and local professional meetings; and perhaps later through a commercial publisher.

AMOUNT: $176,225
AWARDED: 07-15-81
TERMINATES: 07-31-83

AWARD NUMBER: SED80-25176

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education/Science Education
TARGET AUDIENCE: Grades 7-12
DESCRIPTORS: Computer Assisted Instruction; Instructional Materials; Microcomputers; Secondary School Science; Secondary School Mathematics; Biology; Science Instruction; Chemistry; Earth Science; Space Sciences; Material Development; Computer Graphics; Commodore PET Computer; Apple II Computer; Atari Computer; Physics

Sunrise Semester: A Televised Course on Energy Involving Schools of Continuing Education

Leslie C. Tuttleton
New York University
70 Washington Square South, Room 1104
New York, NY 10012

This project will combine a nationally televised series on science and society with continuing education (CE) programs to enhance the public's understanding of science and to demonstrate the importance of television as a medium for the continuing education of attentive adults. A network of CE schools will offer multidisciplinary courses using the Columbia Broadcasting System/New York University (CBS/NYU) Sunrise Semester Series, and will supplement the courses with activities geared to adult education. Cooperating schools will have the option of offering the courses on either a credit-bearing or non-credit basis.

The first course "Energy: Science and Public Policy" will be taught by NYU's president, John C. Sawhill, a recognized energy expert. Consisting of 45 half-hour segments, the series will be accompanied by interviews with energy experts and supplemented with sophisticated graphics. In addition to providing a background in energy science to a broad adult audience, the project will describe the world energy situation and discuss factors which shape public policy.

Dissemination will be carried out at both national and local levels through the network of schools of continuing education. A two part evaluation will be developed, first to assess the overall project, and second to assess its direct impact on course participants. Results will be disseminated through appropriate journals and the sharing of material directly with communications experts and cooperating institutions.

AMOUNT: $383,568
AWARDED: 09-15-81
TERMINATES: 11-30-83

AWARD NUMBER: SED80-19314

PROGRAM: Development in Science Education

DISCIPLINE: Science Education
TARGET AUDIENCE: Continuing Education Students
DESCRIPTORS: Television Curriculum; Continuing Education; Outreach Programs; Adult Students; Scientific Literacy; Science Programs; Telecommunications; Technology; Columbia Broadcasting System/New York University (CBS/NYU); Energy Education

Wildlife Inquiry Through Zoo Education (WIZE)

Annette Berkovits
New York Zoological Society
New York, NY 10001

In collaboration with the Philadelphia Zoo, the Riverbanks Zoo, (Columbia, SC), and the Topeka Zoo, the New York Zoological Society will develop a model program designed to enrich the life sciences curriculum for grades 6-9 using the unique resources of zoos. Called Wildlife Inquiry through Zoo Education (WIZE), the project will be planned cooperatively by educators from the four zoos in collaboration with specialists in adolescent education, curriculum design, graphic design, and zoology. The goals of WIZE are to lay the groundwork for a better understanding of the life sciences and an appreciation for wildlife by providing zoos and local schools with three supplementary curriculum modules (Diversity of Lifestyles, Survival Strategies, and Ecology) and by training educators in their use. Each module will include a series of resource booklets, discovery activities (for both classroom and in-zoo use), and hands-on kits amounting to 45 hours of class and zoo instruction. The WIZE Consortium will produce prototype materials and activities which will be replicable nationally and require a minimum of local adaptation.

As materials are developed, they will be field-tested by cooperating zoos using a total of approximately 40 classes and 1,200 students. Each consortium zoo will also establish a local Advisory Panel of teachers and/or administrators, other science specialists, and zoo staff in order to provide a link with local schools to deal with teacher training, scheduling, and transportation procedures. Dissemination will be carried out through the American Association of Zoological Parks and Aquariums and commercial publication will be provided. Consortium zoos will also become nuclei for disseminating the program and building regional networks among educators and zoo professionals.

AMOUNT: $175,333
AWARDED: 03-15-81
TERMINATES: 02-28-83

AWARD NUMBER: SED80-20410

PROGRAM: Development in Science Education

DISCIPLINE: Fish and Wildlife/Life and Medical Sciences
TARGET AUDIENCE: Teachers and Students; Grades 6-9
DESCRIPTORS: Zoos; Biological Sciences; Wildlife Management; Curriculum Development; Instructional Materials; Zoo Education; Life Sciences; Curriculum Modules; Ecology; Environment

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 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.

This project includes a Small College Faculty Research Supplement to enable Dr. Ruth Murray, Chair of the Mathematics Department of Russell Sage College, to continue her research in the learning of mathematical spatial concepts and in math anxiety and avoidance in women.

AMOUNT: $133,817*
AWARDED: 08-15-80
TERMINATES: 01-31-83

AWARD NUMBER: SED80-12633

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 9-10
DESCRIPTORS: Material Development; Mathematics Instruction; Problem Solving; Visualization; High School Students; Spatial Perception; Computer Graphics; Computer Assisted Instruction; Sex Differences; Orientation Training

*Cumulative amount. Fiscal Year 1981 award: $9,048.
Funded in part by the National Institute of Education.

Contemporary Issues in Science

Vincent J. Cusimano
Staten Island Continuum of Education, Inc.
130 Stuyvesant Place, Room 609
Staten Island, NY 10301

This project will develop an instructional program aimed at providing secondary school students with a working knowledge of advances in science and technology, including an understanding of their impact on society. The program will be designed to be implemented as a separate course, as part of an existing science course, or as an enrichment theme to be integrated into a number of different subjects and classes within the same school. It will include printed materials describing classroom activities such as lectures by scientists, small-group discussions, and guided library research. Provisions will be made for adapting the materials to a wide range of student backgrounds and abilities. Guidelines for conducting an annual Science Forum involving students, teachers, school administration, community leaders, scientists, and other professionals will also be provided. Its emphasis is on a novel teaching strategy--a "mode"--rather than on developing instructional materials. However, adequate materials will be developed to exemplify the process and support the field trials.

The materials will be tested and evaluated by a large number of students and teachers in a variety of demographic settings. An external advisory/review board composed of experienced professionals will provide guidance and feedback for the project. Dissemination will be carried out through publication in professional journals, workshops, presentations at national conferences, bulletins, and, if possible, through commercial publication.

AMOUNT: $121,820
AWARDED: 09-15-81
TERMINATES: 08-31-83

AWARD NUMBER: SED81-13600

PROGRAM: Development in Science Education

DISCIPLINE: Science - Secondary/Education
TARGET AUDIENCE: Grades 10-12
DESCRIPTORS: Technological Advancement; Curriculum Enrichment; Science Curriculum; Instructional Innovation; Experimental Teaching; Learning Activities; Science Activities; Secondary School Science; Social Change

Coordinated Use of Microcomputers in High School Chemistry, Physics, Biology, and Mathematics

Carl S. Davis
North Carolina School of Science and Mathematics
1912 West Club Boulevard
Durham, NC 27705

This project seeks to improve the teaching of high school mathematics by developing prototype microcomputer-based materials which show the application of mathematics to chemistry, physics, and biology, and which enhance the teaching of selected mathematics concepts through the use of computer graphics. Students will use microcomputers to apply, in the science laboratory, principles learned in the mathematics classroom. The specific materials to be developed are (1) software for a graphics package to be used in mathematics classes and science laboratories; (2) nine packages of experiments (three each in chemistry, physics, and biology) consisting of software and courseware (i.e., documentation, workbooks) which permit use of the microcomputer to process experimental data using graphics; and (3) a mathematics package consisting of software and courseware dealing with topics in the high school mathematics curriculum for which graphics treatment is particularly appropriate. Students will be able to use these materials without any previous computer experience.

The graphics package will consist of a family of interactive programs basic to the other materials. It will be able to plot experimental data points; plot curves from user supplied equations; calculate numerical approximations to experimental data; and display the calculated curve, data points, and possibly another theoretical curve all on the same screen. The early portion of the mathematics package will treat the topics of the graphing of experiental data, the types of experimental errors, and numerical approximations to experimental data. In the science laboratory the microcomputer will be used to receive experimental data via a graphics tablet or A/D converters, and to process the data using the graphics package in the manner discussed in the math classroom.

AMOUNT: $78,857*
AWARDED: 04-15-81
TERMINATES: 02-28-83

AWARD NUMBER: SED80-24473

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Microcomputers; Chemistry; Physics; Biology; Mathematics; Instructional Materials; Computer Graphics; Mathematics Instruction

*Funded in part by the National Institute of Education.

Science Careers for Women and Minorities — In-Service Materials for Teachers of Grades 4-9 (Final Phase)

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

This project will complete the development of materials for a science careers in-service program for teachers of grades 4-9. The program, aimed at improving the access of women and minorities to science and technology careers, is intended to illustrate the following: there is a diversity of science and technology careers requiring different levels of education; the ability to be a successful scientist is not restricted by race or sex; one does not need to be a genius to succeed in a science career; successful science careers can be combined with full personal lives; and it is important to keep one's options open by getting a good background in science and mathematics.

Phase I of the project has produced: (1) 12 classroom activities, teacher guidelines, and background information for teachers; (2) guidelines for in-service workshop leaders; (3) 20 posters showing pictures and biographical information on contemporary male and female scientists from various race/ethnic backgrounds, areas of science, and types of employment; and (4) a slide presentation about science and engineering careers.

Phase II will produce a revision of existing materials on the basis of the preliminary field test data, a pamphlet on contributions of famous women scientists, 20 new posters dealing with areas of science not covered in the first set, and additional classroom activities. The complete program will be evaluated using experimental and control groups. The availability of the final products will be made widely known via mechanisms which include listings in ERIC and NTIS, direct mailings to state science supervisors and in-service directors, publications, and presentations at professional meetings by project staff and by local resource teachers geographically dispersed throughout the country.

AMOUNT: $143,752
AWARDED: 08-15-81
TERMINATES: 09-30-83

AWARD NUMBER: SED81-14640

PROGRAM: Development in Science Education

DISCIPLINE: Science Education
TARGET AUDIENCE: Grades 4-9; Minorities; Females; Teachers

DESCRIPTORS: Material Development; Career Exploration; Science Careers; Inservice Education; Career Awareness; Elementary School Science; Secondary School Science; Science Teachers; Minorities; Class Activities; Females; Technology; Guidelines

Education Materials on Mount St. Helens

Michael Fiasca
Portland State University
School of Education
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 video tape) 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 was 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: $34,573*
AWARDED: 07-15-80
TERMINATES: 12-31-81

AWARD NUMBER: SED80-20737

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; Curriculum Enrichment; Films; Photographs; Videotape Recordings; Slides; High School Instructional Enrichment; Mount St. Helens; Volcanic Activity

*Cumulative amount. Fiscal Year 1981 award: $16,936.

Educational Modules for Materials Science and Engineering: EMMSE

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

This is Phase 3 of a project (SED77-14149) to accelerate the clarification of the curriculum and the inclusion of recent advances in materials science and engineering (MSE) education. In previous work, the project has developed and distributed 125 weeks of instructional materials, set up a journal for peer-reviewed and student-tested tutorials, and organized several similar and collaborative groups abroad.

The three major activities are curriculum analysis, materials production and dissemination, and evaluation and revision of materials and procedures. To foster an emphasis on cross-cutting concepts and techniques in MSE, the project will use computerized methods of analysis developed in neighboring disciplines to analyze the MSE course and curriculum content in leading university and continuing education programs. In addition to the previous activities of materials production and dissemination, the project will sponsor six workshops concentrating on developing materials for MSE core courses in thermodynamics, kinetics, and properties of solids. To guide further development of procedures and revision of materials, the project will study in greater detail present utilization patterns and user needs. In addition, the project will devote 10% of its resources to the distribution of test questions, to preparing distribution methods and a data base of phase diagrams, and to coordinating exchanges of materials with similar groups, which the project has instigated in other countries.

AMOUNT: $150,000
AWARDED: 12-01-81
TERMINATES: 11-30-83

AWARD NUMBER: SED81-15089

PROGRAM: Development in Science Education

DISCIPLINE: Materials/Engineering; Engineering Education
TARGET AUDIENCE: Undergraduates; Continuing Education Students
DESCRIPTORS: Engineering Education; Curriculum Enrichment; Curriculum Evaluation; Material Development; Information Dissemination; Computer Assisted Instruction; Science Course Improvement Projects; Instructional Aids; Materials Science and Engineering (MSE)

A Computer Graphics Learning Environment for High School Trigonometry

Eugene A. Klotz
Swarthmore College
Department of Mathematics
Swarthmore, PA 19081

This project will create a learning environment for high school trigonometry based on microcomputer color graphics units. Students can explore these units on their own or under the direction of a teacher.

These user-oriented materials will be written so that they are highly visual in character, and they will encourage browsing among the lessons rather than require the student to adhere to a pre-defined path.

The primary audience of the materials is the high school academic mainstream. High school teachers are part of the development team and the materials will be tested in two local high schools. A special effort will be made to assure that the materials are attractive to women students.

The product of the effort will be a number of interactive color graphics units, documented and tested, which can be used in learning trigonometry. For wide distribution to potential users, these materials will be submitted to CONDUIT and MicroSIFT (a clearinghouse for pre-college computer-based materials supported by the National Institute of Education).

AMOUNT: $149,799*
AWARDED: 05-15-81
TERMINATES: 04-30-83

AWARD NUMBER: SED80-24474

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics, Trigonometry
TARGET AUDIENCE: Grades 7-12
DESCRIPTORS: Computer Assisted Instruction; Trigonometry; Mathematics Curriculum; High School Students; Computer Graphics; Microcomputers; Programmed Instructional Materials

* Funded in part by the National Institute of Education.

You, Me and Technology: An Instructional TV Series in Technology and Society for Secondary Schools

Minaruth Galey
Temple University
College of Education
Educational Media
Broad Street & Montgomery Avenue
Philadelphia, PA 19122

Two videotape television programs and associated teachers' guides for teaching the interrelationships of science, technology, and society will be developed for pupils in grades 7-12. Designed to help secondary school students become effective citizens in a technological society, the project will focus on the following: (1) the nature of modern technology; (2) the impact of technology on the individual and on society; and (3) the effects of social factors and actions on technology. The pilot tapes are planned to be part of a coherent set of course materials that will consist of an instructional television series of 12 videotaped 20-minute programs, plus 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 science, social studies, industrial arts, and other appropriate subjects. In-service 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. The two programs produced in the pilot year will be distributed nationally when the evaluation is completed.

AMOUNT: $172,470
AWARDED: 10-01-81
TERMINATES: 03-31-83

AWARD NUMBER: SED81-15657

PROGRAM: Development in Science Education

DISCIPLINE: Science-Secondary/Education; Multidisciplinary Sciences/Social Studies
TARGET AUDIENCE: Grades 7-12
DESCRIPTORS: Educational Television; Videotape Recordings; Scientific Literacy; Secondary School Science; Technology; Technological Advancement; Social Change; Social Studies; Social Influences; Interdisciplinary Approach; Telecourses; Multimedia Instruction

High School Computer Science Education

J. M. Moshell
University of Tennessee
Department of Computer Science
Knoxville, TN 37916

To reduce computer and math anxiety and to teach instructional programming and problem-solving skills are the goals of this high school development project. Designed for average students rather than whiz kids, the one-semester curriculum centers around color television microcomputer graphics. Simple games lead students to the drawing of pictures, the creation of stick-figure, puppet-show cartoons, and finally to the development of their idea of an automatic cartoon procedure or program. After graphics experiences link students and computer in a play relationship, symbolic programming skills are introduced, using a structured dialect of BASIC (a computer language).

The project employs existing microcomputer hardware and software selected for transportability to different computers. High school teachers and computer scientists will prepare workbooks, lesson plans and programs, and field-test them in several high schools. The resulting curriculum and materials will be useful to teachers throughout the nation and should help enhance graphics-based teaching methods.

AMOUNT: $245,280*
AWARDED: 10-01-79
TERMINATES: 09-30-83

AWARD NUMBER: SED79-18991

PROGRAM: Development in Science Education

DISCIPLINE: Computer Science, Education; Mathematics Education
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Computer Science Instruction; Problem Solving; Computer Graphics; Programming; Computer Programs; Computer Oriented Programs; Curriculum; High School Students

*Cumulative amount. Fiscal Year 1981 award: $38,680.

Curriculum Analysis, Student Interrogation and Information System

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

This is the fourth and final year of a continuing grant to a project to develop computer software for computer-aided curriculum management. The purpose of the software is to help faculty analyze and develop modularized engineering curricula, and to help students in a self-directed study (e.g. on-the-job continuing education) to choose a sequence of instructional units that addresses their particular needs-to-know. In this phase, the project will finish writing the necessary curriculum programs, classroom test them, evaluate their effectiveness, re-package the software for use on stand-alone microcomputers, and distribute the results for use in several other national projects developing science education curriculum materials.

In the previous year, software was developed and applied to the analysis of the software of the chemical engineering curriculum at two universities, and to advising students on their optimum study paths. It was found that faculty, student and catalog models of these curricula were mutually and internally inconsistent; thus, a more detailed and empirically derived description of the curriculum needs to be developed as a reliable basis for curriculum reform. Analysis of the text content of 150 lectures, and of student characterization of that content indicates that users not already familiar with the curriculum content cannot make reliable and expert choices of what to study next, nor can they use current lexicographic methods (using standardized key words with short definitions) to retrieve needed new information. A glossary-based (using basic concepts explained in page-length introductions and references to longer modules) curriculum and authoring information system is being developped to help faculty and students overcome these problems.

AMOUNT: $281,960*
AWARDED: 06-01-77
TERMINATES: 08-31-82

AWARD NUMBER: SED76-21950

PROGRAM: Development in Science Education

DISCIPLINE: Software Systems/Computer Science
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Information Systems; Information Utilization; Dial Access Information Systems; Educational Planning; Curriculum Planning; Data-Base Management System

*Cumulative amount. Fiscal Year 1981 award: $56,000.

A Proposal to Design, Develop, Implement, Test, Evaluate, and Disseminate an Associate Degree Curriculum to Train Solar Engineering Technologists — Phase III

Charles G. Orsak, Jr.
Navarro College
P.O. Box 1170
Corsicana, TX 75110

This project is the third phase of a 5-year activity to develop (a) an information system in solar energy technology, (b) a system of curriculum materials, and (c) a consortium of (predominantly 2-year) colleges implementing associate degree programs and courses. The overall goals are to make available new skills and knowledge which provide manpower and technology transfer through a computer-based network of (a) usage guides for teachers, students, and administrators; (b) materials containing technical information not currently available; and (c) coordinated industrial and college participation.

During the last three years, the project has surveyed needs, developed detailed course outlines, helped set up five test sites with necessary equipment, and taught the first year of a prototype program from initial outlines.

During the next two years of the continuing grant the project would (a) fill out the outline of needed course content for a wider range of users; (b) collect extant materials and recruit persons expert in current best practice, and then write new materials--using the latest information--where none exist; and (c) revise the materials and curriculum structure on the basis of field tests. The materials will be produced both in machine-readable and electronic form, and in print.

The materials will be designed to be used in all parts of the country for the 2- and 4-year programs in solar technology, alternative energy, energy conservation and appropriate technology; in addition the materials are designed to be delivered for technical updating installers, as continuing education for engineers and paraprofessionals, and as supplements to science and engineering standard courses.

AMOUNT: $229,380
AWARDED: 05-15-81
TERMINATES: 10-31-82

AWARD NUMBER: SED80-19327

PROGRAM: Development in Science Education

DISCIPLINE: Science Education
TARGET AUDIENCE: Undergraduates; Two Year College Students
DESCRIPTORS: Computer Assisted Instruction; Radiation; Energy Conservation; Technology Transfer; Curriculum Development; Science Instruction; Two Year Colleges; College Students; Solar Energy

Continuing Education and College Instructional Modules in Chemical Engineering

David M. Himmelblau
[CACHE Corporation]
University of Texas
Austin, TX 78712

This project will extend the work of two previous projects to develop, in modular form for computer retrieval, instructional materials and computer programs covering the content of the core undergraduate Chemical Engineering (Ch.E.) curriculum, plus extensions of those programs into advanced principles and applications to make the collection appropriate for use in continuing education. The first project in 1974 developed 125 computer programs, each with about 15 pages of explanation and problems to be used in instruction; the second, in 1975-9, developed about 250 modules, each of about 25 pages, covering most Ch.E. core courses.

Over the next three years, the present project will write or completely revise about 500 modules, fit in the preceding computer programs, give mini-study guides and explanations for 2,000 topics in computer-retrievable form, test the system in about 12 industrial and university programs and provide for electronic distribution of the results. During the first year of this project, there will be an open call for participation, task forces will be started, the computer topic-guide file will be started, the electronic distribution system will be set up in initial form, materials from the preceding project will be field-tested in a school and an industrial program, and new authors will be recruited.

AMOUNT: $334,884
AWARDED: 10-01-79
TERMINATES: 09-30-83

AWARD NUMBER: SED79-13021

PROGRAM: Development in Science Education

DISCIPLINE: Chemical Engineering; Engineering Education
TARGET AUDIENCE: Undergraduates; Graduate Students; Continuing Education Students
DESCRIPTORS: Engineering Education; Computer Assisted Instruction; Continuous Progress Plan; Curriculum Design; Instructional Materials; Computer Programs; Chemical Engineering Curriculum

*Cumulative amount. Fiscal Year 1981 award: $36,384

An Intelligent Videodisc System: Evaluation in Developmental Biology

C. Victor Bunderson
WICAT, Inc.
1160 South State Street
Suite 10
Orem, UT 84057

This project is designed to develop and evaluate a flexible, intelligent videodisc system using low-cost components chosen to be center-stream in the next five years. Text and graphics of flexible format can be generated by the computer and mixed with color videodisc pictures. Medium resolution computer graphics will be presented on a separate black and white monitor.

The course materials will support instruction in developmental biology in universities, colleges, and high schools. The basic lesson material is suitable for all three levels. The basic disc is now available and ideally suited for the addition of intelligent enhancements. The basic concepts will be elaborated in the laboratory with the videodisc providing colorful overviews of each lab session, easy access to a file of reference materials, drill and practice in basic skills, a lab tutorial, and two lab simulation packages for complex, costly experiments.

The evaluation is unique because the existing manual disc can be used as a control to assess the added value of the intelligent enhancements. The extent to which community college students are drawn into the content of the advanced simulations will be evaluated. A detailed cost analysis of courseware development and hardware cost projections will be produced.

AMOUNT: $424,598*
AWARDED: 04-01-79
TERMINATES: 03-31-82

AWARD NUMBER: SED79-00794

PROGRAM: Development in Science Education

DISCIPLINE: Biology, General/Life and Medical Sciences
TARGET AUDIENCE: Grades 9-12; Undergraduates
DESCRIPTORS: Computer Assisted Instruction; Biology; Science Instruction; Video Equipment; Videodisc Recordings; Material Development; High School Students; Two Year College Students; Universities; Computer Graphics

*Cumulative amount. Fiscal Year 1981 award, funded in part by the Research in Science Education (RISE) Program: $37,627.

Computer Literacy Guides for Elementary and Junior High Schools

Beverly Hunter
Human Resources Research Organization
300 North Washington Street
Alexandria, VA 22314

This project will produce a curriculum kit which 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 supplement will support the purchases of the three most popular microcomputers used in schools. The project staff will use the computers to test already-available materials. High-quality materials will be referred or included in the kit.

When the project was originally supported, kits were to be produced that did not require the use of the computer. However, recent trends have indicated that a large number of schools will have access to computing by the mid-1980s.

The project feels that references to good materials will improve the usefulness of the kits. Montgomery County, Maryland, schools will try out the package in the classroom; 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: $226,455*
AWARDED: 04-15-80
TERMINATES: 09-30-83

AWARD NUMBER: SED79-23684

PROGRAM: Development in Science Education

DISCIPLINE: Software Systems/Computer Science; Science Education
TARGET AUDIENCE: Grades K-8
DESCRIPTORS: Social Studies; Instructional Materials; Curriculum Development; Computer Oriented Programs; Microcomputers; Junior High Schools; Mathematics Instruction; Elementary School Curriculum; Secondary School Curriculum; Science Instruction

*Cumulative amount. Fiscal Year 1981 award: $9,700.

Scientific Instrumentation Information Network and Curricula (Project SIINC)

Frank A. Settle
Virginia Military Institute
Lexington, VA 24450

The aims of this project are, first, to survey the status and needs of colleges and industrial technologists for instructional materials and information on new scientific instruments, and second, to provide the needed materials via a national network of instrument users and developers.

During a first phase of three years, sample materials will be developed on four types of instruments and their uses in laboratories and industry; these will be field-tested and revised in college classrooms and in continuing education. The choices of types of instruments and kinds of materials will be based on a detailed study of current needs and best practice in the area. The materials will include: discussions of each generic type of instrument and how to mathematically model the performance of example devices; case studies of leading applications (e.g., process control) including the formulation of economic models of cost and usage factors; reviews of the scientific topics involved with an annotated bibliography, physical property data, or computer programs for the models; and instruction on how to combine the above mathematical models into a measurement strategy. Much of this information will be in a telephone-accessible computer data base for remote retrieval and updating.

The present project is limited to an exploratory development phase.

AMOUNT: $183,152*
AWARDED: 01-01-80
TERMINATES: 12-31-83

AWARD NUMBER: SED79-19780

PROGRAM: Development in Science Education

DISCIPLINE: Computer Systems Design/Computer Science
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Instrumentation; Instructional Materials; Material Development; Information Networks; Computer Assisted Instruction; Educational Technology; Chemical Analysis; Technology Transfer

*Cumulative amount. Fiscal Year 1981 award: $23,452.

Computer-Aided Design and Manufacturing Consortium for Engineering Education

John E. Gibson
University of Virginia
School of Engineering and Applied Science
Charlottesville, VA 22901

The goals of this project are: (1) to develop instructional materials, case studies, and computer programming necessary to introduce computer-aided design and manufacturing (CAD/CAM) into undergraduate and graduate curricula of all the major engineering disciplines and into continuing education for engineers and applied scientists; (2) to explore a system for evaluating, training, and rewarding faculty for the production of educational materials which will function in ways similar to the current system of rewarding their contributions to research; and (3) to set up a consortium of colleges and industry to continue the project.

The project is planned for three stages. In this first 30-month stage, there will be exploratory development of: (1) 250 instructional modules (each with computer programs, narrative, instructors' guides, etc.) and case studies; (2) a curriculum guide which relates an exhaustive listing of engineering concepts currently taught to the most productive engineering practice; (3) an initial consortium of about 20 engineering schools, which, with several industrial members, will form the basis of a nonprofit, independent corporation eventually to include all interested schools and firms; and (4) procedures for design, evaluation, and dissemination of the materials needed for consortium operations.

The project's initial emphasis in content will be on CAD, and it will collaborate with the national curriculum development project in CAM based at Purdue. During the first year, the key task will be the funding of the consortium.

AMOUNT: $305,925
AWARDED: 10-15-80
TERMINATES: 09-30-82

AWARD NUMBER: SED80-19647

PROGRAM: Development in Science Education

DISCIPLINE: Engineering Education
TARGET AUDIENCE: Undergraduates; Graduates
DESCRIPTORS: Computer Assisted Instruction; Instructional Materials; Engineering Education; Educational Technology; Computer Oriented Programs; Curriculum Development; Consortia; Instructional Technology; Computer Programs; CAD/CAM (Computer-Aided Design/Computer-Aided Manufacturing)

Mathematics in Biology: Computer-Controlled Videodisc Materials for Women and Minorities (High School and Undergraduate Level)

James M. Laffey
University of Washington
Education Assessment Center
4535 Schmitz-Hall PB-30
Seattle, WA 98105

This project will teach mathematics within the context of biology to women and minority students who are interested in careers in the life and health sciences. The project will use an intelligent (computer-controlled) videodisc system and the material will be suitable for use in high school, community college or university environments. Four modules will be developed on the topics of proportional reasoning, measurement and notation, functions and their representation, and sampling. The results will be reported in the appropriate journals. Presentations will be made at national meetings and the videodisc will be available, on a cost-recovery basis, from the University of Washington.

AMOUNT: $117,400
AWARDED: 07-15-81
TERMINATES: 12-31-83

AWARD NUMBER: SED80-24346

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Females; Minorities
DESCRIPTORS: Computer Assisted Instruction; Mathematics Instruction; Computer Programs; Biology; Material Development; Microcomputers; Secondary School Mathematics; Videodisc Recordings; Mathematics Anxiety; Women's Education; Software; Females

Preparation for Undergraduate Physical Sciences Through Concept-Based Modules

Lillian C. McDermott
University of Washington
Department of Physics, FM 15
Seattle, WA 98195

The purpose of this project is to develop physical science curriculum materials to prepare academically disadvantaged undergraduate students for mainstream college science courses. The products will be two modules on the topics of (1) electricity and magnetism and (2) the atomic-molecular model of matter, each consisting of a student manual and an accompanying instructor's guide. These two modules, together with the four produced under a current grant (Properties of Matter, Kinematics, Heat and Temperature, and Models of the Heavens) will constitute a set of instructional materials for use in undergraduate physics, chemistry, or other physical science departments.

The curriculum is laboratory-centered. It is organized into modules of related subject matter with topics chosen from the group of very basic concepts that are common to all the sciences. The modules are designed to provide flexibility for the instructor in choice of subject matter, in sequencing of topics, and in length of courses. Altogether there will be enough curriculum for two years of academic work from which instructors can select materials for part of a course, an entire course, or a sequence of courses. The range of topics makes it possible to meet special student needs and institutional requirements.

Development of the curriculum will be guided by an empirical assessment of the kind of preparation which academically disadvantaged students need. This assessment is based on an ongoing investigation being conducted in conjunction with a special preparatory program which has been offered at the University of Washington for the past five years for minority students.

AMOUNT: $101,390
AWARDED: 12-01-81
TERMINATES: 08-31-83

AWARD NUMBER: SED81-16017

PROGRAM: Development in Science Education

DISCIPLINE: Education; Physical Sciences
TARGET AUDIENCE: Undergraduates; Academically Disadvantaged
DESCRIPTORS: Physical Sciences; Atomic Structure; Electricity; Learning Modules; Matter; Material Development; Astronomy; Heat; Temperature; Instructional Materials; Chemistry; Concept Formation; Physics; Disadvantaged Youth; Laboratories; Curriculum Development; College Students; Minority Groups; Magnetism; Atomic Molecular Model

A High School Course Integrating Statistics and Computer Programming

Walter R. Kasenschmidt
Racine Unified School District
J. I. Case High School
2220 Northwestern Avenue
Racine, WI 53404

The goal of this project is to design, conduct, and evaluate a high school course which integrates non-calculus statistics with computer programming. The product will be an instructor's course guide with associated student materials, (e.g., programming exercises, statistical problems to be solved with the computer). The computer will be used for three purposes: (1) to teach programming in the BASIC language; (2) to serve as a sophisticated computational tool for statistical calculations; and (3) to display commercial statistical programs which simulate experiments too costly or too time-consuming to be conducted by high school students. As students progress through the course, they will gradually build a statistics package which can be used at the end of the course to analyze a practical problem requiring statistical treatment.

Potential outcomes of the course are projected as follows: (a) by writing and interacting with their own computer programs, students will become more knowledgeable of computer capabilities and limitations; (b) through the teaching of computer programming the students' problem-solving capabilities will be heightened by careful analysis of a problem and the steps required to complete it successfully; (c) by selection of statistical problems for computer programming, a more thorough understanding of the statistical concepts and formulas will be gained. Students will use self-designed computer programs to do involved calculations which, done manually, would require inordinately large amounts of time. Students thus will be able to spend more time interpreting the results of their calculations.

AMOUNT: $31,623*
AWARDED: 07-15-81
TERMINATES: 12-31-82

AWARD NUMBER: SED80-24212

PROGRAM: Development in Science Education

DISCIPLINE: Mathematics Education; Software Systems/ Computer Science
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Computer Programs; Statistics; Mathematics Instruction; Problem Solving; High School Students; Computer Science Education; Computer Assisted Instruction

* Funded in part by the National Institute of Education.

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

Morris Sica
California State University/Fullerton
Division of Teacher Education
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 of 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 described and probed to determine the attributes of instruction judged to be helpful to learning and those which hindered learning. Science instructors who have had blind students in their science classes also will be interviewed with a similar objective; namely, to discover the attributes of successful and unsuccessful strategies. A principal consultant to the project is a biology teacher who is blind. A content analysis of the critical incidents provided by both students and teachers will be the basis for identifying 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: $51,278*
AWARDED: 01-15-80
TERMINATES: 05-31-82

AWARD NUMBER: SED79-20597

PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Handicapped; Undergraduates
DESCRIPTORS: Blindness; Disabilities; Cognitive Processes; Scientific Concepts; Scientific Literacy; Learning Problems; Handicapped; Instructional Improvement; Interviews; Evaluation Methods; Blind College Students; Blind Post-Secondary School Students; Visual Impairments

*Cumulative amount. Fiscal Year 1981 award: $20,596.

Mathematical Reasoning Improvement Study (MRIS)

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

Mathematical reasoning of early adolescents is an important area for research because (1) reasoning is an essential but underemphasized aspect of mathematics learning, (2) early adolescence is a key period in which to stimulate continuing interest in mathematics and its applications to science and to everyday life, and (3) difficulties in mathematics become an almost insurmountable barrier preventing many women and minority students from entering careers in science, mathematics, and engineering. This project will design mathematical reasoning tasks and administer them to students between 12 and 16 years of age. The purpose of the research is to describe the reasoning used by the students and to identify factors that enhance or inhibit performance, especially factors with differential effects on subpopulations with differing characteristics, such as women or minority groups. Furthermore, the project will devise minimal training procedures to determine whether any subject's performance can be improved with very slight effort. The findings will be disseminated to other researchers and classroom teachers through professional meetings and appropriate journals.

AMOUNT: $198,270
AWARDED: 09-01-81
TERMINATES: 02-29-84

AWARD NUMBER: SED81-09271

PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 7-11
DESCRIPTORS: Mathematical Reasoning; Quantitative Tests; Training Methods; Mathematics Instruction; Adolescents; Minority Groups; Cognitive Processes; Skill Analysis; Reasoning Tasks

Acquisition of Science Literacy In- and Out-of-School: Emphasis on Sex-Differences

Marcia C. Linn
University of California/Berkeley
Lawrence Hall of Science
M-11 Wheeler Hall
Berkeley, CA 94720

This project examines the ways in which male and female adolescents acquire science literacy in out-of-school environments primarily in the Lawrence Hall of Science. It aims to elucidate the underlying reasons for the well-established differences in science literacy among males and females. The project includes nine studies to assess (1) how individuals respond to failure, (2) how male and female adolescents respond to opportunities to acquire science or math, (3) how males and females respond to in-school and out-of-school learning environments, (4) how peers and families influence learning by adolescents, (5) what attitudes might predispose adolescents to learn science and mathematics, and (6) how aptitudes influence the acquisition of science literacy.

The two-year project involves about 700 6th and 8th graders drawn from 28 different classes in the Bay Area, with approximately equal representation from (1) suburban, (2) urban affluent, and (3) urban low-income schools. Data to be collected include observation in naturalistic and controlled conditions, attitude surveys, aptitude tests, performance on Piagetian tasks, and assessments of content knowledge. Analyses will include various multivariate techniques for research audiences and simpler chart and graph summaries for audiences of teachers and curriculum developers.

AMOUNT: $199,790
AWARDED: 08-01-81
TERMINATES: 01-31-84

AWARD NUMBER: SED81-12631

PROGRAM: Research in Science Education

DISCIPLINE: Science Literacy/Education
TARGET AUDIENCE: Grade 6, 8
DESCRIPTORS: Scientific Literacy; Adolescents; Sex Differences; Sex Bias; Scientific Attitudes; Scientific Concepts; Mathematics Anxiety; Cognitive Measurement; Aptitude Tests; Out of School Environments

Dynamic Reading from Computer Screens — Learner Control

Alfred M. Bork
University of California/Irvine
Department of Physics
Irvine, CA 92717

Science students are reading scientific text from a computer screen to an increasing extent, but little research is available to guide the design of such visual text output. This project will investigate the effects on learning and retention of scientific concepts that come from (1) varying the RATE at which text appears on the screen (including the option to start and stop text output), and (2) using NATURAL PHRASING, i.e. breaking the text into short segments, with natural phrase breaks similar to pauses in spoken language, and presenting these segments both as variations in timing and format. The project will examine particularly the influence of user control of text output, creating a new kind of DYNAMIC READING. The experiment will be conducted on college physics and biology students within the context of computer based courses in physics and biology.

AMOUNT: $125,925
AWARDED: 08-01-81
TERMINATES: 04-30-83

AWARD NUMBER: SED81-12378

PROGRAM: Research in Science Education

DISCIPLINE: Biology, General/Life Sciences & Physics, General
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Computer Assisted Instruction; Textbook Research; Reading Research; Biology; Science Instruction; Physics; College Students; Scientific Concepts; Retention (Psychology); Dynamic Reading; Readability

Individual and Group Behavior in Computer-Based Learning of Scientific Reasoning

Alfred Bork
University of California/Irvine
Department of Physics
Irvine, CA 92717

This project describes an investigation of learning from computer-based activities in science and mathematics. Although it is generally assumed that computer-based learning materials are used by a single individual, in actual practice they are often used by several individuals at the same terminal. This mode of usage may turn out to be both cost effective and pedagogically superior for science education. A two pronged research strategy will be used involving individual interviews and systematic group observations to investigate the effects of group interaction on learning of scientific reasoning. Using various group sizes (1-5) and two age levels (adults and young adolescents), this project will examine several aspects of scientific reasoning skills including problem solving, formal reasoning, and reasoning with hypotheses, inferences and scientific models. The project will have two phases: a pilot study in which interview techniques and observational methods will be developed, and a formal study in which measurements of reasoning ability will be made. Data from the formal study will be analyzed to determine how group size and age level affect learning of scientific reasoning. Educational computer-based materials already available from several outside sources as well as from the Educational Technology Center at Irvine will be used.

AMOUNT: $116,739
AWARDED: 09-15-81
TERMINATES: 08-31-83

AWARD NUMBER: SED81-12633

PROGRAM: Research in Science Education

DISCIPLINE: Science Education; Mathematics Education
TARGET AUDIENCE: Adults; Grades 7-9
DESCRIPTORS: Computer Assisted Instruction; Material Development; Interviews; Mathematics Instruction; Problem Solving; Small Group Instruction; Instructional Innovation; Cognitive Processes; Observation; Scientific Methodology; Scientific Concepts; Science Instruction; Adolescents; Scientific Reasoning

Development of Estimation Skills in Mathematics Using Computer Games

James A. Levin
University of California/San Diego
Center for Human Information Processing
La Jolla, CA 92093

This research project seeks to study the development of mathematical estimation skills within a computer-game environment. The research will teach and assess estimation skills using computer games and will investigate the effectiveness of transfer of the developed skills to mathematical problem solving outside of the computer context.

The goal is to develop an explicit cognitive theory of estimation processes and learning and a pedagogical theory of instruction in estimation using microcomputers in the classroom. The target population is elementary school children, grades one to four.

The results of these studies will provide information about the usefulness of microcomputers for teaching estimation skills as well as new insights into mathematical learning difficulties among children.

AMOUNT: $95,314
AWARDED: 09-01-81
TERMINATES: 02-28-83

AWARD NUMBER: SED81-12645

PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 1-4
DESCRIPTORS: Instructional Materials; Mathematics Instruction; Computer Assisted Instruction; Educational Games; Cognitive Objectives; Skill Development; Material Development; Microcomputers; Problem Solving; Elementary School Students; Learning Theories; Estimation Skills

Problem-Solving Processes of Upper Elementary and Junior High School Mathematics Students

Nicholas A. Branca
San Diego State University
Department of Mathematical Sciences
San Diego, CA 92182

The project is a longitudinal (3-year) study of the nature and development of mathematical problem-solving processes of upper elementary and junior high school students. The investigation attempts to determine the effects of a long-term instructional program on 5th, 6th, and 7th grade students' ability to solve mathematics problems. The methodology used is that of a teaching experiment--a research form popularized by Soviet researchers in which qualitative data are collected in interview settings and protocols are recorded.

The results of the study will include quantitative and descriptive longitudinal data. Protocols and analyses of students' responses are being developed for problems which have been used previously by American and Soviet researchers and also for problems which are specific to the curriculum. This data base will allow the formulation of research hypotheses to be tested in the future.

AMOUNT: $186,890*
AWARDED: 09-15-79
TERMINATES: 02-28-83

AWARD NUMBER: SED79-19617

PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 5-7
DESCRIPTORS: Problem Solving; Cognitive Development; Longitudinal Studies; Mathematics Education; Discussion (Teaching Technique); Hypothesis Testing; Program Effectiveness; Adolescents; Protocols; Soviet Union

*Cumulative amount. Fiscal Year 1981 award: $63,570.

Synthesis of Research Related to Mathematics Problem-Solving Instruction

Edward A. Silver
San Diego State University
Department of Mathematical Sciences
San Diego, CA 92182

The project will survey and integrate research related to mathematics problem-solving instruction. The project goals are encompassed by three questions: (1) What is the "state of the art" in research on mathematics problem-solving instruction? (2) In what promising directions might research on mathematics problem-solving instruction proceed? (3) What implication does research on mathematics problem solving have for educational practice? Project activities will consist of: (1) a critical analysis of research on mathematics problem-solving instruction; (2) a survey of the general problem-solving literature in cognitive science and mathematics education; and (3) an examination of current problem-solving programs in mathematics and other quantitative domains. The interdisciplinary and comprehensive scope of the project is directed at the interface between cognitive science and mathematics education. The synthesis produced by the project should be of significant value to mathematics education researchers, cognitive scientists interested in mathematical problem solving, and educational practitioners who design or teach mathematics curriculum.

AMOUNT AWARDED: $149,561
EFFECTIVE: 06-01-81
TERMINATES: 11-30-83

AWARD NUMBER: SED80-19328

PROGRAM: Research in Science Education

DISCIPLINE: Mathematics, Problem Solving
TARGET AUDIENCE: Education Administrators; College Instructors; Teachers
DESCRIPTORS: Mathematics Instruction; Cognitive Processes; Problem Solving; Educational Research

The Synthesis of Evidence and Theoretical Explanations of the Underrepresentation of Women in Science

Alma E. Lantz
Eclectic Systems Research
3451 East Asbury
Denver, CO 80210

The project will synthesize and integrate past research on the causes of the underrepresentation of women in science and mathematical careers. Specifically, the project will review various theories postulated to account for the relative absence of women in the sciences. A detailed analysis of the existing literature published since 1950 will be conducted. The analysis will include research studies, and descriptions of programmatic interventions and evaluations of their effectiveness. The studies will be synthesized via review, cross project comparisons, box tallies, or meta-analysis techniques. The results of the literature synthesis will be organized according to the position each theory represents. This synthesis will serve to guide intervention efforts and to formulate future research questions.

AMOUNT: $79,403
AWARDED: 04-01-81
TERMINATES: 09-30-82

AWARD NUMBER: SED80-20854

PROGRAM: Research in Science Education

DISCIPLINE: Science Education; Mathematics Education
TARGET AUDIENCE: Females
DESCRIPTORS: Surveys; Evaluation Methods; Women's Education; Females; Mathematics Education; Science Education; Career Choice; Literature Reviews; Role Theory; Synthesis of Research; Meta-Analysis

Misconceptions of Novice Computer Programmers

Elliot M. Soloway
Yale University
Department of Computer Science
New Haven, CT 06520

A major problem for the widespread use of computers in education is the need for students to learn a language in which to express their intentions to the computer, i.e., they must learn to program. This study will focus on the difficulties novice programmers in college have with three fundamental programming concepts: name-value association, repetition, and conditional branching. Attention will be given to those classes of programming problems which illustrate common plan types, e.g., accumulate a running total. Bugs in student programs will be identified and catalogued. Teaching strategies and language constructions will be suggested which might remedy or avoid the difficulties.

Three types of data will be analyzed: on-line protocols, concurrent verbal reports from individual interviews, and group tests. On-line protocols will capture a copy of the student-computer interactions; this allows observation of novices as they perform a real, not an artificial, task.

Results from this research will aid educators in the selection and instruction of cognitively appropriate languages for novices or casual users, and also aid the programming language designer in the development of languages and systems which are easier to learn and use.

AMOUNT: $174,202
AWARDED: 08-01-81
TERMINATES: 01-31-84

AWARD NUMBER: SED81-12403

PROGRAM: Research in Science Education

DISCIPLINE: Software Systems/Computer Systems
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Programming; Computer Programs; Programming Languages; Computer Assisted Instruction; Teaching Methods; Data Analysis; College Students; Cognitive Measurement; Loop Constructs; Programming Bugs

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

This award provides support to the Conference Board of the Mathematical Sciences (CBMS) to do an in-depth survey and trend analysis of data on undergraduate education in the mathematical sciences in universities, in four-year, and in two-year colleges.

The survey is being conducted for the academic year 1980-81 and is the fourth in a series conducted by CBMS at five-year intervals since 1965-66. These studies have produced 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, but also to individuals and industrial, governmental, and professional organizations concerned with the mathematical sciences. Like the earlier CBMS studies, this survey is being carried out under the direction of a broadly representative survey committee (eight persons), by an executive secretary drawing upon consultants who will provide technical advice and assistance, and with staff support from CBMS. The survey data come primarily from responses to questionnaires sent to a statistically designed sample of departments in the mathematical sciences. After reduction and analysis of these data, the results will be published in a report which will be publicized through announcements, articles and panel discussions at professional meetings.

AMOUNT: $59,800*
AWARDED: 12-01-79
TERMINATES: 11-30-82

AWARD NUMBER: SED79-19946

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; Conference Board of the Mathematical Sciences; CBMS; Four Year Colleges

*Cumulative amount. Fiscal Year 1981 award: $7,000.

Conceptual Systems and Decisionmaking in Teaching Mathematics

Thomas J. Cooney
University of Georgia
Department of Mathematics Education
105 Aderhold Hall
Athens, GA 30602

This project involves the development and application of a scheme for describing teachers' conceptual systems, and a description of how those systems relate to instructional decisions in the teaching of mathematics. The analysis of conceptual systems will focus on three aspects of teachers' belief systems: what they believe to be mathematics; what they believe to be purposes for teaching mathematics; and what theories, either implicit or explicit, they have for explaining how mathematics is learned and taught. The relationship between conceptual systems and instructional decisions (such as choice of content, selection of pedagogical approach, and degree of emphasis given to various levels of mathematical knowledge) will be investigated. Data will be gathered using interviews with teachers and case study methods. Results will be disseminated through presentations at professional meetings and publication in appropriate journals.

AMOUNT: $150,663
AWARDED: 07-15-81
TERMINATES: 12-31-83

AWARD NUMBER: SED81-12635

PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Teachers
DESCRIPTORS: Mathematics Instruction; Decision Making Skills; Learning Theories; Interviews; Case Studies; Teacher Attitudes; Teachers' Conceptual Systems

Construct Analysis, Manipulative Aids, Representational Systems, and the Learning of Rational Numbers

Merlyn J. Behr
Northern Illinois University
Department of Mathematics Education
DeKalb, IL 60115

The proposed project will continue and extend the work in progress under NSF grant No. SED79-20591 (The Role of Manipulative Aids in the Learning of Rational Numbers). Through further development of new or refinement of existing prototypical instructional materials, the project will seek further substantiation of cognitive structures needed and developed by children in learning rational number concepts. Work will be extended to a longitudinal study involving classroom-size groups of children, to the investigation of the role of the oral mode in facilitating mathematical symbol learning and the role of manipulatives in facilitating program solving, and to the effectiveness of basing the development of the rational number concept on iteration of unit fractions.

AMOUNT: $150,000
AWARDED: 07-01-81
TERMINATES: 02-29-84

AWARD NUMBER: SED81-12643

PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 2-8
DESCRIPTORS: Problem Solving; Elementary School Mathematics; Mathematics Instruction; Number Concepts; Intermediate Grades; Instructional Materials; Manipulative Materials; Longitudinal Studies; Rational Numbers; Construct Analysis; Unit Fraction Approach

A Critical Examination of Factors Associated with Public Attentiveness to Science

Jon D. Miller
Northern Illinois University
The Graduate School
DeKalb, IL 60115

This project will conduct a critical examination of a newly defined measure of public attentiveness to science and of the utility of this measure as an indicator of the state of the U.S. public's understanding of science. The attentiveness to science measure is a composite index that includes (1) interest, (2) knowledge, and (3) regular information consumption components. The development of science attentiveness and its relation to a number of critical individual and societal factors were the focus of the 1978 National Public Affairs Study (NPAS), a cross-sectional study of U.S. high school and college youth, that resulted in the book, Citizenship in an Age of Science.

With the assistance of a distinguished National Advisory Committee, the project staff will conduct a thorough review of the attentiveness construct and several related factors, using the 1978 NPAS data set and such other large national data sets as are appropriate. The project will identify the major theories and models of socialization and attitude development, will derive testable hypotheses of science attentiveness, and will synthesize the growing research literature on longitudinal measures, that are prerequisite to a design of a national study.

AMOUNT: $122,393
AWARDED: 08-01-81
TERMINATES: 07-31-83

AWARD NUMBER: SED80-18947

PROGRAM: Research in Science Education

DISCIPLINE: Science Literacy/Education
TARGET AUDIENCE: Grades 11-12; Young Adults
DESCRIPTORS: Scientific Literacy; Attitude Measures; Longitudinal Studies; Young Adults; Sex Differences; High School Students; Science Attentiveness; Adults; Secondary Analysis; Sociological Factors; Individual Factors

Format Variables and Learner Characteristics in Mathematical Problem Solving

Larry Sowder
Northern Illinois University
Department of Mathematical Sciences
DeKalb, IL 60115

The project will examine the mathematical problem-solving performance of normal and learning disabled students. Mathematical story problems, some involving multiple calculations and/or extraneous data, will be used, with presentation format a major variable. Two areas will be explored over a two-year period:

1. Is there a cross-sectional, longitudinal pattern over grades 3-8 in the relative performance of girls and boys on problems in two formats--verbal and drawn? Do cognitive variables such as field dependence-independence and spatial visualization bear a differential relationship to performance in the two formats?

2. How is the performance affected by including motion in a drawn version, as opposed to using a static drawing or a verbal form?

The results would have special pertinence to the preparation of curriculum materials and to the use of certain learner characteristics in planning instruction and further research. Findings will be disseminated through appropriate journals and professional meetings.

AMOUNT: $196,121
AWARDED: 06-15-81
TERMINATES: 01-31-84

AWARD NUMBER: SED81-08134

PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 3-8
DESCRIPTORS: Problem Solving; Mathematics Instruction; Longitudinal Studies; Cognitive Measurement; Curriculum Development; Cross Sectional Studies; Elementary School Mathematics; Aptitudes; Learning Disabled

An Investigation of Instructional Strategies to Enhance Meaningful Learning in Biology

Jane Butler Kahle
Purdue University
Chemistry Building
West Lafayette, IN 47901

The purpose of this project is to study learning aids relative to the formation and retention of concepts. The subjects will be urban, black students in ninth grade biology/life science classes. The learning aids, concept mapping and Gowin's epistemological "V", have been studied by a research group at Cornell University. Concept mapping is an activity by which relationships between concepts introduced in an instructional unit and concepts previously established are illustrated. Gowin's "V" is a learning tool which facilitates the identification of relationships between observations made during laboratory activities and corresponding conceptual systems. This project will extend the Cornell study to an alternate group of subjects. A close working relationship has been established with the cooperating school system, whose inservice teachers previously have developed the instructional materials to be utilized. The importance of this project is twofold. First, it will address problems of the meaningful learning of concepts by carefully integrating successful concept formation strategies into instructional materials; and second, it will increase science achievement in a sample of students which nationally falls below the mean on science achievement.

AMOUNT: $75,366
AWARDED: 04-15-81
TERMINATES: 03-31-83

AWARD NUMBER: SED80-19477

PROGRAM: Research in Science Education

DISCIPLINE: Biology, General/Life Sciences; Education
TARGET AUDIENCE: Grade 9; Minorities
DESCRIPTORS: Learning; Cognitive Processes; Education; Learning Processes; Concept Formation; Educational Media; Instructional Materials; Biology; Learning Aids; Concept Mapping; Gowin's "V"

Children's Understanding of Decimal Numbers

James Hiebert
Diana Wearne
University of Kentucky
Department of Curriculum and Instruction
105 Kinkead Hall
Lexington, KY 40506

This project investigates elementary and junior high school students' understanding of decimals. The study will document the students' proficiency in manipulating the symbols of the decimal system, map out the rule systems they develop to guide their manipulations, and describe the misconceptions of decimal numbers that underlie their algorithmic procedures. Students' concepts of decimals will be related to their previous knowledge of place value concepts with whole numbers, to the specific instruction on decimals that they receive, and to more basic cognitive skills that may influence their ability to learn decimal concepts.

Students in grades 3, 5, and 7 will be followed over a two-year period in order to trace the development of decimal concepts from when they are first introduced through the junior high school years. Written tests, standardized individual interviews, and flexible in-depth interviews will be used to collect information on students' understanding of decimals. Process analyses and error analyses will be used to uncover and describe the thought processes students use to deal with decimal problems, and textbook analyses and interviews with teachers will provide information on the instructional strategies used to teach decimals. Results will be disseminated through appropriate journals and professional meetings.

AMOUNT: $114,459
AWARDED: 06-01-81
TERMINATES: 11-30-83

AWARD NUMBER: SED81-09731

PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 3, 5, 7
DESCRIPTORS: Elementary School Mathematics; Decimal Fractions; Mathematics Instruction; Cognitive Measurement; Longitudinal Studies

Role of the Family in the Promotion of Science Literacy

John D. Balling
Chesapeake Research Consortium, Inc.
1419 Forest Drive, Suite 207
Annapolis, MD 21403

This series of five studies will increase understanding of the role of the family in the promotion of science literacy. The first study examines families at science-technology centers by surveying visitors' backgrounds, attitudes, and motivations for visiting. The second study assesses the ability of a school-based supplementary science program to encourage families of different socio-economic backgrounds to participate in informal science learning. The third study examines the psychological dimensions underlying informal science learning experiences for families, using Q-sort methodology. The fourth study is observational, collecting detailed data about social and educational interactions among family members in two different science learning environments. The fifth study will measure the degree to which a family orientation in science learning activities enhances participation, cognitive gains, and changes in attitude in all participants.

AMOUNT: $172,715
AWARDED: 08-01-81
TERMINATES: 01-31-84

AWARD NUMBER: SED81-12927

PROGRAM: Research in Science Education

DISCIPLINE: Science Literacy/Education
TARGET AUDIENCE: General Public
DESCRIPTORS: Scientific Literacy; Family Attitudes; Family Involvement; Family School Relationship; Q Methodology; Social Science Research; Science Programs; Socioeconomic Influences; Cognitive Measurement; Attitude Change

A Cognitive Perspective on Women Students' Experience with Science Education: Implication for Women's Career Bahavior

Gabriel Haim
Boston University
Center for Applied Social Science
881 Commonwealth Avenue
Boston, MA 02215

Aspects of self-selection and early career behavior among college women majoring in several different scientific disciplines will be studied. A new cognitive model about women's experience with science education will be used to explain how cultural stereotypes are translated into a cognitive disadvantage. A whole category of women having certain valuable cognitive abilities for scientific research may not attempt to pursue scientific careers while a minority of women who do attempt to pursue scientific careers may well have different cognitive strengths from those of the majority of men who are their colleagues. Cognitive differences between men and women in various disciplines, as well as other differences between them as regards those disciplines, and the consequent selection/self-selection, may depend on the developmental state of a given discipline. The design of the study includes a sample of 3,600 men and women students of four fields: physics, chemistry, economics, and sociology. The students will be tested for cognitive styles using differentiation and remote association tests, perceived successful cognitive qualities, and self-images. The study has policy implications regarding women and other culturally disadvantaged groups.

AMOUNT: $151,860
AWARDED: 08-01-81
TERMINATES: 01-31-84

AWARD NUMBER: SED80-20855

PROGRAM: Research in Science Education

DISCIPLINE: Science Education
TARGET AUDIENCE: Undergraduates; Females
DESCRIPTORS: Females; Minority Groups; College Students; Career Choice; Cognitive Measurement; Scientific Attitudes

Analysis of the Development of Deductive Reasoning, with Applications to Instruction in Geometry

Rachel Joffe Falmagne
Clark University
950 Main Street
Worcester, MA 01610

This project focuses on the acquisition and development of competence in deductive reasoning. Two related sets of questions are addressed, concerning respectively the cognitive processes underlying deductive inference, (especially indeterminate conditional inferences); and the interface between those processes and instructional methods. Six experiments conducted in the second through seventh grades, will be concerned with (1) the process whereby rules of deductive inferences can be acquired without direct instruction, and specifically with children's ability to abstract the structure of a given pattern; (2) the interplay between logical form, content and level of competence, and specifically with the effect of mental imagery on the mode of solution of various inferences (determinate and indeterminate) with a specific focus on individual differences in that respect; and (3) the way in which different linguistic expressions of indeterminacy affect the reasoning process. A seventh experiment will examine whether patterns of deductive inference acquired in linguistic contexts carry over to reasoning within the subject matter of geometry, with an experimental instructional method providing closely coordinated instruction in logical inference and in geometry.

AMOUNT: $119,876
AWARDED: 04-15-81
TERMINATES: 09-30-83

AWARD NUMBER: SED80-21459

PROGRAM: Research in Science Education

DISCIPLINE: Geometry/Mathematical Sciences; Mathematics Deductive Reasoning/ Mathematical Sciences
TARGET AUDIENCE: Grades 2-7
DESCRIPTORS: Deduction; Logical Thinking; Experiments; Induction; Thinking Processes; Learning Processes; Geometry; Instruction; Cognitive Processes; Deductive Reasoning

Cognitive Structures Underlying Statistical Inference

Alexander Pollatsek
University of Massachusetts/Amherst
Department of Cognitive Psychology
Amherst, MA 01003

This study concerns the way college students and other adults use their intuition in learning about and applying statistical methods. The inquiry will be similar in spirit to the recent work of Tversky and Kahneman on cognitive structures for dealing with uncertainty, but with an important difference in methodology. Whereas Tversky and Kahneman base their research on written answers to multiple-choice (or similar) tests, the plan here is to gather much of the data from one-on-one clinical interviews, which is more flexible and more informative. The research will concentrate on two sets of ideas essential to any system of statistical inference, (1) randomness, random sampling, and sampling distributions; and (2) conditional probabilities. A better understanding of the preconceptions and misconceptions which students bring to the study of these topics should improve the way they are taught. Intuitions that novices share with trained professionals whose judgments are correct can serve as a foundation for statistics courses from which to build, while those which interfere with correct judgments can be more easily changed if they are explicitly recognized by both student and teacher.

AMOUNT: $128,844
AWARDED: 08-01-81
TERMINATES: 01-31-85

AWARD NUMBER: SED81-13323

PROGRAM: Research in Science Education

DISCIPLINE: Probability and Statistics/Mathematical Sciences
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: College Students; Cognitive Processes; Statistical Analysis; Sampling; Probability; Adults; Educational Psychology; Randomness; Conditional Probabilities

Planning and Teaching of Intermediate Science

Edward L. Smith
Michigan State University
Science and Mathematics Teaching Center
E-7 McDonel Hall
East Lansing, MI 48825

Mismatches between teachers' planning processes and the content and organization of science program teachers' guides seem to be one important and potentially modifiable factor that limits the quality of science instruction at the upper elementary level. The objectives of this project are to test this idea by (1) analyzing existing patterns in teachers' use of science program materials and their effects on instruction, teacher satisfaction, and student learning; (2) 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. First, the planning and teaching of science by 20 sixth grade teachers will be observed. Student learning and teacher satisfaction will be measured to identify successful patterns. Second, these successful patterns will be used to develop an experimental intervention. Third, 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: $152,090*
AWARDED: 10-01-80
TERMINATES: 06-30-83

AWARD NUMBER: SED80-20022

PROGRAM: Research in Science Education

DISCIPLINE: Science Education
TARGET AUDIENCE: Grade 6
DESCRIPTORS: Science Instruction; Teaching Guides; Instructional Materials; Cognitive Measurement; Teaching Methods; Planning; Teacher Effectiveness; Curriculum Development; Case Studies; Comparative Analysis; Science Teachers; Intermediate Grades; Upper-elementary Science

*Cumulative amount. Fiscal Year 1981 award: $90,766.

Computer Awareness and Literacy of Adolescent and Early Adolescent Students: An Empirical Assessment

Ronald E. Anderson
Minnesota Educational Computing Consortium
2520 Broadway Drive
St. Paul, MN 55113

The purpose of the study is to analyze data describing computer literacy from a statewide sample of all eleventh grade students in Minnesota and a survey of eighth grade students. The data will be analyzed for factors that influence computer literacy.

The current supplement and extension will more fully report the existing findings with respect to missing responses and investigate the extent to which nonresponse and uncertainty response patterns have biased or distorted the comparisons among reporting groups particularly by gender, minority status, and region.

AMOUNT: $91,012*
AWARDED: 09-01-79
TERMINATES: 05-31-81

AWARD NUMBER: SED79-20087

PROGRAM: Research in Science Education

DISCIPLINE: Computer Science, Education; Tests and Measurements Education
TARGET AUDIENCE: Grades 7-12
DESCRIPTORS: Testing; Test Bias; Sex; Minority Testing Problems; Computer Science Education; Response Style (Tests); Educational Research; Intelligence; Comprehension; Computer Literacy

*Cumulative amount. Fiscal Year 1981 award: $8,118.

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, on attentiveness to science, and on 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) and will take place in 1981-82. 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: $416,579*
AWARDED: 09-15-80
TERMINATES: 02-28-83

AWARD NUMBER: SED80-22125

PROGRAM: Research in Science Education

DISCIPLINE: Multidisciplinary Sciences
TARGET AUDIENCE: Grades 4-12 (9-, 13-, and 17-year olds)
DESCRIPTORS: Scientific Literacy; Theoretical Models; Student Attitudes; Social Factors; Decision Making; Demography; Trend Analysis; Science Understanding; Science Achievement; Education Commission of the States (ECS); National Assessment of Education Progress/Science

*Cumulative amount. Fiscal Year 1981 award: $276,579.

The Brain and Education: A Study of Neuroscience, Cognitive Science, and Education

Kenneth A. Klivington
Alfred P. Sloan Foundation
630 Fifth Avenue
New York, NY 10111

The purpose of this project is to plan and convene a conference intended to assess the current state of research relating neuroscience to cognitive science and education. Six persons yet to be identified from these fields will be invited to meet in April with agency personnel (NSF, National Institute of Education, and the Sloan Foundation) to plan the detailed structure and content of the conference. The tentative date for the conference is late fall 1981. A final report will include commissioned papers as well as a summary of the discussions, conclusions, and recommendations.

AMOUNT: $10,000
AWARDED: 06-01-81
TERMINATES: 11-30-81

AWARD NUMBER: SED81-12062

PROGRAM: Research in Science Education

DISCIPLINE: Cognitive Neuroscience/Education
TARGET AUDIENCE: Education Administrators; College Instructors; Teachers
DESCRIPTORS: Cognitive Objectives; Learning Theories; Cognitive Science; Scientific Literacy; Educational Research; Biochemistry; Conferences; Neuroscience; Brain Functions

School, Family, and Individual Influences on Commitment to and Learning of Science Among Adolescent Students

Kay M. Troost
North Carolina State University
Department of Sociology and Anthropology
Raleigh, NC 27650

Despite the ever-increasing importance of science in our society, there is compelling evidence that adolescent students in our schools are turning away from science. Enrollment figures also show that female and minority students as a group tend to shy away from taking additional science courses.

A major aim of this study is to search for variables and relationships that influence learning in science and commitment to science among adolescent students. Model(s) will be examined temporally and substantively that explain how antecedent and intervening variables influence cognitive and affective outcomes in science. Another aim of this study is to develop action guidelines for policy makers in this country to follow as attempts are made to improve science education for adolescent students of both sexes and all races.

A longitudinal, multimethod, multivariate investigation is proposed. This proposal requests funds for the first two stages of an investigation which is planned for a six-year period. Using structural equations, extensive data from classrooms from grades 6-10 will be analyzed and used to build a predictive model for commitment to and learning of science. Differences in student attitudes and achievement patterns between experimental and control groups will be used to modify and strengthen the predictability of the model in subsequent projects.

AMOUNT: $147,130*
AWARDED: 09-15-79
TERMINATES: 08-31-83

AWARD NUMBER: SED79-19784

PROGRAM: Research in Science Education

DISCIPLINE: Science Literacy/Education
TARGET AUDIENCE: Grades 6-10; Adolescents; Females; Minorities
DESCRIPTORS: Scientific Literacy; Science Curriculum; Scientific Attitudes; Attitude Measures; Longitudinal Studies; Models; Predictions; Achievement; Cognitive/Affective Measures; Females; Minorities

*Cumulative amount. Fiscal Year 1981 award: $25,900.

Structure and Process in Children's Mental Arithmetic

Mark H. Ashcraft
Cleveland State University
East 24th & Euclid Avenue
Cleveland, OH 44115

The development of children's knowledge of basic addition and order relationships is the focus of this project. The research employs both reaction time and clinical interview methods in order to investigate the mental structures and processes which account for arithmetic performance. The project includes experiments on simple mental addition, numerical inequality judgments, and complex addition problems to determine the nature of children's memory structures for numerical information and the evolution of those structures and processes across ages. Children in grades 1-4 are tested intensively within the experiments, first to determine the variety of processes used, and second, to trace the emergence of more adult-like processes and structures. Results of the project will be disseminated through professional meetings.

AMOUNT: $47,035
AWARDED: 03-01-81
TERMINATES: 02-28-83

AWARD NUMBER: SED80-21521

PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 1-4
DESCRIPTORS: Elementary School Mathematics; Addition; Mathematics; Arithmetic; Computation; Cognitive Measurement; Cognitive Tests; Elementary School Students; Problem Solving; Memorization; Numerical Inequality Judgments

Sequencing Language and Activities in Teaching High School Chemistry and Physics

John W. Renner
University of Oklahoma
Department of Science Education
Norman, OK 73019

This project seeks to understand a particular model of science instruction called the Learning Cycle model. Developers, researchers, and instructors who have adopted this model often report that it facilitates intellectual development and learning of science. The model consists of a sequence of three overlapping phases: an exploratory phase in which students observe physical phenomena and collect and discuss data according to instructions; an invention phase in which students and teachers attempt to organize the data and provide language to describe the phenomena; and an expansion phase, in which students attempt through readings or other activities to relate the phenomena to other knowledge or phenomena known to them. Studies will be conducted to assess the necessity of each phase, the importance of its order in the sequence, and the importance of various forms which each phase could take for students of physics and chemistry in high school. The project is therefore designed to deepen our understanding of both the effects of this model and of the reasons why they occur. It is expected to have implications for both instruction and curriculum development.

AMOUNT: $184,726
AWARDED: 02-01-81
TERMINATES: 04-30-83

AWARD NUMBER: SED80-15814

PROGRAM: Research in Science Education

DISCIPLINE: Chemistry, General; Physics, General; Science Education
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Chemistry Instruction; Prototype Curriculum Development; Physics Instruction; Language Skills; High School Students; Learning Cycle Model; Cognitive Processes

An Information Processing Analysis of Learning in Geometry

John R. Anderson
Carnegie-Mellon University
Department of Psychology
Schenley Park
Pittsburgh, PA 15213

A theory of human information processing will be tested in the domain of acquisition of theorem-proving skills in geometry. The specific skills investigated will be reason-giving and the generating of steps in a proof. Traditionally the former is used to introduce the latter, but the theory assigns these two skills very different information processes. Special experimental software will be developed both to study the skill acquisition and to direct its development.

The theory to be tested is the investigator's ACT model which comprises a propositional network representation of declarative knowledge and a production system model of procedural knowledge. This general approach will be rendered more explicit in a simulation model. The simulation will be guided by analyses of protocols of students engaged in acquiring the skills.

AMOUNT: $125,000*
AWARDED: 02-15-81
TERMINATES: 07-31-84

AWARD NUMBER: IST80-15357

PROGRAM: Research in Science Education/Information Science and Technology

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Geometry; Mathematics; Information Processing; Mathematics Education; Skill Development; Skills; Theorem-proving Skills; ACT Model; Cognitive Science

*Jointly funded with NSF Division of Information Science and Technology. Total Fiscal Year 1981 award: $259,742.

Correlates of Attitudes Toward Mathematics, Science, and Social Studies

Thomas M. Haladyna
Oregon State System of Higher Education
Teaching Research Division
Monmouth, OR 97361

As an outcome of a large-scale study of students' attitudes toward science and other subject matters recently performed by the principal investigator and colleagues, the current research will investigate the relationship between teacher, school, student, and environmental variables and student attitudes. It will cross three curricular areas in science (i.e., science, mathematics, and social studies) and three grade levels (four, seven, and eleven) for 270 teachers and their respective students, approximately 6,000.

A review of current literature reveals the lack of coordinated and comprehensive research of this type across the dimensions described above. Further, most studies of attitudes fail to provide a theoretical base as well as a multivariate methodology, which has greater potential for uncovering complex relationships that seemingly exist.

Products of this project include (a) the research study, (b) a review of salient research, (c) a review of instruments used to measure attitudes, (d) a sourcebook of these instruments, and (e) two technical reports documenting the reliability and validity of the instruments employed in the study.

AMOUNT: $2,359
AWARDED: 04-01-81
TERMINATES: 08-31-81

AWARD NUMBER: SED81-09982*

PROGRAM: Research in Science Education

DISCIPLINE: Science Education; Mathematics Education; Social Science Education
TARGET AUDIENCE: Grades 4, 7, 11
DESCRIPTORS: Science Education; Student Attitudes; Teacher Attitudes; Attitude Tests; Predictor Variables; Mathematics Education; Social Science

*This supplements SED78-17367.

The Role of Television Entertainment in Public Education About Science

George Gerbner
University of Pennsylvania
Annenberg School of Communications
3452 Walnut Street
Philadelphia, PA 19104

This study examines the role of prime time television in the cultivation of public conceptions of science, technology, and scientists. The underlying assumption, supported by previous research, is that television exerts a standardizing and legitimizing influence largely through its ability to streamline, codify, amplify, and ritualize information, and reach into previously isolated subcultures of society. The study will examine all television programs shown from 8:00 to 11:00 p.m. EST, Monday through Saturday, and 7-11 p.m. Sunday, during a one-week interval in the fall of each of eleven successive years (1969-80). Two week-long spring samples will also be included (1975 and 1976). Researchers will analyze fictional story units and major characters using coding instruments and methods that have been pretested in a pilot study. The authors will then commission a survey, based on these findings, to examine the extent to which television drama cultivates images and beliefs about science in different groups of adult viewers. Findings will be disseminated by popular and scholarly publications, by a press release, and by direct mailing.

AMOUNT: $199,716
AWARDED: 07-15-81
TERMINATES: 12-31-83

AWARD NUMBER: SED81-12372

PROGRAM: Research in Science Education

DISCIPLINE: Science Literacy/Education
TARGET AUDIENCE: General Public
DESCRIPTORS: Scientific Concepts; Scientific Literacy; Television Viewing; Television Research; Information Dissemination

Research on Instruction of Problem-Solving Skills in Newtonian Mechanics

Audrey B. Champagne
University of Pittsburgh
Learning Research and Development Center (LRDC)
1028 Cathedral of Learning
Pittsburgh, PA 15260

Studies of physics learning demonstrate that students' pre-instructional world knowledge is often logically antagonistic to the principles of Newtonian mechanics taught in introductory physics. Under these conditions psychological theory predicts that learning will be inhibited, a prediction consistent with both the experiences of physics teachers and the results of empirical investigation. Consideration of cognitive research on problem solving, semantic memory, and knowledge acquisition suggests an instructional strategy that would promote the qualitative analysis of physics problems by engaging the student in instructional dialogues.

This project investigates (a) the processes of change in instances where features of existing views are logically antagonistic to features of the views to be acquired, and (b) the efficacy of an instructional strategy derived from an examination of current psychological theory in promoting such view change. Cognitive research supports the theoretical position that relevant world knowledge has facilitative effects. By investigating the effectiveness of the innovative instructional strategy in promoting a reconciliation of world knowledge and physics content for middle-school and college students, this work will both illuminate the processes of change in understanding and allow further tests of the principles included in the instruction. Hypotheses will be tested with pre-adolescents and adults to determine what effect, if any, the more sophisticated reasoning strategies of mature learners have on the process of idea or schema change.

AMOUNT: $107,380
AWARDED: 09-01-81
TERMINATES: 02-29-84

AWARD NUMBER: SED81-12392

PROGRAM: Research in Science Education

DISCIPLINE: Physics; Mechanics
TARGET AUDIENCE: Grades 5-8; Undergraduates
DESCRIPTORS: Problem Solving; Mechanics (Physics); Physics; Learning Theories; Cognitive Objectives; Cognitive Processes; Instructional Innovation; Middle Schools; College Students; Newtonian Mechanics; Qualitative Analysis

Instruction by Mapping: Processes of Learning Mathematics Through Models

Lauren B. Resnick
University of Pittsburgh
Learning Research and Development Center (LRDC)
1028 Cathedral of Learning
Pittsburgh, PA 15260

The investigators will conduct both empirical and theoretical studies of children's understanding of addition and subtraction. They will observe children solving problems with individual instruction, and they will develop computational models that represent hypothetical cognitive structures and processes that they infer that children have or have acquired. These will be evaluated in terms of their success in simulating selected aspects of children's behavior in solving problems and responding to questions..

Two forms of instruction in subtraction involving concrete materials will be compared: a top-down, general correspondence between procedures and a more detailed, bottom-up instructional regime. This will test a hypothesis that detailed and explicit mapping of procedures facilitates comprehension of their general properties.

A study will also be conducted of children's transfer of place values from whole numbers to decimal fractions. Relations between the ability of children to add and subtract and their ability to solve word problems will also be studied, especially where the size of numbers can be related to the number of steps required to solve the problem. The investigators will finally extend their studies to include the use of negative numbers in addition and subtraction, including negative quantities in naturalistic settings.

AMOUNT: $149,313
AWARDED: 09-01-81
TERMINATES: 02-28-85

AWARD NUMBER: SED81-12453

PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Elementary School Students
DESCRIPTORS: Elementary School Mathematics; Mathematics Materials; Problem Solving; Material Development; Addition; Cognitive Processes; Individualized Instruction; Learning Modules; Number Concepts; Subtraction; Decimal Fractions; Negative Numbers

Identification of Factors Influencing Changes in Conceptual Understanding of Science

James A. Minstrell
Mercer Island School District #400
Department of Science and Mathematics
4160 86th Avenue, SE
Mercer Island, WA 98040

This project will extend the study of conceptual understanding of high school mathematics and physics which was begun in 1979. The earlier research uncovered and documented the existence of concepts held by students which interfered with learning elementary statics according to Newtonian physics. In addition to documenting interesting misconceptions such as "gravity is caused by air pressure," the original project provided a hypothetical explanation for an instructional sequence which seemed to overcome many such misconceptions. The new project will permit the proposer to test the effectiveness of his instructional strategies on additional topics in mathematics and physics, particularly those in which mathematics seems particularly important for understanding the physics. In addition, the project will enable the project staff and others to integrate findings from this project and others and to consider the implications for the teaching of science and mathematics more generally.

They will collect data from observations and videotapes of classes plus item analyses of paper and pencil tests of conceptions identified by observation. The results will include a descriptive model of students' conceptions and of instructional strategies which are designed to improve them. The project also proposes to integrate findings from other projects with this one from the perspectives of the teachers.

AMOUNT: $43,274
AWARDED: 09-01-81
TERMINATES: 03-31-84

AWARD NUMBER: SED81-13590

PROGRAM: Research in Science Education

DISCIPLINE: Science-Secondary/Education; Education, Physics and Mathematics

TARGET AUDIENCE: Grades 9-12

DESCRIPTORS: Scientific Concepts; Concept Formation; High School Students; Secondary School Science; Mathematics Instruction; Physics; Science Curriculum; Fundamental Concepts; Concept Teaching; Science Instruction; Error Patterns

An Empirical Investigation of Student Knowledge in Introductory Physics

Lillian C. McDermott
University of Washington
Department of Physics FM-15
Seattle, WA 98195

In this project, an empirical investigation of conceptual understanding will be conducted in several areas of college physics, examining student understanding of individual concepts and relationships among concepts. A major focus will be the ability to apply physical concepts to real situations and an investigation of the relationship between conceptual understanding and problem-solving performance.

The primary data source will be structured individual interviews. These will be supplemented by information gathered during instruction from homework assignments, examination questions, instructor-student dialogues, and group and class discussions.

The research will require the development of a task analysis model of expert understanding in topics from introductory physics, which will serve as a guide for the construction of a detailed analysis of student difficulties in applying physical concepts to real situations and to the solution of physics problems. The pedagogical implications of these findings will be explored through an extensive instructional program.

The work on conceptual understanding and its relation to problem-solving will also provide preliminary data about other components of physics knowledge. A start will be made on two of these: facility with formal scientific representations and competence in analytical reasoning. Preliminary data on these additional components of student knowledge in physics will provide the basis for a future research project.

AMOUNT: $220,600
AWARDED: 10-01-81
TERMINATES: 03-31-85

AWARD NUMBER: SED81-12924

PROGRAM: Research in Science Education

DISCIPLINE: Physics, General
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Concept Formation; Physics; Science Instruction; Scientific Concepts; Problem Solving; College Students; Interviews; Knowledge Level; Cognitive Measurement

Research on Changes in Intellectual Development and Critical Thinking Ability

Robert D. Allen
West Virginia University
Department of Biology
Morgantown, WV 26505

William Perry, in a nine-year study summarized in a book called The Intellectual and Ethical Development of College Students, proposes nine distinct states of ethical and intellectual development which are characteristic of students in their college years. Perry's work has been extended by other investigators at other universities.

This project aims to examine the relationship between (a) a student's ethical and intellectual development according to the Perry model, and (b) the student's ability to develop and practice critical thinking in biology. It is hypothesized that there will be a strong correlation and interaction between the two lines of development.

Subjects will be students enrolled in an introductory biology course. Each student's position on the Perry scale will be measured at the beginning and end of the course according to techniques developed by Perry and by the Syracuse Rating Group; the latter assists many researchers in Perry classification, and they are consultants on this project. Each student's critical thinking skills will be measured by instruments developed by the principal investigator and his staff; these measurements will also be made at the beginning and end of the quarter, with interim measurements as well.

The project is of one year's duration. It is a pilot study, the first to explore the relationship between Perry development and biology learning. A more specific hypothesis concerning the relationship between Perry stage and biology learning is anticipated from this research.

AMOUNT: $50,107
AWARDED: 05-15-81
TERMINATES: 11-30-82

AWARD NUMBER: SED80-26487

PROGRAM: Research in Science Education

DISCIPLINE: Field Biology, General/Life & Medical Sciences; Ethics & Values
TARGET AUDIENCE: Undergraduates
DESCRIPTORS: Intellectual Development; Cognitive Processes; Critical Thinking; Ethics; Biology; Perry Model; Syracuse Rating Group

Research on Relationship of Spatial Visualization and Confidence to Male/Female Mathematics Achievement in Grades 6-8

Elizabeth Fennema
University of Wisconsin
School of Education
Department of Curriculum and Instruction
225 N. Mills Street
Madison, WI 53706

This project will investigate the factors contributing to underrepresentation of women in careers related to mathematics, particularly individual differences in spatial visualization, and anxiety or confidence toward mathematics. The development and stability of such factors, and their effect upon individual mathematical problem solving will be identified and compared.

This project is part of a three-year longitudinal study and is proceeding on schedule. Sixth-grade students who differ in spatial ability or confidence have been identified and tested, interview procedures have been developed and refined, and a substantial amount of data has been gathered. The data have been organized and analysis has begun. The funding of this continuing grant provides for the remaining data collection and analyses.

Assessing and interviewing these students over the three-year period will provide extensive information about the relationship of spatial visualization and mathematics confidence to mathematical problem solving and the participation of women in mathematics-oriented careers. Both sexes are being studied to determine what factors are related to decisions by females and males to continue their study of mathematics.

AMOUNT: $260,822*
AWARDED: 09-28-78
TERMINATES: 08-31-82

AWARD NUMBER: SED78-17330

PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades 6-8
DESCRIPTORS: Sex Differences; Mathematics; Visual Perception; Cognitive Processes; Longitudinal Studies; Research Projects; Problem Solving; Females; Mathematics Anxiety

*Cumulative amount. Fiscal Year 1981 award: $30,732.

Classroom Processes, Sex Differences, and Autonomous Learning Behaviors in Mathematics

Elizabeth Fennema
University of Wisconsin
School of Education
Department of Curriculum and Instruction
225 N. Mills Street
Madison, WI 53706

The major purpose of the study is to identify classroom processes that lead to inequities for females in mathematics education. The most significant difference that has been observed between male and female performance in mathematics is the rate and extent to which autonomous behavior is exhibited in solving higher order tasks (that is, those which go beyond rote learning). A number of studies indicate that there are many differences in the way teachers treat male and female students in their elementary classrooms, such as in the number of contacts, the frequency of praise and criticism, the types of behavior which elicit praise or criticism, and the extent to which questioning behaviors are encouraged. This study will examine these classroom interactions and assess their relationship to the development of autonomous learning behavior. The authors define autonomous learning behavior as (1) willingness to do high level tasks in mathematics, (2) persistence at such tasks, (3) ability to perform such tasks, and (4) confidence in that ability. The study involves pre- and post-measures of autonomous behavior and problem-solving ability as well as detailed observations of classroom interactions and activities. Another phase of the study involves collaboration with students and teachers in and out of the classrooms to try to identify those interactions which may be most critical.

AMOUNT: $197,640
AWARDED: 06-15-81
TERMINATES: 08-31-83

AWARD NUMBER: SED81-09077

PROGRAM: Research in Science Education

DISCIPLINE: Mathematics Education
TARGET AUDIENCE: Grades K-8
DESCRIPTORS: Sex Differences; Sex Bias; Longitudinal Studies; Mathematics Instruction; Classroom Techniques; Student Teacher Relationship; Females; Males; Cognitive Processes; Performance Factors; Student Attitudes; Learning Motivation; Observation; Interaction; Autonomous Learning Behavior

High School Students' Genetics Problem-Solving Strategies and Knowledge

James H. Stewart
University of Wisconsin
School of Education
Department of Curriculum and Instruction
Madison, WI 53706

A descriptive study of ninth and tenth grade students' learning and problem solving in genetics will be conducted. The study is based upon the view that a major factor influencing meaningful problem solutions is the context-relevant conceptual knowledge of the problem solver. The central question addressed is "How does genetics knowledge in long-term memory influence problem-solving strategies employed by students when solving a variety of types of genetics problems?" The answer to this and related questions will be obtained from interviews where subjects are asked to solve genetics problems while "thinking aloud." This procedure has proved to be highly successful in physics and mathematics problem-solving studies. It is expected that knowledge gained from this research will have utility in increasing the quality of high school genetics instruction.

AMOUNT: $116,598
AWARDED: 04-01-81
TERMINATES: 12-31-83

AWARD NUMBER: SED80-22912

PROGRAM: Research in Science Education

DISCIPLINE: Genetics/Life & Medical Sciences; Problem Solving/Education
TARGET AUDIENCE: Grades 9-12
DESCRIPTORS: Genetics; Problem Solving; Cognitive Processes; Information Utilization; Learning; Conceptual Knowledge

Section III

Fiscal Year 1980
and Earlier Years' Awards

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

DEVELOPMENT IN SCIENCE EDUCATION

Scientist-in-Residence in Eskimo/Indian High Schools **A**

Raymond P. Bailey
University of Alaska
Fairbanks, Alaska 99701

Development of a Mobile Spectroscopy Laboratory **B**

T.D. Roberts
University of Arkansas
Fayetteville, Arkansas 72701

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

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

Career-Oriented Degree Programs in the Mathematical Sciences with Emphasis on Practical Experience **D**

Jerome Spanier
Claremont University Center
Claremont, California 91711

Learner-Controlled Instructional Strategies: An Empirical Investigation **E**

M. David Merrill
Courseware, Inc.
9820 Willow Creek Road
San Diego, California 92131

Exhibit Development Including a Linguistic Display Area **F**

Robert Semper
The Exploratorium
3601 Lyon Street
San Francisco, California 94123

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

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

Development of a Coherent Series of Participatory Exhibits for the Palace of Arts and Science Foundation Exploratorium in San Francisco — A

Frank Oppenheimer
Palace of Arts & Science Foundation
San Francisco, California 94123

ComputerTown, USA - Bringing Computer Literacy to the Entire Community — B

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

Development of Instructional Modules on the Environment — C

John J. Holleman
Peralta Community College District
Oakland, California 94610

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

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

Mathematics Network Curriculum Project for Middle School Teachers and Students — E

Jose E. Gutierrez
San Francisco State University
1640 Holloway Avenue
San Francisco, California 94132

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

Patrick Suppes
Stanford University
Stanford, California 94305

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

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

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

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

Activity-Based Education Programs for Small- and Medium-Size Planetariums **B**

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

Development of Pilot Astronomy Activities for Informal Learning **C**

Robert Karplus
University of California/Berkeley
Berkeley, California 94720

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

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

Materials and Strategies to Improve Women's Access to Scientific Careers **E**

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

Outdoor Biology Instructional Strategies (OBIS) **F**

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

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

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

Development of Reasoning Skills in Early Adolescence **A**

Alfred M. Bork
University of California/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

Role Models for Adolescent Girls in Science and Mathematics **C**

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

An Urban Extension Service Model **D**

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

Visual Geometry and Mathematics Cognition for Beginning College Science Students **E**

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

An Instructional Model in Human Genetics for High School Students **F**

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

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

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

Innovations: The Social Consequences of Science and Technology **A**

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

Digital System Educational Materials (DISEM Project) **B**

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

Quantitative Understanding to Enhance Social Science Teaching **C**

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

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

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

Development of Problem Solving Skills in Physics/ Electrostatics **E**

Neil Ashby
University of Colorado/Boulder
Boulder, Colorado 80309

Personal Computers and Cross-Age Instruction **F**

Marc Swadener
University of Colorado/Boulder
School of Education
Boulder, Colorado 80309

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

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

A World Model for Undergraduate College Classroom Use **A**

Barry B. Hughes
University of Denver
Graduate School of International Studies
University Park
Denver, Colorado 80210

Secondary School Course in Applications of Mathematics to Science **B**

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

Undergraduate Education Improvement in Political Science: Innovation in Instructional Materials **C**

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

Outlines in Microbiology for Community and Junior Colleges **D**

Helen L. Bishop
American Society for Microbiology
1913 Eye Street, NW
Washington, DC 20006

Teaching Materials in Microbiology **E**

Helen L. Bishop
American Society for Microbiology
1913 Eye Street, NW
Washington, DC 20006

Teaching Materials in Microbiology for Community and Junior Colleges **F**

Helen L. Bishop
American Society for Microbiology
1913 Eye Street, NW
Washington, DC 20006

Teaching and Learning in Graduate Geography **G**

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

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

A

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

Conservation Classroom Program (Advanced)

B

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

Individualized Science Instructional System

C

Ernest Burkman
Florida State University
Tallahassee, Florida 32306

Instruction for Problem Solving Using the Microcomputer in High School Mathematics

D

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

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

E

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

F

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

A Prototype System to Deliver Continuing Education to Engineers

G

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

Development of an Interactive Conversational Computer Model for Linear Programming — A

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

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

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

Family-Involving Science Education for Elementary School Children — C

Michael E. Browne
University of Idaho
Moscow, Idaho 83843

Space-Centered Activity Kit for Junior High Science Instruction — D

Thomas C. Campbell
Illinois Central College
Peoria, Illinois 61635

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

Raymond G. Wilson
Illinois Wesleyan University
Bloomington, Illinois 61701

Interactive Science Museum Exhibits for Preschool Children — F

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 — G

Mark Pinsky
Northwestern University
Evanston, Illinois 60201

Arithmetic and Its Applications **A**

Zalman Usiskin
University of Chicago
Chicago, Illinois 60637

Survey of Recent East European Literature in School and College Mathematics **B**

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

Prototype Microcomputer Courseware for Teaching High School Algebra **C**

Sharon Dugdale
University of Illinois
Urbana, Illinois 61801

Demo-Graphics: Teaching Population Dynamics in a Multidisciplinary 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

Engineering Education Materials for Computer Aided Manufacturing (ECAM) — B

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

CONDUIT: Consortium for the Dissemination of Computer-Based Curricular Materials — C

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

Use of Microcomputers for Learning Science — D

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

Computer-Assisted Data Analysis — E

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

Educational Modules Development for the Nuclear Fuel Cycle — F

N. Dean Eckoff
Kansas State University
Manhattan, Kansas 66506

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

Walter S. Smith
University of Kansas
Lawrence, Kansas 66054

Demonstrations in Experimental Psychology for Junior High Schools — A

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

Graphic Techniques for Teaching Statistical Concepts and Procedures — B

Marshall J. Graney
Wichita State University
Wichita, Kansas 67208

Developing Science Curriculum Units Using the Teams-Games-Tournaments Instructional Process — C

John H. Hollifield
Johns Hopkins University
Center for Social Organization of Schools
Charles & 34th Streets
Baltimore, Maryland 21218

Dissemination of Logo-Based Educational Research — D

Wallace Feurzeig
Bolt, Beranek & Newman, Inc.
Cambridge, Massachusetts 02101

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

Brice Carnahan
CACHE Corporation
77 Massachusetts Avenue
Cambridge, Massachusetts 02139

Technology and the Individual - A School TV Series for Adolescents — F

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

Instructional Modules in Applied Mathematics in Higher Education (UMAP) — G

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

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

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

Administrative Activities Related to NSF-Supported Curriculum Materials **B**

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

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

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

Psychoacoustic Demonstration Tapes **D**

David M. Green
Harvard University
Cambridge, Massachusetts 02138

Conversion of Text to Speech for Computer-Aided Instruction **E**

Jonathan Allen
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

A Model Program for Continuing Education in Chemical Engineering **F**

Karen C. Cohen
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

Interest Worlds: Precollege Mathematics in a Computer Culture **G**

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

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

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

The Modular Course in Electronic Instrumentation (ME) Final Phase — B

Robert F. Tinker
Technical Education Research Centers
575 Technology Square
Cambridge, Massachusetts 02139

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

Richard D. Konicek
University of Massachusetts-Amherst
Amherst, Massachusetts 01003

The Worcester Polytechnic Institute Plan — D

William R. Grogan
Worcester Polytechnic Institute
Worcester, Massachusetts 01609

Development of Science Materials for Early Adolescent Minority Students — E

Claudia B. Douglass
Central Michigan University
Mt. Pleasant, Michigan 48559

Support Centers for Microcomputer Applications in Science Education — F

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

Instruction Materials and Delivery Systems for an Undergraduate Curriculum in Pest Management for Plant Protection — G

D.L. Armstrong
Fred H. Tschirley
Michigan State University
East Lansing, Michigan 48824

Impact of Microcomputers on Teaching Math and Science to Junior High School Students — A

Herman D. Hughes
Michigan State University
East Lansing, Michigan 48824

Problem-Oriented College Physics Instruction — B

Peter Signell
Michigan State University
East Lansing, Michigan 48824

Problem-Oriented Physics Instruction — C

Peter Signell
Michigan State University
East Lansing, Michigan 48824

Adaptable Microcomputer Graphics for Undergraduate Life Science Instruction — D

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

Curricular Materials in Computer-Aided Ship Design — E

John Woodward
University of Michigan
Department of Naval Architecture
Ann Arbor, Michigan 48109

Instructional Materials for Computer Literacy — F

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

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

Lynn Arthur Steen
St. Olaf College
Northfield, Minnesota 55057

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

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

High School Minicourse on Chronobiology **B**

Franz Halberg
University of Minnesota
Minneapolis, Minnesota 55455

Development of a General Engineering Technician Curriculum **C**

Donald R. Mowery
Junior College District of St. Louis
St. Louis, Missouri 63110

The Preparation of Supplemental Instructional Units Based on Current Crustal Research, Grades 8-10 **D**

Edward C. Stoever
Southeast Missouri State University
Cape Girardeau, Missouri 63701

Development of Resource Material for Instruction in Use of Underground Space **E**

Truman Stauffer
University of Missouri/Kansas City
Department of Geosciences
Kansas City, Missouri 64110

Inventory of Computing Activities and Related Degree Programs in U.S. Higher Education **F**

John W. Hamblen
University of Missouri/Rolla
Rolla, Missouri 65401

Self-Paced Tutorial Courses for Mineral Science-Metallurgy Departments **G**

L.G. Twidwell
Montana College of Mineral Science & Technology
Butte, Montana 59701

Low Cost Approach to Videodisc Education **A**

Robert G. Fuller
University of Nebraska
Lincoln, Nebraska 68508

Diagnostic and Instructional Services for Undergraduate Students of Statistics **B**

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

New Undergraduate Engineering Materials--Computer Models in the Context of Competing Social Values **C**

John M. Mulvey
Princeton University
Princeton, New Jersey 08540

Development of Laboratory and Lecture Materials for Oceanography Teaching **D**

Harvey M. Sachs
Princeton University
Princeton, New Jersey 08540

Computer Storytelling Mathematics for Pueblo Indian Upper-Elementary Level Students **E**

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

Tutorial Review Articles to Update Collegiate Physics Instruction **F**

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 **G**

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 **A**

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 **B**

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) **C**

Samuel Devons
Barnard College
New York, New York 10027

Development of Instructional Films in Ethology--"Behavior of the Ring Dove" **D**

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

Professional Competencies Development in the Undergraduate Engineering Curriculum **E**

Jean LeMee
Cooper Union--School of Engineering
51 Astor Place
New York, New York 10003

On Using Program Verifiers in Elementary Computer Programming Instruction **F**

Robert L. Constable
Cornell University
Ithaca, New York 14850

Microcomputer Courseware to Develop Insight into Arithmetic Using Perceivable Algorithms **G**

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

Validation of the Continuing Education Achievement of Professional Engineers — A

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

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

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

Development of a Cooperative Graduate Program in Engineering and Public Administration — C

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

A Computer Based Annotated List of Laboratory Experiments in College Chemistry — D

Stanley C. Bunce
Rensselaer Polytechnic Institute
Troy, New York 12181

Master of Science Degree in Applied Mathematics — E

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

Improving Spatial Skills in Pre-College Mathematics Through Computer Graphics — F

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

Computer Graphics in Engineering Education — G

Michael Wozny
Rensselaer Polytechnic Institute
Troy, New York 12181

Development of Selected Undergraduate Course Materials in Applied Mathematical Modeling **A**

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

Modular Materials on Socio-Technological Problems and Issues **B**

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

Self-Instructional In-Service Program in Science Careers: Teachers of Grades 4-9 **C**

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 **D**

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

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

William H. Kraus
Wittenberg University
Springfield, Ohio 45501

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

Richard V. Andree
University of Oklahoma
Norman, Oklahoma 73069

Pre-College Science Education Materials on Mount Saint Helens' 1980 Eruption **G**

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

Interdisciplinary Master's Programs in Building Studies **A**

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

Computer Graphics in a High School Mathematics Laboratory **B**

John H. Staib
Drexel University
Philadelphia, Pennsylvania 19104

XPRT-Experimental Partnership for the Reorientation of Teaching **C**

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

A Model Computer-Based Interpretive System for Science Museums **D**

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

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

William E. Schiesser
Lehigh University
Bethlehem, Pennsylvania 18105

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

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

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

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

A

Educational Modules for Materials Science and Engineering (EMMSE)

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

B

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

Gerald J. Porter
University of Pennsylvania
Philadelphia, Pennsylvania 19104

C

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

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

D

Development of Curriculum and Instructional Material in Applied Sociology

Burkart Holzner
University of Pittsburgh
Pittsburgh, Pennsylvania 15260

E

An Alternative in Higher Education in the Mathematical Sciences

Clayton V. Aucoin
Clemson University
Clemson, South Carolina 29631

F

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, Tennessee 38104

G

High School Computer Science Education

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

An Associate Degree Curriculum in Solar Engineering Technology - Phase II **A**

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

Curriculum Analysis, Student Interrogation and Information System **B**

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) **C**

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

Using Non-Formal Contexts to Teach Children Science **D**

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

Continuing Education and College Instructional Modules in Chemical Engineering **E**

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

Computer-Oriented Teaching Modules in Geochemistry **F**

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

Extension of TVCAI Project to Include Demonstration of Intelligent Videodisc System **G**

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

An Intelligent Videodisc System: Evaluation in Developmental Biology — A

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

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

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

Computer Literacy Guides for Elementary and Junior High Schools — C

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

Graphing in High School Level Algebra and Trigonometry for Adults — D

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

Scientific Instrumentation Information Network and Curricula (Project SIINC) — E

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

Educating Prospective Engineers in Technology-Related Public Policy — F

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

Physical Processes in Terrestrial and Aquatic Ecosystems — G

Douglas G. Chapman
University of Washington
Seattle, Washington 98195

Preparing Academically Disadvantaged Students in Sciences Through Concept-Based Modules — A

Lillian C. McDermott
University of Washington
Seattle, Washington 98195

Service-Oriented Options in Mathematics — B

Donald Bushaw
Washington State University
Pullman, Washington 99163

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

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

Development of Video Systems for Teaching Meteorology — D

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

Sociotechnical Systems Design Program — E

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 — F

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

Workshop on Continuing Education for Industry, Professional Societies and Universities — G

Sonja S. Marchand
California State University
Northridge, California 91330

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

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 — B

Martha Maxwell
University of California/Berkeley
Berkeley, California 94720

Evaluation of Short Course Method of Instruction for Professionals in Engineering — C

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 — D

Bernard N. Samers
Cooper and Company
Stamford, Connecticut 06905

Multimedia User-Controlled Modes of Continuing Education in Chemistry — E

Moses Passer
American Chemical Society
Washington, DC 20036

University Consortium to Increase National Effectiveness of Continuing Education for Engineers — F

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 — G

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

Measurement for Learning Outcomes in Continuing Education for Scientists and Engineers — A

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

Pilot Study of Continuing Environmental Health Education for Scientists and Engineers — B

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

New Directions in Continuing Education: Comparative Perspectives of Decision-Making and R & D Personnel — C

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

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

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 — E

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

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

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 — G

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 — A

Lawrence G. Welling
Battelle Memorial Institute
Columbus, Ohio 43201

Behavior Anchored Scales - A Method of Identifying Continuing Education Needs of Engineers — B

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

Relationships Among Individual Motivation, Work Environment and Updating in Engineering — C

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

A Model Continuing Education Needs Assessment/Response System in Science and Engineering — D

John W. Zemp
Medical University of South Carolina
Charleston, South Carolina 29403

Continuing Education for Employed Clinical Engineers — E

Cesar A. Caceres
AAMI Foundation
Arlington, Virginia 22209

CEXY: A Tool for Assessing Regional CE Needs in XY Coordinates — F

Robert Ehrlich
George Mason University
Fairfax, Virginia 22030

First World Conference on Continuing Engineering Education — G

John P. Klus
American Society for Engineering Education
Continuing Education Studies Division
432 N. Lake Street
Madison, Wisconsin 53706

Assessment of Scientists/Engineers' Continuing Education Needs in Small, Geographically-Dispersed Industries **A**

W. Sam Adams
University of Wisconsin
Oshkosh, Wisconsin 54901

Study of CLE Methodologies Potentially Transferable to CESE **B**

Robert J. Smith
Department of Engineering & Applied Science
University of Wisconsin-Ext.
Madison, Wisconsin 53706

ASSESSMENT OF SCIENCE EDUCATION IN THE TWO-YEAR COLLEGE

Local Assessment of Science Education in the Two-Year College **C**

Lena Dexter
James H. Faulkner State Junior College
Bay Minette, Alabama 36507

Local Assessment of Science Education in the Two-Year College **D**

G. Elliott Tyler
John C. Calhoun State Community College
Decatur, Alabama 35602

Assessment of Mathematics Program at S.D. Bishop State Junior College **E**

Roy Daigle
S.D. Bishop State Junior College
351 North Broad Street
Mobile, Alabama 36603

Local Assessment of Science Education in the Two-Year College **F**

Janan M. Hayes
American River College
Los Rios Community College District
4700 College Oak Drive
Sacramento, California 95841

Appraisal of Current Science Education at a Developing Community College **G**

Richard A. Dodge
Cerro Coso Community College
College Heights Boulevard
Ridgecrest, California 93555

Science Education in the Non-Campus College: A Needs Assessment — A

Jack McGill
Coastline Community College
Coast Community College District
10231 Slater Avenue
Fountain Valley, California 92708

An Investigation of the Applicability of Computer-Assisted Instruction in the Social Science Division of Monterey Peninsula College — B

Bela Banathy
Monterey Peninsula College
Monterey, California 93490

The Next Step: A Computer Facilites Master Plan for Saddleback — C

Dave Campbell
Saddleback College
28000 Marguerite Parkway
Mission Viejo, California 92692

Conference on the Assessment of Science Education in the Two-Year College — D

Richard E. Wilson
American Association of Community & Junior Colleges
Washington, DC 20036

Local Assessment of Science Education in the Two-Year College — E

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 — F

Martha T. Hatcher
Gainesville Junior College
Gainesville, Georgia 30501

Assessment of a Change to a Modularized Approach to Science Instruction — G

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 **A**

Thomas C. Campbell
Illinois Central College
Box 2400
East Peoria, Illinois 61635

Triton's Comprehensive Self-Assessment of Science Education **B**

William Collien
Triton College
2000 Fifth Avenue
River Grove, Illinois 60171

Local Assessment of Science Education in the Two-Year College **C**

Robert Ernst
Kirkwood Community College
P.O. Box 2068
Cedar Rapids, Iowa 52406

Assessment of Science Education at Cowley County Community College **D**

Mike Watters
Cowley County Community College
125 South Second Street
Arkansas City, Kansas 67005

Local Assessment of Science Education in the Two-Year College **E**

William J. Lembeck
Louisiana State University
Eunice, Louisiana 70535

Local Assessment of Science Education in the Two-Year College **F**

Robert L. Sawyer
Catonsville Community College
800 South Rolling Road
Catonsville, Maryland 21228

Local Assessment of Science Education in the Two-Year College **G**

William F. Hibschman
Harford Community College
401 Thomas Run Road
Bel Air, Maryland 21014

Study of Science Education in Two-Year Colleges **A**

Lance Hodes
Westat, Inc.
Rockville, Maryland 20852

Analysis of Student Skills, Needs and Goals **B**

Frank E. Truesdale
Bunker Hill Community College
Rutherford Avenue
Charlestown, Massachusetts 02129

Students, Curricula and Laboratories - A Needs Assessment **C**

Malcolm Nason
North Shore Community College
Beverly, Massachusetts 01915

Chemistry and Biology Laboratory Facilities and Curricula **D**

Edward Eagan
Quinsigamond Community College
670 West Boylston Street
Worcester, Massachusetts 01606

Suomi College Science Education Assessment Project **E**

Donald Wanhala
Suomi College
Hancock, Michigan 49930

Local Assessment of Science Education in the Two-Year College **F**

Charles Allbee
Burlington County College
Pemberton-Brown Mills Road
Pemberton, New Jersey 08068

Local Assessment of Science Education in the Two-Year College **G**

Donald Fama
Cayuga County Community College
Auburn, New York 13021

Assessing the Biological Science Needs of Community College Freshman **A**

Donald S. Emmeluth
Fulton-Montgomery Community College
Route 67
Johnstown, New York 12095

Local Assessment of Science Education in the Two-Year College **B**

John T. Collins
John N. Sarrubbo
Westchester Community College
75 Grasslands Roads
Walhalla, New York 10595

Local Assessment of Science Education in the Two-Year College **C**

Bobbie Jean Nicholson
Brevard College
Brevard, North Carolina 28712

Assessment of Placement Needs of Students **D**

Donna E. Scott
Southeastern Community College
Whiteville, North Carolina 28472

Local Assessment of Science Education in the Two-Year College **E**

Timothy I. Edwards
Wake Technical Institute
Route 10 Box 200
Raleigh, North Carolina 27605

Local Assessment of Science Education in the Two-Year College **F**

Everett G. House
Nashville State Technical Institute
120 White Bridge Road
Nashville, Tennessee 37209

Local Assessment of Science Education in the Two-Year College **G**

Edward A. Ochoa
El Paso County Community College
6601 Dyer Street
El Paso, Texas 79904

Local Assessment of Science Education in the Two-Year College. A

Clifford D. Miller
Mountain View College
4849 W. Illinois
Dallas, Texas 75211

Local Assessment of Science Education in the Two-Year College B

Martha W. Sellars
Northern Virginia Community College
8333 Little River Turnpike
Annandale, Virginia 22003

Local Assessment of Science Education in the Two-Year College C

George G. West
Northern Virginia Community College
Alexandria, Virginia 22311

Local Assessment of Science Education in the Two-Year College D

John S. DiYorio
Wytheville Community College
1000 East Main Street
Wytheville, Virginia 24382

Evaluation and Needs Assessment for Mathematics Education E

William J. Bonini
Western Wyoming Community College
Box 428
Rock Springs, Wyoming 82901

RESEARCH IN SCIENCE EDUCATION

An Inquiry Into the Graduate Training Needs of Two-Year College Teachers of Mathematics F

Robert McKelvey
Rocky Mountain Mathematics Consortium
c/o Arizona State University
Tempe, Arizona 85281

Factors Influencing Mathematics Participation of Highly Able Mexican-American Adolescents G

Linda M. Oldaker
Arizona State University
Tempe, Arizona 85281

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

Morris Sica
California State University
Fullerton, California 92634

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

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

A Study of Science Instructional Programs in Two-Year Colleges — C

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

A Longitudinal Study of Women and Minorities in Science and Engineering — D

Rita A. Scherrei
Higher Education Research Institute
924 Westwood Boulevard, Suite 835
Los Angeles, California 90024

Problem-Solving Processes of Upper Elementary and Junior High School Mathematics Students — E

Nicholas A. Branca
San Diego State University
5300 Campanile Drive
San Diego, California 92182

The Role of Cognitive Style in the Learning of Mathematics: A Research Study — F

Douglas B. McLeod
San Diego State University
San Diego, California 92182

Expert-Novice Differences in Computer Science Problem Comprehension: Studies in Knowledge Organization — G

Michael E. Atwood
Science Applications, Inc.
1200 Prospect Street
La Jolla, California 92038

Learning Science in Bilingual Classrooms: Interaction and Social Status **A**

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

Sex Differences in Perceptual, Motor and Cognitive Skills as Related to Mathematics and Science **B**

Karl H. Pribram
Department of Psychiatry
Stanford University
Stanford, California 94305

Early Adolescent Student Reasoning in Mathematics **C**

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

Computer-Assisted Science Exhibits **D**

W.M. Laetsch
Lawrence Hall of Science
University of California/Berkeley
Berkeley, California 94720

A Research Evaluation of Scientific Reasoning Ability in Naturalistic and Laboratory Settings **E**

W.M. Laetsch
Lawrence Hall of Science
University of California/Berkeley
Berkeley, California 94720

Factors Which Influence Scientific Reasoning Among Adolescents in Natural Settings **F**

Marcia C. Linn
Campus Research Office
M-11 Wheeler Hall
University of California/Berkeley
Berkeley, California 94720

Problem Solving in Physics: Models, Experiments, and Instruction **G**

Frederick Reif
University of California/Berkeley
Berkeley, California 94720

Improving Students' Comprehension of Science Prose **A**

Richard E. Mayer
University of California/Santa Barbara
Santa Barbara, California 93106

Increasing the Meaningfulness of Technical Information for Novices **B**

Richard E. Mayer
University of California/Santa Barbara
Santa Barbara, California 93106

The Status of Middle School/Junior High School Science **C**

Paul DeHart Hurd
Biological Sciences Curriculum Study Company
P.O. Box 930
Boulder, Colorado 80306

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

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

Research in Science Education: New Questions, New Directions **E**

James T. Robinson
Biological Sciences Curriculum Study Company
Center for Educational Research and Evaluation
P.O. Box 930
Boulder, Colorado 80306

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

Richard R. Tolman
Biological Sciences Curriculum Study Company
Center for Educational Research and Evaluation
P.O. Box 930
Boulder, Colorado 80306

Social Studies/Social Science Education: Priorities, Practices and Needs **G**

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

A

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

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

B

Project Synthesis: An Interpretive Consolidation of Research Identifying Needs in Precollege Science Education

Norris Harms
University of Colorado
Boulder, Colorado 80309

C

Investigation of Critical Barriers to the Understanding of Science

David Hawkins
University of Colorado
Mountain View Center for Environmental Education
Campus Box B-19
Boulder, Colorado 80309

D

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

Alma E. Lantz
University of Denver
Denver Research Institute
Denver, Colorado 80210

E

The Relationship of Learning Styles to the Continuing Education of Graduate Engineers and Scientists

Bernard N. Samers
Cooper and Company
Operations Research
112 Hoyt Street
Stamford, Connecticut 06905

F

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

G

Support of the Planning Phase of the 1980 International Congress of Mathematics Education

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

Effects of Elaboration Procedures on Learning and Retention of Scientific Principles A

Robert M. Gagne
Florida State University
414 Education Building
Tallahassee, Florida 32306

Science Understanding in Adults Through Television B

Robert M. Gagne
Florida State University
414 Education Building
Tallahassee, Florida 32306

The Microcomputer and Problem Solving Processes in Middle School Mathematics C

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

The Use of Heuristics in Problem Solving: An Expository Study D

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

An Analysis of Research on Mathematical Abilities E

Jeremy Kilpatrick
University of Georgia
Athens, Georgia 32609

Analysis of the Child's Construction of Whole Numbers F

Leslie P. Steffe
University of Georgia
Department of Mathematics Education
Athens, Georgia 30602

Learning and Teaching Whole Numbers: An Interdisciplinary Study of an Experimental Model G

Leslie P. Steffe
University of Georgia
Department of Mathematics Education
Athens, Georgia 30602

A

The Role of Manipulative Aids in the Learning of Rational Numbers

Merlyn J. Behr
Northern Illinois University
DeKalb, Illinois 60115

B

Research Studies on the Scientific Literacy of the Attentive Public

Jon D. Miller
Northern Illinois University
The Graduate School
DeKalb, Illinois 60115

C

A Review of Research of Solving Routine Problems in Pre-College Mathematics

Larry Sowder
Northern Illinois University
DeKalb, Illinois 60115

D

Applied Problem-Solving in Middle-School Mathematics

Richard Lesh
Northwestern University
Evanston, Illinois 60201

E

The Feasibility of Using the National Assessment Science Data for Secondary Analysis

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

F

Increasing the Productivity of Science Learning in Early Adolescents

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

G

A Meta-Analysis of Productive Factors in Science Learning in Grades 6 Through 12

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

Detailed Description of Mathematical Behaviors That Demonstrate Understanding — A

Robert B. Davis
University of Illinois/Urbana
Curriculum Laboratory
1210 W. Springfield Avenue
Urbana, Illinois 61801

Research on Thought Processes Used in 7th to 10th Grade Mathematics — B

Robert B. Davis
University of Illinois/Urbana
Curriculum Laboratory
1210 W. Springfield Avenue
Urbana, Illinois 61801

A Synthesis of Findings on Sex Differences in Science Education Research — C

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

Effects of Topic-Specific Instructional Variables in Eighth Grade Mathematics — D

Kenneth J. Travers
University of Illinois/Urbana
395 Education
Urbana, Illinois 61801

Facilitating Problem Solving in High School Chemistry — E

Dorothy L. Gabel
Indiana University
School of Education, Room 204
Bloomington, Indiana 47401

Analysis and Synthesis of Mathematical Problem-Solving Processes of Early Adolescents — F

Gerald Kulm
Purdue University
West Lafayette, Indiana 47907

Improving Access and Guidance in Engineering: Research into Contributing Factors — G

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

Calculator Use and Problem-Solving Strategies of Early Adolescents — A

Grayson H. Wheatley
Purdue University
West Lafayette, Indiana 47907

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

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

Measurement and Analysis of Patterns of Logical Thinking — C

Frederick P. DeLuca
Iowa State University
Ames, Iowa 50011

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

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

Determining the Impact of a National Educational Computing Conference — E

Theodore J. Sjoerdsma
University of Iowa
Department of Computer Science
Iowa City, Iowa 52242

The Representation and Use of Complex Knowledge: Knowing and Reasoning in Physics — F

Bert F. Green, Jr.
Johns Hopkins University
School of Arts and Sciences
Charles and 34th Streets
Baltimore, Maryland 21218

Research on Gifted Children in Accelerated Teaching Programs in Physics, Chemistry, and Mathematics — G

Julian C. Stanley
Johns Hopkins University
Baltimore, Maryland 21218

A

An Investigation on the Effect of Field Trips on Science Learning

John H. Falk
Smithsonian Institution
Chesapeake Bay Center for Environmental Studies
Edgewater, Maryland 21037

B

An Inquiry into the Nature and Goals of Scientific Literacy

Stephen R. Graubard
American Academy of Arts and Sciences
Editorial Offices
136 Irving Street
Cambridge, Massachusetts 02138

C

Development and Facilitation of Cognitive Representation in Estimation Problems

Alexander W. Siegel
Education Development Center, Inc.
55 Chapel Street
Newton, Massachusetts 02160

D

Conceptual Change in Children and in Adult Scientists

Susan Carey
Massachusetts Institute of Technology
77 Massachusetts Avenue
Cambridge, Massachusetts 02139

E

A Research Study of Computer-Based Tutoring of Mathematical and Scientific Knowledge

Ira P. Goldstein
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

F

Assessment and Documentation of a Children's Computer Laboratory

Seymour A. Papert
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

G

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, Massachusetts 02139

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

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

Identifying Different Levels of Understanding Attained by Physics Students — B

Frederick W. Byron, Jr.
University of Massachusetts-Amherst
Amherst, Massachusetts 01003

Program of Applied Research on Scientific Reasoning Processes — C

Jack Lochhead
University of Massachusetts-Amherst
Amherst, Massachusetts 01003

The Ecology of Failure in Ninth Grade General Mathematics: An Ethnographic, Experimental, and Psychometric Inquiry — D

Perry E. Lanier
Michigan State University
East Lansing, Michigan 48824

Planning and Teaching Middle School Science — E

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

Statistical Analysis of Research Results in College Science Teaching — F

James A. Kulik
University of Michigan
Center for Research on Learning and Teaching
109 E. Madison Street
Ann Arbor, Michigan 48109

Synthesis of Research on Individualized Science Teaching in Secondary Schools — G

James A. Kulik
University of Michigan
Center for Research on Learning and Teaching
109 E. Madison Street
Ann Arbor, Michigan 48109

Computer Awareness and Literacy of Adolescent and Early Adolescent Students: An Empirical Assessment **A**

Daniel L. Klassen
Minnesota Educational Computing Consortium
2520 Broadway Drive
St. Paul, Minnesota 55113

A Study of Computer Use and Literacy in Science Education **B**

Daniel L. Klassen
Minnesota Educational Computing Consortium
2520 Broadway Drive
St. Paul, Minnesota 55113

Scientific Reasoning: Cognitive Processes in Using and Extending Problem-Solving Skills **C**

Paul E. Johnson
University of Minnesota
Minneapolis, Minnesota 55455

Survey of Science Understanding and Attitudes **D**

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

Inventory of Computing Activities and Related Degree Programs in U.S. Higher Education-Dissemination **E**

John W. Hamblen
University of Missouri
325 Mathematics-Computer Science Building
Rolla, Missouri 65401

Effects of Processing Style on Problem Solving in Mathematics **F**

David E. Weldon
Washington University
St. Louis, Missouri 63130

Psychological Problem Space and Motivation in Adolescent Learning: A Study of Information Processing **G**

Donald W. McCurdy
University of Nebraska
Department of Secondary Education
Lincoln, Nebraska 68588

Geometric Thinking Among Adolescents in Inner City Schools **A**

Dorothy Geddes
Brooklyn College of City University of New York
Bedford Avenue and Avenue H
Brooklyn, New York 11210

An Investigation of the Structure and Dynamics of Classroom Communication of Science **B**

Jay L. Lemke
Brooklyn College of City University of New York
Bedford Avenue and Avenue H
Brooklyn, New York 11210

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

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

Strategies and Structures in Understanding Geometry **D**

Harry Beilin
City University of New York
Graduate School & University Center
33 West 42nd Street
New York, New York 10036

Strategies for Learning Emphasizing the Nature and Role of Concepts **E**

Joseph D. Novak
Cornell University
Department of Education and Biological Science
Ithaca, New York 14853

Expert and Novice Mathematical Problem Solving **F**

Alan H. Schoenfeld
Hamilton College
Clinton, New York 13323

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

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

The Relationship Between Continuing Education and Career Development of Scientists and Engineers — A

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

Elementary School Science Processes Program: Meta-Analysis of Evaluation Studies — B

Theodore A. Bredderman
State University of New York/Albany
Albany, New York 12222

Wait Time and Questioning Skills of Middle School Science Teachers — C

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

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

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

School, Family, and Individual Influences on Commitment to and Learning of Science Among Adolescent Students — E

Ronald D. Simpson
North Carolina State University
326 Poe Hall
Raleigh, North Carolina 27650

Determinants of Student Entry and Performance in the Sciences — F

George H. Dunteman
Research Triangle Institute
Research Triangle Park, North Carolina 27709

Structure of Knowledge and Cognitive Processes in Organic Chemistry — G

John E. Gordon
Kent State University
Kent, Ohio 44242

A Study of Priorities in School Mathematics (PRISM) **A**

Alan Osborne
National Council of Teachers of Mathematics
Ohio State University
Columbus, Ohio 43210

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

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

The Relationship Between Student Attitudes Toward the Science Curriculum and Selected Variables **C**

Thomas M. Haladyna
Education/Development Research Program
Oregon State System of Higher Education
Monmouth, Oregon 97361

Assessing Children's Intellectual Growth in Geometry **D**

William F. Burger
Oregon State University
Corvallis, Oregon 97331

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

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

Factors That Influence the Technical Updating of Engineers **F**

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

Semantics of Arithmetic: Teaching Understanding and Computational Skill Via Computer **G**

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

Cognitive Processes and Knowledge Structures Used in Solving Physics Problems — A

Gordon S. Novak, Jr.
University of Texas
Austin, Texas 78712

Conceptual Understanding of Physics Students and Identification of Influencing Factors — B

James A. Minstrell
Mercer Island School District #400
4160 86th Avenue, SE
Mercer Island, Washington 98040

Computing and Higher Education: Issues and Opportunities — C

Robert G. Gillespie
University of Washington
Seattle, Washington 98195

Investigation of Conceptual Development in the Study of Motion — D

Lillian C. McDermott
Department of Physics
University of Washington
Seattle, Washington 98195

Interpretive Reports of the Second National Assessment in Mathematics — E

Thomas Carpenter
[National Council of Teachers of Mathematics]
University of Wisconsin
Department of Curriculum and Instruction
Madison, Wisconsin 53706

Research on Relationship of Spatial Visualization and Confidence in Male/Female Mathematics Achievement in Grades 6 to 8 — F

Elizabeth Fennema
University of Wisconsin
Department of Curriculum & Instruction
Madison, Wisconsin 53706

Systematic Investigation of the Cognitive Effects of Games on Mathematics Learning — G

John G. Harvey
University of Wisconsin
Madison, Wisconsin 53706

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 . . . **A**

Patrick Suppes
Stanford University
Institute for Mathematical Studies in the Social Sciences
Stanford, California 94305

Underlying Heuristic and Formal Structures of Probabilistic Thought **B**

Michael D. Butler
University of California/Irvine
School of Social Sciences
Irvine, California 92717

The Representation and Learning of Knowledge Structures in Experimental Psychology **C**

Leon Manelis
Illinois State University
Normal, Illinois 61761

The Logical, Mathematical, and Psychological Structure of Counting and of Early Number Concepts **D**

Karen C. Fuson
Northwestern University
Evanston, Illinois 60201

Analysis of the Development of Propositional Reasoning **E**

Rachel Joffe Falmagne
Clark University
950 Main Street
Worcester, Massachusetts 01610

The Development of Applied Scientific Thinking in Children and Adolescents **F**

Robert Louis Selman
Harvard College
Cambridge, Massachusetts 01238

The Role of Preconceptions & Representational Transformations in Understanding Science and Mathematics **G**

Frederick W. Byron, Jr.
University of Massachusetts-Amherst
Amherst, Massachusetts 01003

A

Cognitive Processes and the Structure of Knowledge in Physics and Algebra

Herbert A. Simon
Carnegie-Mellon University
Pittsburgh, Pennsylvania 15213

B

Invention and Understanding in the Acquisition of Computation

Lauren B. Resnick
Learning Research & Development Center
3939 O'Hara Street
Pittsburgh, Pennsylvania 15260

C

Psychology of Equation Solving: An Information Processing Study

L. Ray Carry
University of Texas
Austin, Texas 78712

D

Learning From Science and Mathematics Textbooks: Text Structure, Reading Strategies and Comprehension

James Deese
University of Virginia
Charlottesville, Virginia 22901

Appendix A

Fiscal Year 1981 and Earlier Years' Awards
Principal Investigators by State and Institution

Appendix A
Fiscal Year 1981 and Earlier Years' Awards
Principal Investigators by State and Institution

Appendix B

Principal Investigators

Appendix B
Principal Investigators

Directorate for Science and Engineering Education
National Science Foundation
DIVISION OF SCIENCE EDUCATION DEVELOPMENT AND RESEARCH

ORGANIZATIONAL UNIT & TITLE

Office of Division Director	Name
Acting Division Director	Dr. Robert F. Watson
Professional Assistant	Mrs. Mary Louise Charles
Program Analyst	Mr. Jack Jones
Information Dissemination Assistant	Mrs. Patricia Babb
Acting Administrative Officer	Mrs. Anne Keola
Secretary	Mrs. Jackye Lee

Development in Science Education	
Program Director	Mr. Alexander J. Barton
Program Manager	Dr. Dorothy K. Deringer
Program Manager	Dr. Gregg Edwards
Program Manager	Dr. Raymond J. Hannapel
Program Manager	Dr. Carl J. Naegele
Program Manager	Dr. Mary Ann Ryan
Program Manager	Dr. Harold J. Stolberg
Secretary	Miss Myrtle Lashley
Secretary	Mrs. Mary Jones
*Secretary	Mrs. Mildred Bull
*Secretary	Mrs. Bridget Richardson

Research in Science Education	
Program Director	Dr. Rita Peterson
Program Associate	Dr. Kathleen Fisher
Program Manager	Dr. Douglas McLeod
Program Manager	Mr. Erik D. McWilliams
Program Manager	Dr. Andrew R. Molnar
Secretary	Mrs. Eleanor MacMeekin
Secretary	Mrs. Betty Finch
Secretary	Ms. Hattie Johnson

*Part-time