

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)

\*\*\*\*\*  
 \* Reproductions supplied by EDRS are the best that can be made \*  
 \* from the original document. \*  
 \*\*\*\*\*

ED222394 /

# Source Book of Projects

## Science Education

## Development

## and Research

U.S. DEPARTMENT OF EDUCATION  
NATIONAL INSTITUTE OF EDUCATION  
EDUCATIONAL RESOURCES INFORMATION  
CENTER (ERIC)

This document has been reproduced as received from the person or organization originating it.  
Minor changes have been made to improve reproduction quality.

- Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

*Pat Babb*

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

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 . . . . .	vii
Introduction . . . . .	ix
Using Publication SE 82-80 . . . . .	xi
Section I	
Rotated Title Word Index FY 1981 and Earlier Years' Awards . . . . .	1
Key Word/Phrase Index FY 1981 Awards Only . . . . .	41
Section II	
FY 1981 Awards Project Descriptions and Principal Investigators by State and Institution	
Development in Science Education (DISE) . . . . .	47
Research in Science Education (RISE) . . . . .	108
Section III	
FY 1980 and Earlier Years' Awards Project Titles and Principal Investigators by State and Institution	
Development in Science Education (DISE) . . . . .	149
Research in Science Education (RISE) . . . . .	181
Appendixes	
A. Principal Investigators by State and Institution, FY 1981 and Earlier . . . . .	201
B. Principal Investigators, Alphabetically . . . . .	217
Staff Directory . . . . .	Inside Back Cover

## 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:

- o 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
- o 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:

- o Continuing development and availability of high quality science and engineering instructional materials based on the latest research and technological findings.
- o 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:

- o To assure the rapid movement of current research and technology into instructional materials for undergraduate science and engineering education.
- o To support development and research on the incorporation of computing into science and engineering teaching laboratories and instructional materials.
- o 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

		Page
	An Analysis of Research on Mathematical Abilities	186 F
	A Research Evaluation of Scientific Reasoning Ability in Naturalistic and Laboratory Settings	183 F
	In Intellectual Development and Critical Thinking Ability	Research on Changes 143
	Influencing Mathematics Participation of Highly Able Mexican American Adolescents	Factor 181 G
Modules	Preparing Academically Disadvantaged Students in Sciences Through Concept Based	172 A
	Research on Gifted Children in Accelerated Teaching Programs in Physics, Chemistry, and Mathematics	189 G
	Improving Access and Guidance in Engineering Research into Contributing Factors	188 G
	ization and Confidence to Male Female Mathematics Achievement in Grades 6-8	Research on Relationship of Spatial Visual 144
	ization and Confidence in Male Female Mathematics Achievement in Grades 6-1	Research on Relationship of Spatial Visual 196 F
	Validation of the Continuing Education Achievement of Professional Engineers	166 A
r Graphics	Females' Acquisition of 8th Grade Geometry Concepts via Non-Verbal Microcomputer	64
Differences	Acquisition of Science Literacy In and Out of School: Emphasis on Sex	110
	Invention and Understanding in the Acquisition of Computation	198 B
	Inventory of Computing Activities and Related Degree Programs in U.S. Higher Education	163 F
ination	Inventory of Computing Activities and Related Degree Programs in U.S. Higher Education Dissem	192 F
	Science Activities for Informal Learning (SAIL) (Age 11-14)	61
	Development of Pilot Astronomy Activities for Informal Learning	151 C
amlic	Physical Science Activities in Out of School Settings for Early Adolescents and Their I	150 G
	Sequencing Language and Activities in Teaching High School Chemistry and Physics	135
	Administrative Activities Related to NSF-Supported Curriculum Materials	160 B
	Space-Centered Activity Kit for Junior High Science Instruction	156 D
	Logical Competencies and Activity Selection Patterns in Early Adolescents: A Longitudinal Study	184 D
	Activity-Based Education Programs for Small- and Medium-Size Planetari	151 B
	Adaptable Microcomputer Graphics for Undergraduate Life Science Instru	152 D
	Administration Development of a Coope	166 C
	Graduate Program in Engineering and Public Administrative Activities Related to NSF-Supported Curriculum Material	160 B
	Development of Reasoning Skills in Early Adolescence	48
	Development of Reasoning Skills in Early Adolescence	152 A
	Computer Awareness and Literacy of Adolescent and Early Adolescent Students: An Empirical Assessment	130
	Computer Awareness and Literacy of Adolescent and Early Adolescent Students: An Empirical Assessment	192 A
	Role Models for Adolescent Girls in Science and Math	152 B
	Role Models for Adolescent Girls in Science and Mathematics	152 C
	Psychological Problem Space and Motivation in Adolescent Learning: A Study of Information Processing	192 G
	Development of Science Materials for Early Adolescent Minority Students	161 F
	Computer Awareness and Literacy of Adolescent and Early Adolescent Students: An Empirical Assessment	Comput 130
	Person Commitment to and Learning of Science Among Adolescent Students	School, Family, and Individual Influenc 133
	Computer Awareness and Literacy of Adolescent and Early Adolescent Students: An Empirical Assessment	Comput 192 A
	Person Commitment to and Learning of Science Among Adolescent Students	School, Family, and Individual Influenc 194 F
	Activities in Out of School Settings for Early Adolescents and Their Families	Physical Scien 150 G
	Factors Which Influence Scientific Reasoning Among Adolescents in Natural Settings	F 183 F
	Geometric Thinking Among Adolescents in Inner-City Schools	193 A
	encies and Activity Selection Patterns in Early Adolescents: A Longitudinal Study	Logical Comp 184 D
	ology and the Individual: A School TV Series for Adolescents	Techn 159 F
	Participation of Highly Able Mexican American Adolescents	Factors Influencing Mathemat 181 G
	ing the Productivity of Science Learning in Early Adolescents	Increas 187 F
	Mathematical Problem Solving Processes of Early Adolescents	Analysis and Synthesis o 188 F
	Labor Use and Problem Solving Strategies of Early Adolescents	Calcu 189 A
	Assessing the Development of Science Concepts in Adolescents	A Study of the Use of Time Series Designs for 195 B
	in of Applied Scientific Thinking in Children and Adolescents	The Developme 197 F
	Conceptual Change in Children and in Adult Scientists	190 D
part	An Investigation Into Learning Patterns of Adults in Alternative Modes of Continuing Engineering Education as Com	173 D
	Science Understanding in Adults Through Television	186 B
	in High School Level Algebra and Trigonometry for Adults	Graphing/ 171 D
	Conservation Classroom Program (Advanced)	155 B
	Engineering Education Materials for Computer Aided Manufacturing (ECAM)	158 B
	The Role of Manipulative Aids in the Learning of Rational Numbers	187 A
	Construct Analysis, Manipulative Aids, Representational Systems, and the Learning of Rational Number	120
	Graphing in High School Level Algebra and Trigonometry for Adults	171 D
	Microcomputer Courseware for Teaching High School Algebra	Prototype 157 C
	es and the Structure of Knowledge in Physics and Algebra	Cognitive Proces 198 A
	A Study Comparing Formal Algebraic Representation with Natural Mental Representations	191 A
	Develop Insight into Arithmetic Using Perceivable Algorithms	Microcomputer Courseware to 165 G
	An Alternative in Higher Education in the Mathematical Sciences	169 F
	Investigation Into Learning Patterns of Adults in Alternative Modes of Continuing Engineering Education as Compare	An 173 D
	Effectiveness of Continuing Education: Longitudinal Analysis in Engineering Organizations	Factor: Determining the E 174
Research in Science Educ	Computer Assisted Data Analysis (CADA) for Teaching Bayesian Statistics and Applications for	189 D
	Analysis (Meta-Analysis) of Major Facet of Science Education	185 A
	Analysis and Synthesis of Mathematical Problem Solving Processes of Ea	188 F
dy Adolescent	Analysis of Learning in Geometry	137
	An Information Processing Analysis of Patterns of Logical Thinking	189 C
	Measurement and Analysis of Research on Mathematical Ability	186 F
	An Analysis of Research Results in College Science Teaching	191 F
	Statistical Analysis of Student Skills: Need and Goal	179 B

Rotated Title Index FY 1981 and Earlier Years

		Page
to Instruction in Geometry	<b>Analysis of the Development of Deductive Reasoning, with Applications</b>	127
	<b>Analysis of the Child's Construction of Whole Numbers</b>	186 F
	<b>Analysis of the Development of Propositional Reasoning</b>	197 F
aterials.	<b>Application of Dimensional Analysis to Middle School Mathematics Using Microcomputer and Print Materials</b>	160 C
g of Rational Numbers	<b>Analysis, Manipulative Aids, Representational Systems, and the Learning Curriculum</b>	120
	<b>Analysis, Student Interrogation and Information System</b>	98
	<b>Analysis, Student Interrogation and Information System</b>	170 B
	<b>Computer Assisted Data Analysis</b>	158 F
he National Assessment Science Data for Secondary	<b>Analysis</b>	187 F
E Engineers	<b>Behavior</b>	The Feasibility of Using I
	<b>Anchored Scales - A Method of Identifying Continuing Education Needs of</b>	175 B
	<b>A Computer Based Annotated List of Laboratory Experiments in College Chemistry</b>	166 D
ision of Monterey Peninsula	<b>An Investigation of the Applicability of Computer Assisted Instruction in the Social Science D</b>	177 B
Microcomputer and Print Materials	<b>Application of Dimensional Analysis to Middle School Mathematics Using Ana</b>	160 C
	<b>Applications for Research in Science Education - Computer Assisted Data Ana</b>	189 D
	<b>Applications in Science Education</b>	76
	<b>Applications in Science Education</b>	161 F
	<b>Applications of Mathematics in High School Management Science</b>	65
	<b>Applications of Mathematics to Science</b>	154 B
	<b>Applications Project (U MAP)</b>	Modules an
	<b>Applications to Elementary Mathematics Education</b>	83
	<b>Applications to Instruction in Geometry</b>	127
	<b>Applications</b>	177 A
	<b>Applied Mathematics in Higher Education (U MAP)</b>	159 G
	<b>Applied Mathematics</b>	166 F
	<b>Applied Mathematical Modeling</b>	167 A
	<b>Applied Problem Solving in Middle School Mathematics</b>	187 D
	<b>Applied Research on Scientific Reasoning Processes</b>	191 C
	<b>Applied Scientific Thinking in Children and Adolescents</b>	197 F
	<b>Applied Sociology</b>	169 D
	<b>Applying Computers to Precollege Instruction</b>	49
	<b>Appraisal of Current Science Education at a Developing Community Coll</b>	176 G
	<b>Approach to Improving High School Mathematics Instruction</b>	5
	<b>Approach to Inventive Learning</b>	169 C
	<b>Approach to Problem Solving - A Program for Training Junior High School</b>	150 D
	<b>Approach to Science Instruction</b>	177 G
	<b>Approach to Videotape Education</b>	164 A
	<b>Aquatic Ecosystems</b>	171 G
	<b>Area</b>	149 F
	<b>Arithmetic and its Applications</b>	157 A
	<b>Arithmetic Procedures</b>	Development of an Articulate In
	<b>Arithmetic Skills - Their Diagnosis and Remediation in Pre-College Stud</b>	171 B
	<b>Arithmetic Skills</b>	197 A
	<b>Arithmetic Using Perceivable Algorithms</b>	165 G
	<b>Arithmetic Word Problems</b>	Mathematical Rep
	<b>Arithmetic - Teaching Understanding and Computational Skill Via Compute</b>	195 G
	<b>Arithmetic</b>	134
	<b>Articles to Update Collegiate Physics Instruction</b>	164 F
	<b>Articulate Instructional System for Teaching Elementary School Arithme</b>	74
	<b>Arts and Science Foundation Exploratory - Development of a Coherent S</b>	150 A
	<b>Assessing Children's Intellectual Growth in Geometry</b>	195 D
	<b>Assessing Regional CE Needs in NY Coordinates</b>	176
	<b>Assessing the Biological Science Needs of Community College Freshman</b>	180 A
	<b>Assessing the Development of Science Concepts in Adolescents</b>	195 B
	<b>Assessment and Documentation of a Children's Computer Laboratory</b>	190 F
	<b>Assessment for Mathematics Education</b>	181 F
	<b>Assessment in Mathematics</b>	196 F
	<b>Assessment of a Change to a Modularized Approach to Science Instruction</b>	177 G
	<b>Assessment of Continuing Education Delivery Systems for Scientists and</b>	175 A
	<b>Assessment of Mathematics Program at S.D. Bishop State Junior College</b>	176 F
	<b>Assessment of Placement Needs of Students</b>	180 D
	<b>Assessment of Scientists - Engineers' Continuing Education Needs in Small</b>	176 A
	<b>Assessment of Science Education in the Two Year College</b>	176 C
	<b>Assessment of Science Education in the Two Year College</b>	176 D
	<b>Assessment of Science Education in the Two Year College</b>	176 F
	<b>Assessment of Science Education in the Two Year College</b>	177 D
	<b>Assessment of Science Education in the Two Year College</b>	177 F
	<b>Assessment of Science Education in the Two Year College</b>	177 F
	<b>Assessment of Science Education in the Two Year College</b>	178 A
	<b>Assessment of Science Education in the Two Year College</b>	178 C
	<b>Assessment of Science Education at Cowley County Community College</b>	178 D
	<b>Assessment of Science Education in the Two Year College</b>	178 F
	<b>Assessment of Science Education in the Two Year College</b>	178 F
	<b>Assessment of Science Education in the Two Year College</b>	178 G
	<b>Assessment of Science Education in the Two Year College</b>	179 F

## Rotated Title Index FY 1981 and Earlier Years

	Page
Local Assessment of Science Education in the Two-Year College =	179 G
Local Assessment of Science Education in the Two-Year College =	180 B
Local Assessment of Science Education in the Two-Year College =	180 C
Local Assessment of Science Education in the Two-Year College =	180 E
Local Assessment of Science Education in the Two-Year College =	180 F
Local Assessment of Science Education in the Two-Year College =	180 G
Local Assessment of Science Education in the Two-Year College =	181 A
Local Assessment of Science Education in the Two-Year College =	181 B
Local Assessment of Science Education in the Two-Year College =	181 C
Local Assessment of Science Education in the Two-Year College =	181 D
Suomi College Science Education Assessment Project =	179 E
The Feasibility of Using the National Assessment Science Data for Secondary Analysis =	187 E
A Model Continuing Education Needs Assessment/Response System in Science and Engineering =	175 D
Scient and Early Adolescent Students: An Empirical Assessment =	130
ence Education in the Non-Campus College: A Needs Assessment =	177 A
Students, Curricula and Laboratories - A Needs Assessment =	179 C
Scient and Early Adolescent Students: An Empirical Assessment =	192 A
lications for Research in Science Educ =	189 D
velop, Implement, Test, Evaluate, and Disseminate An Associate Degree Curriculum to Train Solar =	99
A Critical Examination of Factors Associated with Public Attention to Science =	170 A
Identifying Different Levels of Understanding Attained by Physics Students =	121
Research Studies on the Scientific Literacy of the Attentive Public =	151 C
cal Examination of Factors Associated with Public Attention to Science =	191 B
Correlates of Attitudes Toward Mathematics, Science, and Social Studies =	121
The Relationship Between Student Attitudes Toward the Science Curriculum and Selected Variables =	136
Survey of Science Understanding and Attitudes =	195 C
Survey of Science Understanding and Attitudes =	131
Classroom Processes, Sex Differences, and Autonomous Learning Behaviors in Mathematics =	192 D
Empirical Assessment =	145
Empirical Assessment =	130
Investigation of Critical Barriers to the Understanding of Science =	192 A
A Computer Based Annotated List of Laboratory Experiments in College Chemistry =	185 C
Preparation of Supplemental Instructional Units Based on Current Crustal Research, Grades 8-10 =	166 D
Research on Process Models of Basic Arithmetic Skills =	163 D
Computer Assisted Data Analysis (CADA) for Teaching Bayesian Statistics and Applications for Research in Science Educ =	197 A
Visual Geometry and Mathematics Cognition for Beginning College Science Students =	189 D
n Needs of Engineers =	152 E
Individual and Group Behavior in Computer-Based Learning of Scientific Reasoning =	175 B
Science Education: Implication for Women's Career Behavior =	112
Processes, Sex Differences, and Autonomous Learning Behaviors in Mathematics =	126
Detailed Description of Mathematical Behaviors That Demonstrate Understanding =	145
Learning Science in Bilingual Classrooms: Interaction and Social Status =	188 A
Assessing the Biological Science Needs of Community College Freshman =	183 A
Outdoor Biology Instructional Strategies (OBIS) =	180 A
Graphic Biology Laboratory Modules for the Blind =	151 F
Chemistry and Biology Laboratory Facilities and Curricula =	68
Problem Solving =	179 D
Microcomputer's in High School Chemistry, Physics, Biology, and Mathematics =	189 B
ies (High School and Undergradua =	90
ent Videodisc System: Evaluation in Developmental Biology =	105
onal Strategies to Enhance Meaningful Learning in Biology =	101
ent Videodisc System: Evaluation in Developmental Biology =	123
Assessment of Mathematics Program at S.D. Bishop State Junior College =	171 A
Research to Promote Science Learning Among Blind Students in Colleges and Universities =	176 E
Research to Promote Science Learning Among Blind Students in Colleges and Universities =	108
Graphic Biology Laboratory Modules for the Blind =	182 A
Education =	68
The Brain and Education: A Study of Neuroscience, Cognitive Science, and E	132
ComputerTown, USA - Bringing Computer Literacy to the Entire Community =	150 B
Interdisciplinary Master's Programs in Building Studies =	168 A
Engineering Curriculum and Continuing Education (CACHE) =	170 C
n Science Educ =	170 C
Computer Assisted Data Analysis (CADA) for Teaching Bayesian Statistics and Applications for Research i	189 D
University Level, Computer-Assisted Instruction (CAI) and Computer-Generated Speech in Mathematics =	150 F
Calculator Use and Problem-Solving Strategies of Early Adolescents =	189 A
Public =	151 G
Elementary Mathematics Concepts with Calculators: Microcomputer-Based Modules for Teachers, Parents and the	151 G
tion and Production =	155 E
Toward Improved Candidate Classroom Instructional Television: Guidelines for Program Eval	126
e with Science Education: Implication for Women's Career Behavior =	126
The Relationship Between Continuing Education and Career Development of Scientists and Engineers =	194 A
Career Oriented Modules to Explore Topics in Science (COMETS) =	158 G
COMETS II - Career-Oriented Science Topics for Elementary and Middle Schools =	69
asis on Practical Experience =	149 D
Grades 4-9 (Final Phase) =	91
Science Careers for Women and Minorities--In-Service Materials for Teachers of	167 C
Self-Instructional In-Service Program in Science Careers: Teachers of Grades 4-9 =	167 C

**Rotated Title Index FY 1981 and Earlier Years**

	Page
ientists and Engineers Delivery Systems in North Carolina =	174 F
CEXY: A Tool for Assessing Regional CE Needs in XY Coordinates =	175 F
Support Centers for Microcomputer Applications in Science Education =	76
Support Centers for Microcomputer Applications in Science Education =	161 F
Science for the Non-Science Student at Illinois Central College: An Assessment of Science Needs for Community College =	178 A
of CLE Methodologies Potentially Transferable to CESE =	176 B
CEXY: A Tool for Assessing Regional CE Needs in XY Coordinates =	175 F
Conceptual Change in Children and in Adult Scientists =	190 D
Assessment of a Change to a Modularized Approach to Science Instruction =	177 G
Identification of Factors Influencing Changes in Conceptual Understanding of Science =	141
Research on Changes in Intellectual Development and Critical Thinking Ability =	143
Format Variables and Learner Characteristics in Mathematical Problem Solving =	122
ng Education and College Instructional Modules in Chemical Engineering =	100
Microcomputer Network and Courseware for Teaching Chemical Engineering Design =	159 E
A Model Program for Continuing Education in Chemical Engineering =	160 F
The Development of Modules for the Undergraduate Chemical Engineering Curriculum and Continuing Education (CACHE) =	170 C
ng Education and College Instructional Modules in Chemical Engineering =	170 E
g Language and Activities in Teaching High School Chemistry and Biology Laboratory Facilities and Curricula =	179 D
Chemistry and Physics =	135
Chemistry in the Community: A Problem-Focused Course for High Schools =	58
dren in Accelerated Teaching Programs in Physics, Chemistry, and Mathematics =	189 G
Coordinated Use of Microcomputers in High School Chemistry, Physics, Biology, and Mathematics =	90
notated List of Laboratory Experiments in College Chemistry =	166 D
User-Controlled Modes of Continuing Education in Chemistry =	173 E
Facilitating Problem Solving in High School Chemistry =	188 E
e of Knowledge and Cognitive Processes in Organic Chemistry =	194 G
Analysis of the Child's Construction of Whole Numbers =	186 F
The Development of Applied Scientific Thinking in Children and Adolescents =	197 F
Conceptual Change in Children and in Adult Scientists =	190 D
of School Science for Pre-Adolescent/Adolescent Children and Their Parents =	163 A
Research on Gifted Children in Accelerated Teaching Programs in Physics, Chemistry, and M	189 G
Using Non-Formal Contexts to Teach Children Science =	170 D
Assessment and Documentation of a Children's Computer Laboratory =	190 F
Assessing Children's Intellectual Growth in Geometry =	195 D
Structure and Process in Children's Mental Arithmetic =	134
Children's Understanding of Decimal Numbers =	124
Children, Television and Science: A Detailed Description of Formative	193 C
Children =	156 C
Interactive Science Museum Exhibits for Preschool Children =	156 F
High School Minicourse on Chronobiology =	163 B
Science, Society, and the Senior Citizen: A Model Educational Program =	53
Science, Society and the Senior Citizen: A Model Educational Program =	153 G
Geometric Thinking Among Adolescents in Inner City Schools =	193 A
uctional Modules for Introductory College Physics Classes =	164 G
An Investigation of the Structure and Dynamics of Classroom Communication of Science =	193 B
Toward Improved Candid Classroom Instructional Television: Guidelines for Program Evaluation a	159 E
Classroom Processes, Sex Differences, and Autonomous Learning Behavior	145
Classroom Process Variables in Urban Integrated Junior High School Ind	194 D
Conservation Classroom Program (Advanced) =	155 B
A World Model for Classroom Use =	56
A World Model for Undergraduate College Classroom Use =	154 A
The Interactive Classroom: A Cost-Effective Approach to Inventive Learning =	169 C
Learning Science in Bilingual Classrooms: Interaction and Social Status =	183 A
Study of CLE Methodologies Potentially Transferable to CESE =	176 B
Impact of Management Practices and Organizational Climate on Motivation of Scientific Engineering Personnel =	173 A
Continuing Education for Employed Clinical Engineers =	175 E
Visual Geometry and Mathematics Cognition for Beginning College Science Students =	152 E
Systematic Investigation of the Cognitive Effects of Games on Mathematics Learning =	196 G
tion: Implication for Women's Career Behavior =	126
A Cognitive Perspective on Women Students' Experience with Science Educa	192 C
Scientific Reasoning: Cognitive Processes in Using and Extending Problem-Solving Skills =	192 C
Structure of Knowledge and Cognitive Processes in Organic Chemistry =	194 G
problems =	196 A
bra =	198 A
Development and Facilitation of Cognitive Processes and Knowledge Structures Used in Solving Physics P	190 C
The Brain and Education: A Study of Neuroscience, Cognitive Representation in Estimation Problems =	132
Sex Differences in Perceptual, Motor and Cognitive Science, and Education =	183 B
Cognitive Skills as Related to Mathematics and Science =	128
Cognitive Structures Underlying Statistical Inference =	182 F
The Role of Cognitive Style in the Learning of Mathematics: A Research Study =	150 A
science Foundation Exploratoriu =	150 A
Development of a Coherent Series of Participatory Exhibits for the Palace of Arts and S	166 D
Based Annotated List of Laboratory Experiments in College Chemistry =	154 A
A World Model for Undergraduate College Classroom Use =	180 A
essing the Biological Science Needs of Community College Freshman =	100
Continuing Education and College Instructional Modules in Chemical Engineering =	170 E
Continuing Education and College Instructional Modules in Chemical Engineering =	170 E

**Rotated Title Index FY 1981 and Earlier Years**

	<b>Page</b>
of Recent East European Literature in School and College Mathematics =	Survey 157 B
Teaching Modern Optical Theory in High School and College Ph = Computer Graphics Technology as a Visualization Tool for	156 E
Problem-Oriented College Physics Instruction =	162 B
e-Oriented Instructional Modules for Introductory College Physics Classes =	Issu 164 G
Geometry and Mathematics Cognition for Beginning College Science Students =	Visual 152 E
Suomi College Science Education Assessment Project =	179 E
Statistical Analysis of Research Results in College Science Teaching =	191 F
quiry into the Graduate Training Needs of Two-Year College Teachers of Mathematics =	An Inq 181 F
A College-Level Introduction to Computing Principles Through Text Proces	55
Science Education in the Non-Campus College: A Needs Assessment =	177 A
e for the Non-Science Student at Illinois Central College: An Assessment of Science Needs for Community College =	Scienc 178 A
l Assessment of Science Education in the Two-Year College =	Loca 176 C
l Assessment of Science Education in the Two-Year College =	Loca 176 D
f Mathematics Program at S. D. Bishop State Junior College =	Assessment o 176 E
l Assessment of Science Education in the Two-Year College =	Loca 176 F
rrent Science Education at a Developing Community College =	Appraisal of Cu 176 G
e Assessment of Science Education in the Two-Year College =	Conference on th 177 D
l Assessment of Science Education in the Two-Year College =	Loca 177 E
l Assessment of Science Education in the Two-Year College =	Loca 177 F
l Assessment of Science Education in the Two-Year College =	Loca 178 C
l of Science Education at Cowley County Community College =	Assessmen 178 D
l Assessment of Science Education in the Two-Year College =	Loca 178 E
l Assessment of Science Education in the Two-Year College =	Loca 178 F
l Assessment of Science Education in the Two-Year College =	Loca 178 G
l Assessment of Science Education in the Two-Year College =	Loca 179 F
l Assessment of Science Education in the Two-Year College =	Loca 179 G
l Assessment of Science Education in the Two-Year College =	Loca 180 B
l Assessment of Science Education in the Two-Year College =	Loca 180 C
l Assessment of Science Education in the Two-Year College =	Loca 180 E
l Assessment of Science Education in the Two-Year College =	Loca 180 F
l Assessment of Science Education in the Two-Year College =	Loca 180 G
l Assessment of Science Education in the Two-Year College =	Loca 181 A
l Assessment of Science Education in the Two-Year College =	Loca 181 B
l Assessment of Science Education in the Two-Year College =	Loca 181 C
l Assessment of Science Education in the Two-Year College =	Loca 181 D
ge: An Assessment of Science Needs for Community College =	Science for the Non-Science Student at Illinois Central Coll 178 A
Promote Science Learning Among Blind Students in Colleges and Universities =	Research to 108
Promote Science Learning Among Blind Students in Colleges and Universities =	Research to 182 A
Outlines in Microbiology for Community and Junior Colleges =	154 D
aterials in Microbiology for Community and Junior Colleges =	Teaching M 154 F
Study of Science Education in Two-Year Colleges =	179 A
the Physically Handicapped Students in Community Colleges =	Science Education for Women, Minority, and 182 B
udy of Science Instructional Programs in Two-Year Colleges =	A St 182 C
Tutorial Review Articles to Update Collegiate Physics Instruction =	164 F
chools =	
er Oriented Modules to Explore Topics in Science (COMETS) =	COMETS II - Career-Oriented Science Topics for Elementary and Middle S 69
puter Conferencing System for Peer Evaluation and Commentary on Essay Tests =	Care 158 G
School, Family, and Individual Influences on Commitment to and Learning of Science Among Adolescent Students	A Com 157 F
School, Family, and Individual Influences on Commitment to and Learning of Science Among Adolescent Students	133
gation of the Structure and Dynamics of Classroom Communication of Science =	An Investi 193 B
Outlines in Microbiology for Community and Junior Colleges =	154 D
Teaching Materials in Microbiology for Community and Junior Colleges =	154 F
isal of Current Science Education at a Developing Community College =	Appra 176 G
ntial College: An Assessment of Science Needs for Community College =	Science for the Non-Science Student at Illinois Ce 178 A
Assessment of Science Education at Cowley County Community College =	178 D
Assessing the Biological Science Needs of Community College Freshman =	180 A
ority, and the Physically Handicapped Students in Community Colleges =	Science Education for Women, Min 182 B
Chemistry in the Community: A Problem-Focused Course for High Schools =	58
n, USA - Bringing Computer Literacy to the Entire Community =	Computer Tow 150 B
New Directions in Continuing Education: Comparative Perspectives of Decision-Making and R & D Personnel =	174 C
tive Modes of Continuing Engineering Education as Compare =	An Investigation Into Learning Patterns of Adults in Alterna 173 D
A Study Comparing Formal Algebraic Representations with "Natural" Mental Repre	191 A
Logical Competencies and Activity Selection Patterns in Early Adolescents: A L	184 D
Professional Competencies Development in the Undergraduate Engineering Curriculum =	165 E
ng Materials -- Computer Models in the Context of Competing Social Values =	New Undergraduate Engineeri 84
ring Materials--Computer Models in the Context of Competing Social Values =	New Undergraduate Enginee 164 C
The Representation and Use of Complex Knowledge: Knowing and Reasoning in Physics =	189 F
Improving Students' Comprehension of Science Prose =	184 A
rt-Novice Differences in Computer Science Problem Comprehension: Studies in Knowledge Organization =	Expe 182 G
Textbooks: Text Structure, Reading Strategies and Comprehension =	Learning From Science and Mathematics 198 D
Triton's Comprehensive Self-Assessment of Science Education =	178 B
Invention and Understanding in the Acquisition of Computation =	198 B
A Computational Estimation Program for Middle Grades Mathematics =	81
antics of Arithmetic: Teaching Understanding and Computational Skill Via Computer =	Se 195 G

**Rotated Title Index FY 1981 and Earlier Years**

	Page
Engineering Education Materials for Computer Aided Manufacturing (ECAM) =	158 B
s and Applications for Research in Science Educ =	189 D
dents: An Empirical Assessment =	130
dents: An Empirical Assessment =	192 A
mistry =	166 D
entific Problem Solving =	189 B
ay Tests =	157 F
Interest Worlds: Precollege Mathematics in a Computer Culture =	160 G
	80
The Next Step: A Computer Enhanced Statistics Modules for the Upper Elementary Grades =	177 C
Development of Estimation Skills in Mathematics Using Computer Games =	Deve 113
Guidebook for the Implementation and the Use of Computer Generated Graphic Displays in the Undergraduate Mathematics =	169 B
Spatial Skills in Pre-College Mathematics Through Computer Graphics =	Improving 88
	95
Optical Theory in High School and College Ph =	156 E
Spatial Skills in Pre-College Mathematics Through Computer Graphics =	Improving 166 F
	166 G
	168 B
Assessment and Documentation of a Children's Computer Laboratory =	190 F
Computers =	LOGO (A Computer Language), Methods in Science Education Using Low Cost Home Co 161 A
	102
ComputerTown, USA - Bringing Computer Literacy Guides for Elementary and Junior High Schools =	150 B
Instructional Materials for Computer Literacy to the Entire Community =	162 F
Study of Courses in Computer Literacy =	165 B
	171 C
Development of an Interactive Conversational Computer Literacy and the Impact of Computers on Society =	156 A
New Undergraduate Engineering Materials -- Computer Model for Linear Programming =	84
A High School Course Integrating Statistics and Computer Models in the Context of Competing Social Values =	107
	117
Misconceptions of Novice Computer Programmers =	165 F
On Using Program Verifiers in Elementary Computer Programming Instruction	167 D
Development of Teaching Materials for Computer Programming	97
High School Computer Science Education	169 G
High School Computer Science Education	182 G
Expert-Novice Differences in Computer Science Problem Comprehension: Studies in Knowledge Organizat	111
Dynamic Reading from Computer Screens--Learner Control	184 E
Level Students Computer Storytelling Mathematics for Pueblo Indian Upper-Elementary I.	192 B
	67
A Study of Computer Use and Literacy in Science Education	104
Engineering Education Materials for Computer-Aided Manufacturing =	160 E
Conversion of Text to Speech for Computer-Aided Instruction	162 E
Curricular Materials in Computer-Aided Ship Design =	150 F
University Level, Computer-Assisted Instruction (CAI) and Computer-Generated Speech in M	158 E
	177 B
Computer-Assisted Data Analysis	183 D
An Investigation of the Applicability of Computer-Assisted Instruction in the Social Science Division of Monter	50
	57
Intensive Computer-Based Mathematics Training for Re-entry Women	85
A Modular Computer-Based Approach to Improving High School Mathematics Instructi	112
Development of Computer-Based Learning Models in Secondary School Science and Mathema	158 C
Individual and Group Behavior in Computer-Based Learning of Scientific Reasoning	168 D
CONDUIT: Consortium for the Dissemination of Computer-Based Curricular Materials	168 E
	190 E
A Model Computer-Based Interpretive System for Science Museums	105
Educational Computer-Based Models for Socio-Economic-Technological Situations (E-C	150 F
A Research Study of Computer-Based Tutoring of Mathematical and Scientific Knowledge	170 F
School and Undergradua Mathematics in Biology: Computer-Controlled Videodisc Materials for Women and Minorities (High	195 G
ty Level, Computer-Assisted Instruction (CAI) and Computer-Generated Speech in Mathematics	153 F
	175 G
Computer-Oriented Teaching Modules in Geochemistry	165 B
eaching Understanding and Computational Skill Via Computer Semantics of Arithmetic: T	49
Personal Computers and Cross-Age Instruction	161 A
of Courses in Computer Literacy and the Impact of Computers on Society	150 B
ork for Educating Teachers of Science in Applying Computers to Precollege Instruction	163 F
Methods in Science Education Using Low Cost Home Computers	192 E
	196 C
Inventory of Computing Activities and Related Degree Programs in U.S. Higher Educat	189 E
Inventory of Computing Activities and Related Degree Programs in U.S. Higher Educat	55
	169 F
Determining the Impact of a National Educational Computing Conference =	106
A College-Level Introduction to Computing Principles Through Text Processing	172 A
Visual Technique to Teach High School Students the Concept of Variables in Polynomials =	Using a V 159 B
ation for Undergraduate Physical Sciences Through Concept-Based Modules	71
ically Disadvantaged Students in Sciences Through Concept-Based Modules	195 B
Graphic Techniques for Teaching Statistical Concepts and Procedures	64
Fundamental Mathematics Concepts for Physically Handicapped Students	
Designs for Assessing the Development of Science Concepts in Adolescents	
Females' Acquisition of 8th Grade Geometry Concepts via Non-Verbal Microcomputer Graphics	
	A Study of the Use of Time-Series 195 B

## Rotated Title Index FY 1981 and Earlier Years

			Page
Parents and the Public	Elementary Mathematics Concepts with Calculators: Microcomputer-Based Modules for Teachers, P		151 G
	The Development of Quantification Concepts: A Synthesis =		190 G
	Concepts for Learning Emphasizing the Nature and Role of		193 E
	Logical Structure of Counting and of Early Number Concepts =	The Logical, Mathematical, and Psycho	197 D
	Conceptual Change in Children and in Adult Scientists =		190 D
	Investigation of Conceptual Development in the Study of Motion =		196 D
	Conceptual Systems and Decisionmaking in Teaching Mathematics =		119
	Identification of Factors Influencing Changes in Conceptual Understanding of Science =		141
Influencing Factors --	Conceptual Understanding of Physics Students and Identification of Inf		196 B
Materials =	CONDUIT: Consortium for the Dissemination of Computer-Based Curricular		158 C
	First World Conference on Continuing Engineering Education =		175 G
Age	Conference on the Assessment of Science Education in the Two-Year Coll		177 D
	ng the Impact of a National Educational Computing Conference =	Determini	189 E
	A Computer Conferencing System for Peer Evaluation and Commentary on Essay Tests =		157 F
	earch on Relationship of Spatial Visualization and Confidence in Male/Female Mathematics Achievement in Grades 6-8 =	Rese	196 F
	earch on Relationship of Spatial Visualization and Confidence to Male/Female Mathematics Achievement in Grades 6-8 =	Rese	144
	t of the Planning Phase of the 1980 International Congress of Mathematics Education =	Suppor	185 G
	Innovations: The Social Consequences of Science and Technology =		153 A
	Conservation Classroom Program (Advanced) =		155 B
ation	Project Synthesis: An Interpretive Consolidation of Research Identifying Needs in Precollege Science Educ		185 B
	Computer-Aided Design and Manufacturing Consortium for Engineering Education =		104
	CONDUIT: Consortium for the Dissemination of Computer-Based Curricular Material		158 C
for Engineers	University Consortium to Increase National Effectiveness of Continuing Education		155 F
for Engineers	University Consortium to Increase National Effectiveness of Continuing Education		173 F
the Learning of Rational Numbers	Construct Analysis, Manipulative Aids, Representational Systems, and t		120
	Analysis of the Child's Construction of Whole Numbers		186 F
	ailed Description of Formative Research for 3-2-1 CONTACT Children, Television and Science: A Det		193 C
	Temporary Issues in Science		89
	e Engineering Materials -- Computer Models in the Context of Competing Social Values	New Undergraduat	84
	ate Engineering Materials -- Computer Models in the Context of Competing Social Values	New Undergraduat	164 C
	Using Non-Formal Contexts to Teach Children Science		170 D
	Microcomputer-Based Continuing Education Courses in Control Engineering		82
	A Televised Course on Energy Involving Schools of Continuing Education	Sunrise Semester:	86
incering	Continuing Education and College Instructional Modules in Chemical Eng		100
	Consortium to Increase National Effectiveness of Continuing Education for Engineers	University	155 F
	A Prototype System to Deliver Continuing Education to Engineers		155 G
	A Model Program for Continuing Education in Chemical Engineering =		160 F
	Validation of the Continuing Education Achievement of Professional Engineers		166 A
incering	Undergraduate Chemical Engineering Curriculum and Continuing Education (CACHE) The Development of Modules for the		170 C
	Continuing Education and College Instructional Modules in Chemical Eng		170 E
	Regional Workshop for Continuing Education of Working-Level Scientists and Their Supervisors		172 F
ties	Workshop on Continuing Education for Industry, Professional Societies and Universi		172 G
	Multimedia User-Controlled Modes of Continuing Education in Chemistry		173 E
	Consortium to Increase National Effectiveness of Continuing Education for Engineers	University	173 F
	U.S. Electronics Industry Continuing Education Effectivity Study		173 G
	Measurement for Learning Outcomes in Continuing Education for Scientists and Engineers		174 A
R & D Personnel	New Directions in Continuing Education: Comparative Perspectives of Decision-Making and		174 C
(Ozark Region	Continuing Education Needs of Engineers/Scientists in the Three-State		174 D
ns	Factors Determining the Effectiveness of Continuing Education: Longitudinal Analyses in Engineering Organizatio		174 E
North Carolina	Continuing Education for Scientists and Engineers: Delivery Systems in		174 F
by Industry and Government	A Survey of Continuing Education for Nonacademic Scientists and Engineers Provided		174 G
loyed in Small, Geographical	Needs Assessment of Continuing Education Delivery Systems for Scientists and Engineers Emp		175 A
ngineering	ehavior Anchored Scales - A Method of Identifying Continuing Education Needs of Engineers		175 B
	A Model Continuing Education Needs Assessment/Response System in Science and E		175 D
	Continuing Education for Employed Clinical Engineers		175 E
es	Assessment of Scientists/Engineers' Continuing Education Needs in Small, Geographically-Dispersed Industri		176 A
	The Relationship of Learning Styles to the Continuing Education of Graduate Engineers and Scientists		185 E
	The Relationship Between Continuing Education and Career Development of Scientists and Engineer		194 A
	arning Patterns of Adults in Alternative Modes of Continuing Engineering Education as Compare	An Investigation Into I	173 D
	First World Conference on Continuing Engineering Education		175 G
	Pilot Study of Continuing Environmental Health Education for Scientists and Engineers		174 B
	Access and Guidance in Engineering: Research into Contributing Factors	Improving	188 G
icrocomputer-Based Continuing Education Courses in	Control Engineering	Mi	82
Dynamic Reading from Computer Screens--Learner	Control =		111
	Development of an Interactive Conversational Computer Model for Linear Programming		156 A
	Conversion of Text to Speech for Computer-Aided Instruction		160 E
	Development of a Cooperative Graduate Program in Engineering and Public Administration =		166 C
iology, and Mathematics	Coordinated Use of Microcomputers in High School Chemistry, Physics, B		90
	EXY: A Tool for Assessing Regional CE Needs in XY Coordinates		175 F
	Correlates of Attitudes Toward Mathematics, Science, and Social Studie		136
	Low Cost Approach to Videodisc Education		164 A
	Language) Methods in Science Education Using Low Cost Home Computers	LOGO (A Computer	161 A
	The Interactive Classroom: A Cost-Effective Approach to Inventive Learning		169 C
	cal, Mathematical, and Psychological Structure of Counting and of Early Number Concepts	The Logi	197 D

**Rotated Title Index FY 1981 and Earlier Years**

		Page
	Assessment of Science Education at Cowley County Community College -	178 D
	Chemistry in the Community: A Problem-Focused Course for High Schools =	58
	Global Geography Course for the Middle Grades -	157 G
	A Science Course for Youth in Informal Settings; Learning to Experiment	150 A
	Secondary School Course in Applications of Mathematics to Science =	154 B
	The Modular Course in Electronic Instrumentation (ME) Final Phase	161 B
	A High School Course Integrating Statistics and Computer Programming	107
	Development of Selected Undergraduate Course Materials in Applied Mathematical Modeling -	167 A
	Evaluation of Short Course Method of Instruction for Professionals in Engineering	173 C
	Sunrise Semester: A Televised Course on Energy Involving Schools of Continuing Education	86
	Self-Paced Tutorial Courses for Mineral Science-Metallurgy Departments	163 G
	Study of Courses in Computer Literacy and the Impact of Computers on Society	165 B
	Microcomputer-Based Continuing Education Courses in Control Engineering -	82
Sophomores	Development of Modular Courses in Science, Technology and Society for University Freshmen and	168 F
	ng Female Selection of First Optional Mathematics Courses =	Research into Important Factors Influenci 185 D
	Prototype Microcomputer Courseware for Teaching High School Algebra	157 C
	Development of a Microcomputer Network and Courseware for Teaching Chemical Engineering Design	159 E
thms	Microcomputer Courseware to Develop Insight into Arithmetic Using Perceivable Algori-	165 G
	Assessment of Science Education at Cowley County Community College	178 D
aterial--Final Phase	Creation, Testing and Dissemination of Problem Solving Instructional M	167 F
	Investigation of Critical Barriers to the Understanding of Science	185 C
o Science	A Critical Examination of Factors Associated with Public Attentiveness t	121
	Search on Changes in Intellectual Development and Critical Thinking Ability	Re 143
	Personal Computers and Cross-Age Instruction	153 F
	Supplemental Instructional Units Based on Current Crustal Research, Grades 8-10	The Preparation of 163 D
	rest Worlds: Precollege Mathematics in a Computer Culture	Inte 160 G
	tion of Supplemental Instructional Units Based on Current Crustal Research, Grades 8-10	The Prepara 163 D
	Appraisal of Current Science Education at a Developing Community College	176 G
	cientific Instrumentation Information Network and Curricula (Project SIINC)	S 103
	cientific Instrumentation Information Network and Curricula (Project SIINC)	S 171 E
	Students, Curricula and Laboratories - A Needs Assessment -	179 C
	gy: Implications for Secondary School Mathematics Curricula	Microelectronic Technolo 73
	Chemistry and Biology Laboratory Facilities and Curricula	179 D
	onsortium for the Dissemination of Computer-Based Curricular Materials	CONDUIT: C 158 C
	Curricular Materials in Computer-Aided Ship Design	162 F
	Curriculum Analysis, Student Interrogation and Information System	98
	Curriculum Analysis, Student Interrogation and Information System	170 B
	Development of Curriculum and Instructional Material in Applied Sociology	169 D
	odules for the Undergraduate Chemical Engineering Curriculum and Continuing Education (CACHE)	The Development of M 170 C
	ship Between Student Attitudes Toward the Science Curriculum and Selected Variables	The Relation 195 C
ram (HSP): A Three-Year Integrated Human Sciences Curriculum for Middle Schools	Human Sciences Prog	152 G
	aterials and Delivery Systems for an Undergraduate Curriculum in Pest Management for Plant Protection	Instruction Ma 161 G
	An Associate Degree Curriculum in Solar Engineering Technology Phase II	170 A
	Administrative Activities Related to NSF-Supported Curriculum Materials	A 160 B
	Mathematics Network Curriculum Project for Middle School Teachers and Students	150 E
	Test, Evaluate, and Disseminate Associate Degree Curriculum to Train Solar	A Proposal to Design, Develop, Implement, 99
ss	Developing Science Curriculum Units Using the Teams Games Tournaments Instructional Proce	159 C
	Development of a General Engineering Technician Curriculum	163 C
	encies Development in the Undergraduate Engineering Curriculum	Professional Competen 165 F
	ational Modules Development for the Nuclear Fuel Cycle	Edu 158 F
for Research in Science Educ	Computer Assisted Data Analysis (CADA) for Teaching Bayesian Statistics and Applications	189 D
	Computer-Assisted Data Analysis	158 F
	sibility of Using the National Assessment Science Data for Secondary Analysis	The Fea 187 F
	Children's Understanding of Decimal Numbers	124
ogy	Decision-Making Modules on Public Policy Issues of Science and Technol	153 D
	Continuing Education Comparative Perspectives of Decision-Making and R & D Personnel	New Directions in 174 C
	Conceptual Systems and Decisionmaking in Teaching Mathematics	119
	Analysis of the Development of Deductive Reasoning, with Applications to Instruction in Geometry	127
	lement, Test, Evaluate, and Disseminate Associate Degree Curriculum to Train Solar	A Proposal to Design, Develop, Imp 99
	An Associate Degree Curriculum in Solar Engineering Technology Phase II	170 A
	Master of Science Degree in Applied Mathematics	166 F
Experience	Career-Oriented Degree Programs in the Mathematical Sciences with Emphasis on Practica	149 D
	Inventory of Computing Activities and Related Degree Programs in U.S. Higher Education	163 F
	Inventory of Computing Activities and Related Degree Programs in U.S. Higher Education-Dissemination	192 E
	A Prototype System to Deliver Continuing Education to Engineers	155 G
r Plant Protection	Instruction Materials and Delivery Systems for an Undergraduate Curriculum in Pest Management fo	161 G
	ontinuing Education for Scientists and Engineers: Delivery Systems in North Carolina	C 174 F
aphica	Needs Assessment of Continuing Education Delivery Systems for Scientists and Engineers Employed in Small, Geogr	175 A
network with Interactive Visual Graphics	Demo-Graphics: Teaching Population Dynamics in a Multidisciplinary Fra	157 D
	tailed Description of Mathematical Behaviors That Demonstrate Understanding	De 188 A
	Extension of TVCAI Project to Include Demonstration of Intelligent Videodisc System	170 G
	Psychoacoustic Demonstration Tapes	160 D
	demonstrations in Experimental Psychology for Junior High Schools	159 A
	d Tutorial Courses for Mineral Science-Metallurgy Departments	Self Pace 163 G

## Rotated Title Index FY 1981 and Earlier Years

		Page
	Detailed Description of Mathematical Behaviors That Demonstrate Understanding	188 A
	Children, Television and Science: A Detailed Description of Formative Research for 3-2-1 CONTACT	193 C
	Computer-Aided Design and Manufacturing Consortium for Engineering Education	104
School Science Teachers	The Guided Design Approach to Problem Solving: A Program for Training Junior High Sociotechnical Systems Design Program	150 D 172 E
Degree Curriculum to Train Solar and Courseware for Teaching Chemical Engineering	A Proposal to Design, Develop, Implement, Test, Evaluate, and Disseminate Associate Degree Design Development of a Microcomputer Network	99 159 E
Curricular Materials in Computer Aided Ship	Design	162 E
A Study of the Use of Time Series	Designs for Assessing the Development of Science Concepts in Adolescents	195 B
standing	Detailed Description of Mathematical Behaviors That Demonstrate Understanding	188 A
	Children, Television and Science: A Detailed Description of Formative Research for 3-2-1 CONTACT	193 C
Analyses in Engineering Organizations	Factors Determinants of Student Entry and Performance in the Sciences	194 F
	Determining the Effectiveness of Continuing Education: Longitudinal Analysis	174 E
	Determining the Impact of a National Educational Computing Conference	189 E
	Develop Insight into Arithmetic Using Perceivable Algorithms	165 G
Curriculum to Train Solar	Geometric Visualization: Dynamic Graphics to Develop Mathematical Perception and Intuition in Pre-Calculus Students	172 C
	A Proposal to Design, Develop, Implement, Test, Evaluate, and Disseminate Associate Degree Curriculum	99
Instructional Process	Appraisal of Current Science Education at a Developing Community College	176 G
	Developing Science Curriculum Units Using the Teams-Games-Tournaments	159 C
Program	Research on Changes in Intellectual Development and Critical Thinking Ability	143
Activity Education	Development and Trial of an Integrated Undergraduate Science Major Program	156 G
Problems	Development and Distribution of Print Modules for Manufacturing Production	158 A
	Development and Facilitation of Cognitive Representation in Estimation	190 C
	Educational Modules Development for the Nuclear Fuel Cycle	158 F
	Professional Competencies Development in the Undergraduate Engineering Curriculum	165 E
	Investigation of Conceptual Development in the Study of Motion	196 D
	Exhibit Development Including a Linguistic Display Area	149 F
	Modules for the Development of Reasoning in Mathematics	47
	Development of Reasoning Skills in Early Adolescence	48
Primary School Arithmetic Procedures	Development of an Articulate Instructional System for Teaching Elementary	74
Science and Mathematics	Development of Computer-Based Learning Models in Secondary School Science	85
	Development of Estimation Skills in Mathematics Using Computer Games	113
in Geometry	Analysis of the Development of Deductive Reasoning, with Applications to Instruction	127
	Development of a Mobile Spectroscopy Laboratory	149 B
College of Arts and Science Foundation Explorations	Development of a Coherent Series of Participatory Exhibits for the Pal	150 A
	Development of Instructional Modules on the Environment	150 C
	Development of Pilot Astronomy Activities for Informal Learning	151 C
	Modules for the Development of Reasoning in Mathematics (Grades 7-9)	151 D
	Development of Reasoning Skills in Early Adolescence	152 A
	Development of Problem Solving Skills in Physics/Electrostatics	153 E
Programming	Development of an Interactive Conversational Computer Model for Linear	156 A
Medical Engineering Design	Development of a Microcomputer Network and Courseware for Teaching Chemistry	159 E
	Development of Science Materials for Early Adolescent Minority Student	161 E
	Development of a General Engineering Technician Curriculum	163 C
	Development of Resource Material for Instruction in Use of Underground	163 E
Space	Development of Laboratory and Lecture Materials for Oceanography Teaching	164 D
ing	Development of Instructional Films in Ethology: Behavior of the Ring	165 D
Dove	Development of a Cooperative Graduate Program in Engineering and Public	166 C
Administration	Development of Selected Undergraduate Course Materials in Applied Math	167 A
Mathematical Modeling	Development of Teaching Materials for Computer Programming	167 D
	Development of Modular Courses in Science, Technology and Society for	168 F
University Freshmen and Sophomores	Development of Curriculum and Instructional Material in Applied Social	169 D
ogy	The Development of Modules for the Undergraduate Chemical Engineering Curriculum	170 C
Curriculum and Continuing Education (CACHE)	The Development of Video Systems for Teaching Meteorology	172 D
	The Development of Quantification Concepts: A Synthesis	190 G
	Relationship Between Continuing Education and Career Development of Scientists and Engineers	194 A
	The Use of Time Series Designs for Assessing the Development of Science Concepts in Adolescents	195 B
	Analysis of the Development of Propositional Reasoning	197 E
	The Development of Applied Scientific Thinking in Children and Adolescents	197 F
	Reasoning Development: In-Service Training for Middle School Science Teachers	161 C
	An Intelligent Videodisc System: Evaluation in Developmental Biology	101
	An Intelligent Videodisc System: Evaluation in Developmental Biology	171 A
	Mental Errors in Arithmetic Skills: Their Diagnosis and Remediation in Pre-College Students	171 B
Statistics	Diagnostic and Instructional Services for Undergraduate Students of Science	164 B
Knowledge Organization	Expert-Novice Differences in Computer Science Problem Comprehension: Studies in Knowledge	182 G
Thematics and Science	Sex Differences in Perceptual, Motor and Cognitive Skills as Related to Mathematics	183 B
	A Synthesis of Findings on Sex Differences in Science Education Research	188 C
	Classroom Processes, Sex Differences, and Autonomous Learning Behaviors in Mathematics	145
	Identifying Different Levels of Understanding Attained by Physics Students	191 B
	Digital System Educational Materials (DISFM Project)	153 B
and Print Materials	Application of Dimensional Analysis to Middle School Mathematics Using Microcomputer	160 C
on Making and R & D Personnel	New Directions in Continuing Education: Comparative Perspectives of Decisions	174 C
	Research in Science Education: New Questions, New Directions	184 E
	Preparing Academically Disadvantaged Students in Sciences Through Concept-Based Modules	172 A

**Rotated Title Index FY 1981 and Earlier Years**

		Page
	Digital System Educational Materials ( DISEM Project)	153 B
	Exhibit Development Including a Linguistic Display Area	149 F
	nation and the Use of Computer Generated Graphic Displays in the Undergraduate Mathematics Guidebook for the Impleme	169 B
	o Design, Develop, Implement, Test, Evaluate, and Disseminate Associate Degree Curriculum to Train Solar A Proposal	75
	Model System for Dissemination of Microcomputer-Based Instructional Materials	99
	CONDUIT: Consortium for the Dissemination of Computer-Based Curricular Materials	158 C
	Dissemination of Logo-Based Educational Research	159 D
	Dissemination of Instructional Materials (History of Physics Laboratory	165 C
	Creation, Testing and Development and Dissemination of Problem Solving Instructional Material-Final Phase	167 F
	Computer-Assisted Instruction in the Social Science Division of Monterey Pen An Investigation of the Applicability of Co	177 B
	Assessment and Documentation of a Children's Computer Laboratory	190 F
	Functional Films in Ethology-"Behavior of the Ring Dove" Development of Instr	165 D
	re-Calculus Students Geometric Visualization: Dynamic Graphics to Develop Mathematical Perception and Intuition in P	172 C
	Demo Graphics: Teaching Population Dynamics in a Multidisciplinary Framework with Interactive Visual Crap	111
	An Investigation of the Structure and Dynamics of Classroom Communication of Science	157 D
	Models for Socio-Economic Technological Situations ( E-COMSE-ITS) Educational Computer Based Mo	193 B
	Development of Reasoning Skills in Early Adolescence	168 E
	Computer Awareness and Literacy of Adolescent and Early Adolescent Students: An Empirical Assessment	48
	Science Activities in Out-of-School Settings for Early Adolescents and Their Families	130
	Development of Reasoning Skills in Early Adolescence	Physical 150 G
	Development of Science Materials for Early Adolescent Minority Students	152 A
	Early Adolescent Student Reasoning in Mathematics	161 E
	Early Adolescents: A Longitudinal Study	183 C
	Increasing the Productivity of Science Learning in Early Adolescents	Logical 184 D
	Analysis of Mathematical Problem Solving Processes of Early Adolescents	187 F
	Calculator Use and Problem Solving Strategies of Early Adolescents	Analysis and Synth 188 F
	Computer Awareness and Literacy of Adolescent and Early Adolescent Students: An Empirical Assessment	189 A
	Early Learning (Grades 2/3) of Geometry and Logic, Using Microcomputer	192 A
	Early Number Concepts The Logical, Mathematical	149 C
	Logical and Psychological Structure of Counting and of Early Number Concepts	197 D
	Survey of Recent East European Literature in School and College Mathematics	157 B
	Survey of Recent East European Mathematical Literature	63
	ation Materials for Computer Aided Manufacturing ( E-CAM) Engineering Educ	158 B
	, Experimental, and Psychometric Inquiry The Ecology of Failure in Ninth Grade General Mathematics. An Ethnographic	191 D
	Physical Processes in Terrestrial and Aquatic Ecosystems	171 G
	uations (E-COMSE-ITS) Educational ( Computer Based Models for Socio Economic Technological Sit	168 F
	Determining the Impact of a National Educational Computing Conference	189 E
	Digital System Educational Materials (DISEM Project)	153 B
	Educational Modules for Materials Science and Engineering (EMMSE)	94
	Educational Modules Development for the Nuclear Fuel Cycle	168 F
	Educational Modules for Materials Science and Engineering (EMMSE)	169 A
	Science, Society, and the Senior Citizen: A Model Educational Program	53
	Science, Society and the Senior Citizen: A Model Educational Program	153 G
	Dissemination of Logo Based Educational Research	159 D
	An Investigation on the Effect of Field Trips on Science Learning	190 A
	University Consortium to Increase National Effectiveness of Continuing Education for Engineers	155 F
	University Consortium to Increase National Effectiveness of Continuing Education for Engineers	173 F
	ering Organizations Factors Determining the Effectiveness of Continuing Education: Longitudinal Analyses in Engine	174 E
	U.S. Electronics Industry Continuing Education Effectivity Study	173 G
	fic Principles Effects of Elaboration Procedures on Learning and Retention of Scienti	186 A
	Systematic Investigation of the Cognitive Effects of Games on Mathematics Learning	196 G
	ematics Effects of Processing Style on Problem Solving in Mathematics	192 F
	Effects of Topic Specific Instructional Variables in Eighth Grade Math	188 D
	Effects of Topic Specific Instructional Variables in Eighth Grade Mathematics	Eff 188 D
	Effects of Elaboration Procedures on Learning and Retention of Scientific Princip	186 A
	d Laboratory Measurement System for Undergraduate Electrical Engineering Laboratories	A Microcomputer Base 168 G
	The Modular Course in Electronic Instrumentation (ME) Final Phase	161 B
	U.S. Electronics Industry Continuing Education Effectivity Study	173 G
	COMSE-ITS Career Oriented Science Topics for Elementary and Middle Schools	69
	Computer Literacy Guides for Elementary and Junior High Schools	102
	Problem Solving Processes of Upper Elementary and Junior High School Mathematics Students	114
	Computer Literacy Guides for Elementary and Junior High Schools	171 C
	Problem Solving Processes of Upper Elementary and Junior High School Mathematics Students	182 F
	On Using Program Verifiers in Elementary Computer Programming Instruction	165 F
	Computer Enhanced Statistics Modules for the Upper Elementary Grades	80
	Interactive Videodisc Applications to Elementary Mathematics Education	83
	Modules for Teachers, Parents and the Public Elementary Mathematics Concepts with Calculators. Microcomputer Based	151 G
	f an Articulate Instructional System for Teaching Elementary School Arithmetic Procedures	Development o 74
	Family Involving Science Education for Elementary School Children	156 C
	on Studies Elementary School Science Processes Program Meta Analysis of Evaluati	194 B
	al Modules for Materials Science and Engineering (EMMSE) Education	169 A
	al Modules for Materials Science and Engineering (EMMSE) Education	94
	Degree Programs in the Mathematical Sciences with Emphasis on Practical Experience	Career Oriented 149 D

**Rotated Title Index FY 1981 and Earlier Years**

		Page
sition of Science Literacy In- and Out-of-School:	<b>Emphasis on Sex-Differences =</b>	Acqui 110
Middle Grades Mathematics Project	<b>Emphasizing Problem Solving =</b>	78
Strategies for Learning	<b>Emphasizing the Nature and Role of Concepts =</b>	193 E
y of Adolescent and Early Adolescent Students: An	<b>Empirical Assessment =</b>	Computer Awareness and Literac 130
y of Adolescent and Early Adolescent Students: An	<b>Empirical Assessment =</b>	Computer Awareness and Literac 192 A
An	<b>Empirical Investigation of Student Knowledge in Introductory Physics</b>	142
Learner-Controlled Instructional Strategies: An	<b>Empirical Investigation =</b>	149 E
Continuing Education for	<b>Employed Clinical Engineers</b>	175 E
ion Delivery Systems for Scientists and Engineers	<b>Employed in Small, Geographica</b>	Needs Assessment of Continuing Educat 175 A
Sunrise Semester: A Televised Course on	<b>Energy Involving Schools of Continuing Education</b>	86
Educational Modules for Materials Science and	<b>Engineering (EMMSE)</b>	169 A
Development of a Cooperative Graduate Program in	<b>Engineering and Public Administration</b>	166 C
nal Competencies Development in the Undergraduate	<b>Engineering Curriculum =</b>	Professio 165 E
velopment of Modules for the Undergraduate Chemical	<b>Engineering Curriculum and Continuing Education (CACHE)</b>	The Devp 170 C
uter Network and Courseware for Teaching Chemical	<b>Engineering Design</b>	Development of a Microcomp 159 E
ter Aided Design and Manufacturing Consortium for	<b>Engineering Education Materials for Computer-Aided Manufacturing</b>	67
Computer Graphics in	<b>Engineering Education</b>	Compu 104
erns of Adults in Alternative Modes of Continuing	<b>Engineering Education as Compare</b>	An Investigation Into Learning Patt 173 D
First World Conference on Continuing	<b>Engineering Education</b>	175 G
y Measurement System for Undergraduate Electrical	<b>Engineering Laboratories</b>	A Microcomputer Based Laborator 168 G
New Undergraduate	<b>Engineering Materials - Computer Models in the Context of Competing S</b>	84
New Undergraduate	<b>Engineering Materials - Computer Models in the Context of Competing Soc,</b>	164 C
of Continuing Education: Longitudinal Analyses in	<b>Engineering Organizations</b>	Factors: Determining the Effectiveness 174 E
rganizational Climate on Motivation of Scientific	<b>Engineering Personnel</b>	Impact of Management Practices and O 173 A
Development of a General	<b>Engineering Technician Curriculum</b>	163 C
An Associate Degree Curriculum in Solu	<b>Engineering Technology Phase II</b>	170 A
Educational Modules for Materials Science and	<b>Engineering: EMMSE</b>	94
Improving Access and Guidance in	<b>Engineering: Research into Contributing Factors</b>	188 G
ter Based Continuing Education Courses in Control	<b>Engineering</b>	Microcompu 82
ion and College Instructional Modules in Chemical	<b>Engineering</b>	Continuing Educat 100
odel Program for Continuing Education in Chemical	<b>Engineering</b>	AM 160 F
ion and College Instructional Modules in Chemical	<b>Engineering</b>	Continuing Educat 170 E
Course Method of Instruction for Professionals in	<b>Engineering</b>	Evaluation of Short 173 C
dual Motivation, Work Environment and Updating in	<b>Engineering</b>	Relationships Among Indivi 175 C
n Needs Assessment Response System in Science and	<b>Engineering</b>	A Model Continuing Educatio 175 D
inal Study of Women and Minorities in Science and	<b>Engineering</b>	A Longitud 182 D
ng Styles to the Continuing Education of Graduate	<b>Engineers and Scientists</b>	The Relationship of Learn 185 E
ing Education Delivery Systems for Scientists and	<b>Engineers Employed in Small, Geographica</b>	Needs Assessment of Continui 175 A
Educating Prospective	<b>Engineers in Technology Related Public Policy</b>	171 F
ntinuing Education for Nonacademic Scientists and	<b>Engineers Provided by Industry and Government</b>	A Survey of Co 174 G
Continuing Education Needs of	<b>Engineers/Scientists in the Three State Ozark Region</b>	174 D
Related to Life Long Learning for Scientists and	<b>Engineers: A Feasibility Study</b>	Factors 193 G
Continuing Education for Scientists and	<b>Engineers: Delivery Systems in North Carolina</b>	174 F
ational Effectiveness of Continuing Education for	<b>Engineers</b>	University Consortium to Increase N 155 F
ototype System to Deliver Continuing Education to	<b>Engineers</b>	A Pr 155 G
Continuing Education Achievement of Professional	<b>Engineers</b>	Validation of the 166 A
el for State of the Art Programs for Professional	<b>Engineers</b>	An Evaluation Mod 173 B
ational Effectiveness of Continuing Education for	<b>Engineers</b>	University Consortium to Increase N 173 F
comes in Continuing Education for Scientists and	<b>Engineers</b>	Measurement for Learning Ou 174 A
Environmental Health Education for Scientists and	<b>Engineers</b>	Pilot Study of Continuing 174 B
thod of Identifying Continuing Education Needs of	<b>Engineers</b>	Behavior Anchored Scales A Me 175 B
Continuing Education for Employed Clinical	<b>Engineers</b>	175 E
ducation and Career Development of Scientists and	<b>Engineers</b>	The Relationship Between Continuing E 194 A
Factors That Influence the Technical Updating of	<b>Engineers</b>	195 F
An Investigation of Instructional Strategies to	<b>Enhance Meaningful Learning in Biology</b>	123
Quantitative Understanding to	<b>Enhance Social Science Teaching</b>	153 C
Computer	<b>Enhanced Statistics Modules for the Upper Elementary Grades</b>	80
The Role of Television	<b>Entertainment in Public Education About Science</b>	138
uter Town, USA Bringing Computer Literacy to the	<b>Entire Community</b>	Comp 150 B
Determinants of Student	<b>Entry and Performance in the Sciences</b>	194 F
Relationships Among Individual Motivation, Work	<b>Environment and Updating in Engineering</b>	175 C
A Computer Graphics Learning	<b>Environment for High School Trigonometry</b>	95
Development of Instructional Modules on the	<b>Environment</b>	150 C
Pilot Study of Continuing	<b>Environmental Health Education for Scientists and Engineers</b>	174 B
Psychology of	<b>Equation Solving - An Information Processing Study</b>	198 C
Mental	<b>Errors in Arithmetic Skills: Their Diagnosis and Remediation in Pre-Co</b>	171 B
e Education Materials on Mount Saint Helens: 1980	<b>Eruption -</b>	Pre College Science 167 G
Scientist in Residence in	<b>Eskimo Indian High Schools</b>	149 A
ing System for Peer Evaluation and Commentary on	<b>Essay Tests</b>	A Computer Conferen 157 F
t and Facilitation of Cognitive Representation in	<b>Estimation Problems</b>	Developmen 190 C
A Computational	<b>Estimation Program for Middle Grades Mathematics</b>	81
Development of	<b>Estimation Skills in Mathematics Using Computer Games</b>	113

Social Values  
Cultural Values



Rotated Title Index FY 1981 and Earlier Years

		Page
h School =	Ethical Uses of Scientific Knowledge: An Instructional TV Unit for High School	72
	of Failure in Ninth Grade General Mathematics: An Ethnographic, Experimental, and Psychometric Inquiry -- The Ecology	191 D
	Development of Instructional Films in Ethnology--"Behavior of the Ring Dove" --	165 D
	Survey of Recent East European Literature in School and College Mathematics	157 B
	Survey of Recent East European Mathematical Literature	63
	A Proposal to Design, Develop, Implement, Test, Evaluate, and Disseminate Associate Degree Curriculum to Train Solar --	99
	A Computer Conferencing System for Peer Evaluation and Commentary on Essay Tests	157 F
	Evaluation and Needs Assessment for Mathematics Education	181 E
	An Intelligent Videodisc System: Evaluation in Developmental Biology	101
	An Intelligent Videodisc System: Evaluation in Developmental Biology	171 A
ervention Programs for Girls: Follow up Study and	Evaluation Kit	149 G
	An Evaluation Model for State of the Art Programs for Professional Engine	173 B
ers	Evaluation of Short Course Method of Instruction for Professionals in	173 C
Engineering	A Research Evaluation of Scientific Reasoning Ability in Naturalistic and Laborat	183 E
ory Settings	Evaluation Studies -- Elementary S	194 B
	Evaluation and Production = Toward Improved Candid Classroom	155 E
chool Science Processes Program: Meta-Analysis of	Evidence and Theoretical Explanations of the Underrepresentation of Wo	116
Instructional Television: Guidelines for Program	A Critical Examination of Factors Associated with Public Attentiveness to Science	121
men in Science	Exhibit Development Including a Linguistic Display Area --	149 F
	Interactive Science Museum Exhibits for Preschool Children =	156 F
	Development of a Coherent Series of Participatory Exhibits for the Palace of Arts and Science Foundation Exploratori =	150 A
	Computer-Assisted Science Exhibits =	183 D
viator	A Cognitive Perspective on Women Students' Experience with Science Education: Implication for Women's Career Beha	126
	Mathematical Sciences with Emphasis on Practical Experience -- Career-Oriented Degree Programs in the	149 D
	course for Youth in Informal Settings: Learning to Experience = A Science C	150 A
	g Whole Numbers: An Interdisciplinary Study of an Experimental Model = Learning and Teachin	186 G
	Demonstrations in Experimental Psychology for Junior High Schools =	159 A
	resentation and Learning of Knowledge Structures in Experimental Psychology -- The Repre	197 C
	Ninth Grade General Mathematics: An Ethnographic, Experimental, and Psychometric Inquiry -- The Ecology of Failure in	191 D
	A Computer Based Annotated List of Laboratory Experiments in College Chemistry --	166 D
	Problem Solving in Physics: Models, Experiments, and Instruction	183 G
	Expert and Novice Mathematical Problem Solving =	193 F
udies in Knowledge Organization	Expert-Novice Differences in Computer Science Problem Comprehension: S	182 G
ics	An Expert-Novice Information Processing Study of Problem-Solving in Genet	184 F
	The Synthesis of Evidence and Theoretical Explanations of the Underrepresentation of Women in Science =	116
	its for the Palace of Arts and Science Foundation Exploratori = Development of a Coherent Series of Participatory Exhib	150 A
	Career Oriented Modules to Explore Topics in Science (COMETS) :	158 G
	The Use of Heuristics in Problem Solving: An Expository Study	186 D
	ific Reasoning: Cognitive Processes in Using and Extending Problem-Solving Skills	192 C
odisc System	Extension of TVCAI Project to Include Demonstration of Intelligent Vid	170 G
	An Urban Extension Service Model =	152 D
	Analysis (Meta-Analysis) of Major Facets of Science Education	185 A
	Development and Facilitation of Problem Solving in High School Chemistry	188 E
	Chemistry and Biology Laboratory Facilitation of Cognitive Representation in Estimation Problems	190 C
	The Next Step: A Computer Facilities and Curricula :	179 D
	A Critical Examination of Facilities Master Plan for Saddleback	177 C
dinal Analyses in Engineering Organizations :	Factors Associated with Public Attentiveness to Science	121
	A Meta-Analysis of Productive Factors Determining the Effectiveness of Continuing Education: Longitu	174 E
	Identification of Factors in Science Learning in Grades 6 Through 12	187 G
merican Adolescents	Factors Influencing Changes in Conceptual Understanding of Science	141
ries	Factors Influencing Mathematics Participation of Highly Able Mexican A	181 G
Feasibility Study	Factors Influencing Female Selection of First Optional Mathematics Cou	185 D
	Factors Related to Life-Long Learning for Scientists and Engineers: A	193 G
ral Settings	Factors That Influence the Technical Updating of Engineers	195 F
	Factors Which Influence Scientific Reasoning Among Adolescents in Natu	183 F
	Guidance in Engineering: Research into Contributing Factors = Improving Access and Gu	188 G
tal, and Psychometric Inquiry	Physics Students and Identification of Influencing Factors = Conceptual Understanding of P	196 B
	The Ecology of Failure in Ninth Grade General Mathematics: An Ethnographic, Experimen	191 D
	Science Education for Families in Informal Learning Settings =	62
	f School Settings for Early Adolescents and Their Families = Physical Science Activities in Out-o	150 G
ence Among Adolescent Students	Role of the Family in the Promotion of Science Literacy --	125
ence Among Adolescent Students	School, Family, and Individual Influences on Commitment to and Learning of Sci	133
	School, Family, and Individual Influences on Commitment to and Learning of Sci	194 E
	Family-Involving Science Education for Elementary School Children =	156 C
y Analysis	The Feasibility of Using the National Assessment Science Data for Secondar	187 E
	Spanish Translation and Feasibility Study of Ranger Rick's Nature Magazine =	60
	ife-Long Learning for Scientists and Engineers: A Feasibility Study = Factors Related to L	193 G
rocomputer Graphics	Research into Important Factors Influencing Female Selection of First Optional Mathematics Courses	185 D
	Females' Acquisition of 8th Grade Geometry Concepts via Non-Verbal Mic	64
	An Investigation on the Effect of Field Trips on Science Learning =	190 A
	Development of Instructional Films in Ethnology "Behavior of the Ring Dove" --	165 D
	In-Service Materials for Teachers of Grades 4-9 ( Final Phase) = Science Careers for Women and Minorities-	91
	Modular Course in Electronic Instrumentation (ME) Final Phase -- The	161 B
	A Synthesis of Findings on Sex Differences in Science Education Research	188 C

Rotated Title Index FY 1981 and Earlier Years

		Page
Important Factors Influencing Female Selection of	First Optional Mathematics Courses	185 D
Science Intervention Programs for Girls	First World Conference on Continuing Engineering Education	175 G
A Study Comparing	Follow-up Study and Evaluation Kits	149 C
Underlying Heuristic and	Formal Algebraic Representations with "Natural" Mental Representations	191 A
Television and Science: A Detailed Description of	Formal Structures of Probabilistic Thought	197 B
atory Exhibits for the Palace of Arts and Science	Format Variables and Learner Characteristics in Mathematical Problem Solving	122
aching Population Dynamics in a Multidisciplinary	Formative Research for 3-2-1 CONTACT	193 C
the Biological Science Needs of Community College	Foundation Exploratorium Development of a Coherent Series of Participatory	150 A
in Science, Technology and Society for University	Framework with Interactive Visual Graphics	157 D
Educational Modules Development for the Nuclear	Freshman	180 A
Thematic Investigation of the Cognitive Effects of	Freshmen and Sophomores	168 F
Estimation Skills in Mathematics Using Computer	Fuel Cycle	158 F
Development of a	Fundamental Mathematics Concepts for Physically Handicapped Students	71
The Ecology of Failure in Ninth Grade	Games on Mathematics Learning	196 G
ok for the Implementation and the Use of Computer	Games	113
An Instructional Model in Human	General Engineering Technician Curriculum	163 C
High School Students'	General Mathematics: An Ethnographic, Experimental, and Psychometric I	191 D
Information Processing Study of Problem Solving in	Generated Graphic Displays in the Undergraduate Mathematics	169 B
Computer Oriented Teaching Modules in	Genetics for High School Students	152 F
for Scientists and Engineers Employed in Small,	Genetics Problem Solving Strategies and Knowledge	146
Engineers' Continuing Education Needs in Small,	Genetics	184 F
Global	Geochemistry	170 F
Global Studies in	Geographic Needs Assessment of Continuing Education Delivery System	175 A
Teaching and Learning in Graduate	Geographically Dispersed Industries	176 A
Geometric Thinking Among Adolescents in Inner City Schools	Geography Course for the Middle Grades	157 G
Geometric Visualization: Dynamic Graphics to Develop Mathematical Perc	Geography for the Middle Grades	66
Geometry and Logic, Using Microcomputers	Geography	154 G
Geometry and Mathematics Cognition for Beginning College Science Stud	Geometric Thinking Among Adolescents in Inner City Schools	191 A
Geometry Concepts via Non Verbal Microcomputer Graphics	Geometric Visualization: Dynamic Graphics to Develop Mathematical Perc	172 C
Geometry	Geometry and Logic, Using Microcomputers	149 C
Analysis of the Development of Deducti	Geometry and Mathematics Cognition for Beginning College Science Stud	152 F
137	Geometry Concepts via Non Verbal Microcomputer Graphics	64
193 D	Geometry	127
195 D	Geometry	137
189 G	Geometry	193 D
152 B	Geometry	195 D
152 C	Geometry	189 G
149 G	Gifted Children in Accelerated Teaching Programs in Physics, Chemistry	152 B
157 G	Girls in Science and Math	152 C
66	Girls in Science and Mathematics	152 C
190 B	Girls Follow-up Study and Evaluation Kit	149 G
179 B	Global Geography Course for the Middle Grades	157 G
174 G	Global Studies in Geography for the Middle Grades	66
191 D	Goals of Scientific Literacy	190 B
64	Goals	179 B
162 G	Government	174 G
188 B	Grade General Mathematics: An Ethnographic, Experimental, and Psychome	191 D
188 D	Grade Geometry Concepts via Non Verbal Microcomputer Graphics	64
59	Grade Mathematics Using Simulation of Mathematical Modeling	162 G
155 A	Grade Mathematics	188 B
167 E	Grade Mathematics	188 D
149 C	Grade Mathematics	59
91	Grade Mathematics	155 A
167 C	Grade Mathematics	167 E
196 F	Grade Mathematics	149 C
187 G	Grade Mathematics	91
144	Grade Mathematics	167 C
151 D	Grade Mathematics	196 F
163 D	Grade Mathematics	187 G
78	Grade Mathematics	144
81	Grade Mathematics	151 D
66	Grade Mathematics	163 D
80	Grade Mathematics	78
157 G	Grade Mathematics	81
185 E	Grade Mathematics	66
154 G	Grade Mathematics	80
166 C	Grade Mathematics	157 G
181 F	Grade Mathematics	185 E
68	Grade Mathematics	154 G
169 B	Grade Mathematics	166 C
159 B	Grade Mathematics	181 F
152 D	Grade Mathematics	68
	Grade Mathematics	169 B
	Grade Mathematics	159 B
	Grade Mathematics	152 D

**Rotated Title Index FY 1981 and Earlier Years**

	Page
Computer Graphics in a High School Mathematics Laboratory	168 B
Computer Graphics in Engineering Education	166 G
A Computer Graphics Learning Environment for High School Trigonometry	95
Computer Graphics Technology as a Visualization Tool for Teaching Modern Optics	156 E
Geometric Visualization: Dynamic Graphics to Develop Mathematical Perception and Intuition in Pre-Calculus Students	172 C
de Geometry Concepts via Non-Verbal Microcomputer Graphics	64
Skills in Pre-College Mathematics Through Computer Graphics	88
Interdisciplinary Framework with Interactive Visual Graphics	157 D
Skills in Pre-College Mathematics Through Computer Graphics	166 F
Graphics in High School Level Algebra and Trigonometry for Adults	171 D
Individual and Group Behavior in Computer-Based Learning of Scientific Reasoning	112
Assessing Children's Intellectual Growth in Geometry	195 D
Improving Access and Guidance in Engineering: Research into Contributing Factors	188 G
Computer Graphics Displays in the Undergraduate Mathematics or High School Science Teachers	169 B
The Guided Design Approach to Problem Solving: A Program for Training Juniors	150 D
Improved Candid Classroom Instructional Television: Guidelines for Program Evaluation and Production	455 E
Computer Literacy Guides for Elementary and Junior High Schools	102
Computer Literacy Guides for Elementary and Junior High Schools	171 C
Fundamental Mathematics Concepts for Physically Handicapped Students	71
Education for Women, Minorities, and the Physically Handicapped Students in Community Colleges	182 B
Pilot Study of Continuing Environmental Health Education for Scientists and Engineers	174 B
College Science Education Materials on Mount Saint Helens' 1980 Eruption	167 G
Education Materials on Mount Saint Helens	93
Underlying Heuristic and Formal Structures of Probabilistic Thought	197 B
The Use of Heuristics in Problem Solving: An Expository Study	186 D
Computer Based Strategies for Mathematics in Junior High and High School	156 B
Using Problem Solving in Junior High Mathematics	79
Prototype Microcomputer Courseware for Teaching High School Algebra	157 C
Selected Videodisc Materials for Women and Minorities (High School and Undergraduate Mathematics in Biology: Computer-Controlled)	105
ization Tool for Teaching Modern Optical Theory in High School and College Physics (Computer Graphics Technology as a Visual)	156 F
Coordinated Use of Microcomputers in High School Chemistry, Physics, Biology, and Mathematics	90
Sequencing Language and Activities in Teaching High School Chemistry and Physics	135
Facilitating Problem Solving in High School Chemistry	188 F
High School Computer Science Education	97
High School Computer Science Education	169 G
A High School Course Integrating Statistics and Computer Programming	107
Room Process Variables in Urban Integrated Junior High School Individualized Science Programs	194 D
Graphing in High School Level Algebra and Trigonometry for Adults	171 D
Microcomputer Application of Mathematics in High School Management Science	65
A Modular Computer Based Approach to Improving High School Mathematics Instruction	57
Solving Processes of Upper Elementary and Junior High School Mathematics Students	114
on for Problem Solving Using the Microcomputer in High School Mathematics	155 D
Computer Graphics in a High School Mathematics Laboratory	168 B
Solving Processes of Upper Elementary and Junior High School Mathematics Students	182 F
High School Minicourse on Chronology	163 B
to Problem Solving: A Program for Training Junior High School Science Teachers	150 D
The Status of Middle School Junior High School Science	184 C
Microcomputers on Teaching Math and Science to Junior High School Students	77
High School Students' Genetics Problem Solving Strategies and Knowledge	146
An Instructional Model in Human Genetics for High School Students	152 F
Microcomputers on Teaching Math and Science to Junior High School Students	162 A
Using a Visual Technique to Teach High School Students the Concept of Variables in Polynomials	169 F
Computer Biology Simulations for High School Students to Simulate Scientific Problem Solving	189 B
A Computer Graphics Learning Environment for High School Trigonometry	95
Microcomputer and Video Based Mathematics Modules for High School Women and Minority Students	51
Scientific Knowledge: An Instructional TV Unit for High School	72
Selected Strategies for Mathematics in Junior High and High School	156 B
ry in the Community: A Problem Focused Course for High Schools	58
Computer Literacy Guides for Elementary and Junior High Schools	102
Scientist in Residence in Eskimo/Indian High Schools	149 A
Teachers to Teach Social Science in Junior and Senior High Schools	157 F
Demonstrations in Experimental Psychology for Junior High Schools	159 A
Computer Literacy Guides for Elementary and Junior High Schools	171 C
Space Centered Activity Kit for Junior High Schools	156 D
Instructional Modules in Applied Mathematics in Higher Education (UMAP)	159 G
ing Activities and Related Degree Programs in U.S. Higher Education	164 F
An Alternative in Higher Education in the Mathematical Sciences	169 F
ing Activities and Related Degree Programs in U.S. Higher Education Dissemination	192 E
Computing and Higher Education: Issues and Opportunities	196 C
Factors Influencing Mathematics Participation of Highly Able Mexican American Adolescents	181 C
Dissemination of Instructional Materials (History of Physics Laboratory)	165 G
Language Methods in Science Education Using Low Cost Home Computers	161 A
Human Sciences Program (HSP): A Three Year Integrated Human Sciences Curriculum for Middle School	152 G
An Instructional Model in Human Genetics for High School Students	152 F



Rotated Title Index FY 1981 and Earlier Years

		Page
of Mathematics	An Inquiry into the Graduate Training Needs of Two Year College Teachers	181 F
	An Inquiry into the Nature and Goals of Scientific Literacy	190 B
	Wildlife Inquiry Through Zoo Education (WIZE)	87
An Ethnographic, Experimental, and Psychometric Inquiry	The Ecology of Failure in Ninth Grade General Mathematics	191 D
Microcomputer Courseware to Develop Insight into Arithmetic Using Perceivable Algorithms		165 G
The Worcester Polytechnic Institute Plan		161 D
University Level, Computer Assisted Instruction (C AI) and Computer-Generated Speech in Mathematics		150 F
Instruction by Mapping Processes of Learning Mathematics Through Mode		140
Instruction for Problem Solving Using the Microcomputer in High School		155 D
Instruction for Professionals in Engineering		173 C
Instruction in Geometry	Analysis of the Develop	127
Instruction in Use of Underground Space		163 F
Instruction in Grades 1-4		167 E
Instruction in the Social Science Division of Monterey Pen	An Invest	171 B
Instruction Materials and Delivery Systems for an Undergraduate Curric		177 G
Instruction of Problem Solving Skills in Newtonian Mechanics		139
Instruction Network for Educating Teach		49
Instruction A Modular Computer Ba		57
Instruction Synthesis o		115
Instruction		153 F
Instruction		Sp 156 D
Instruction		160 F
Instruction		162 B
Instruction		162 C
Instruction	Adaptable Matr	152 D
Instruction	Tuto	164 F
Instruction	On Using Pro	165 E
Instruction	Assessment	177 G
Instruction	Pro	184 G
Instructional Films in Ethology "Behavior of the Ring Dove"		165 D
Instructional Materials	Mode	75
Instructional Modules in Chemical Engineering		100
Instructional Modules on the Environment		150 Z
Instructional Model in Human Genetics for High School Students		152 F
Instructional Materials	Undergraduate Educatio	154 C
Instructional Modules in Applied Mathematics on Higher Education (UMA)		159 G
Instructional Materials for Computer Literacy		162 E
Instructional Module for Introductory College Physics Classes		164 G
Instructional Materials (History of Physics Laboratory)		165 C
Instructional Material Final Phase	Creal	167 F
Instructional Material in Applied Sociology		169 D
Instructional Modules in Chemical Engineering		170 F
Instructional Process	Developing Science C	159 C
Instructional Programs in Two Year Colleges		182 C
Instructional System for Teaching Elementary School Arithmetic Procedu		74
Instructional Strategies to Enhance Meaningful Learning in Biology		123
Instructional Strategies: An Empirical Investigation		149 F
Instructional Strategies (OBIS)		151 F
Instructional System		155 C
Instructional Services for Undergraduate Students of Statistics		164 B
Instructional TV Operator, High School		72
Instructional TV Series in Technology and Society for Secondary School		96
Instructional Television Guidelines for Program Evaluation and Product		155 F
Instructional Units (for 11th and 12th Grade Mathematics) Using Sumula		162 G
Instructional Units Based on Current Crystal Research, Grades 8-10		163 D
Instructional Variables in Eighth Grade Mathematics		188 D
Instrumentation Information Network and Curricula (Project STINC)		103
Instrumentation (MI) Final Phase		161 B
Instrumentation Information Network and Curricula (Project STINC)		171 E
Integrated Human Sciences Curriculum for Middle Schools		152 G
Integrated Junior High School Individualized Science Programs		194 D
Integrated Undergraduate Science Major Program		156 G
Integrating Statistics and Computer Programming		107
Intellectual Development and Critical Thinking Ability		14V
Intellectual Growth in Geometry		195 D
Intelligent Videodisc System Evaluation in Developmental Biology		101
Intelligent Videodisc System	Estay	170 G
Intelligent Videodisc System Evaluation in Developmental Biology		171 A
Intensive Computer-Based Mathematics Training for Recently Women		50
Interaction and Social Statu		181 A
Interactive Classroom: A Cost Effective Approach to Inventive Learning		169 C
Interactive Conversational Computer Model for Linear Programming		156 A
Interactive Science Museum Exhibits for Preschool Children		156 F
Interactive Videodisc Applications to Elementary Mathematics Education		81

**Rotated Title Index FY 1981 and Earlier Years**

		Page
on Dynamics in a Multidisciplinary Framework with	<b>Interactive Visual Graphics =</b>	157 D
	<b>Demo-Graphics: Teaching Populati</b>	168 A
Learning and Teaching Whole Numbers: An	<b>Interdisciplinary Master's Programs in Building Studies =</b>	186 G
	<b>Interdisciplinary Study of an Experimental Model =</b>	160 G
Planning and Teaching of	<b>Interest Worlds: Precollege Mathematics in a Computer Culture =</b>	129
Support of the Planning Phase of the 1980	<b>Intermediate Science =</b>	185 G
Science Education =	<b>International Congress of Mathematics Education =</b>	196 E
	<b>Interpretive Consolidation of Research Identifying Needs in Precollege</b>	168 D
	<b>Interpretive Reports of the Second National Assessment in Mathematics =</b>	98
	<b>Interpretive System for Science Museums =</b>	170 B
	<b>Interrogation and Information System =</b>	149 G
	<b>Interrogation and Information System =</b>	55
	<b>Intervention Programs for Girls: Follow-up Study and Evaluation Kit =</b>	164 G
	<b>A College-Level Introduction to Computing Principles Through Text Processing =</b>	A 142
Issue-Oriented Instructional Modules for	<b>Introductory College Physics Classes =</b>	172 C
n Empirical Investigation of Student Knowledge in	<b>Introductory Physics =</b>	198 B
e Graphics to Develop Mathematical Perception and	<b>Intuition in Pre-Calculus Students =</b>	The In 169 C
	<b>Geometric Visualization: Dynam</b>	163 F
teractive Classroom: A Cost-Effective Approach to	<b>Inventive Learning =</b>	192 E
Higher Education =	<b>Inventory of Computing Activities and Related Degree Programs in U.S.</b>	173 D
Higher Education-Dissemination =	<b>Inventory of Computing Activities and Related Degree Programs in U.S.</b>	123
Continuing Engineering Education as Compare =	<b>An Investigation Into Learning Patterns of Adults in Alternative Modes of</b>	142
ng in Biology =	<b>An Investigation of Instructional Strategies to Enhance Meaningful Learni</b>	177 B
	<b>An Empirical Investigation of Student Knowledge in Introductory Physics =</b>	185 C
the Social Science Division of Monterey Pen =	<b>An Investigation of the Applicability of Computer-Assisted Instruction in</b>	190 A
	<b>An Investigation of Critical Barriers to the Understanding of Science =</b>	193 B
of Science =	<b>An Investigation on the Effect of Field Trips on Science Learning =</b>	196 D
	<b>An Investigation of the Structure and Dynamics of Classroom Communication</b>	196 G
g =	<b>Investigation of Conceptual Development in the Study of Motion =</b>	149 E
	<b>Investigation of the Cognitive Effects of Games on Mathematics Learnin</b>	86
	<b>Systematic Investigation =</b>	164 G
Controlled Instructional Strategies: An Empirical	<b>Involving Schools of Continuing Education =</b>	165 A
Sunrise Semester: A Televised Course on Energy	<b>Issue-Oriented Instructional Modules for Introductory College Physics</b>	196 C
Classes =	<b>Issue-Oriented Physics Modules Project =</b>	89
	<b>Social Issues and Opportunities =</b>	153 D
	<b>Computing and Higher Education: Issues in Science =</b>	167 B
	<b>Contemporary Issues of Science and Technology =</b>	157 E
Decision-Making Modules on Public Policy	<b>Issues =</b>	Modu 176 E
lar Materials on Socio-Technological Problems and	<b>Junior and Senior High Schools =</b>	154 D
Using Microcomputers to Teach Social Science in	<b>Junior College =</b>	Asses 154 F
ment of Mathematics Program at S.D. Bishop State	<b>Junior Colleges =</b>	Tea 156 B
Outlines in Microbiology for Community and	<b>Junior Colleges =</b>	79
ching Materials in Microbiology for Community and	<b>Junior High and High School =</b>	Impact 102
Microcomputer-Based Strategies for Mathematics in	<b>Junior High Mathematics =</b>	114
Using Problem Solving in	<b>Junior High School Students =</b>	150 D
of Microcomputers on Teaching Math and Science to	<b>Junior High Schools =</b>	162 A
Computer Literacy Guides for Elementary and	<b>Junior High Schools =</b>	171 C
Problem-Solving Processes of Upper Elementary and	<b>Junior High School Mathematics Students =</b>	182 E
proach to Problem Solving: A Program for Training	<b>Junior High School Science Teachers =</b>	194 D
Demonstrations in Experimental Psychology for	<b>Junior High Schools =</b>	156 D
of Microcomputers on Teaching Math and Science to	<b>Junior High School Students =</b>	Science Intervention P 149 G
Computer Literacy Guides for Elementary and	<b>Junior High Schools =</b>	189 F
Problem-Solving Processes of Upper Elementary and	<b>Junior High School Mathematics Students =</b>	194 G
Classroom Process Variables in Urban Integrated	<b>Junior High School Individualized Science Programs =</b>	142
Space-Centered Activity Kit for	<b>Junior High Science Instruction =</b>	198 A
rograms for Girls: Follow-up Study and Evaluation	<b>Kit =</b>	182 G
The Representation and Use of Complex Knowledge:	<b>Knowing and Reasoning in Physics =</b>	196 A
Structure of	<b>Knowledge and Cognitive Processes in Organic Chemistry =</b>	197 C
An Empirical Investigation of Student	<b>Knowledge in Introductory Physics =</b>	72
Cognitive Processes and the Structure of	<b>Knowledge in Physics and Algebra =</b>	189 P
Computer Science Problem Comprehension: Studies in	<b>Knowledge Organization =</b>	195 E
Cognitive Processes and	<b>Knowledge Structures Used in Solving Physics Problems =</b>	High School 146
The Representation and Learning of	<b>Knowledge Structures in Experimental Psychology =</b>	A Research Study of Compu 190 E
Ethical Uses of Scientific	<b>Knowledge: An Instructional TV Unit for High School =</b>	179 C
The Representation and Use of Complex	<b>Knowledge: Knowing and Reasoning in Physics =</b>	168 G
Mathematical Representations of Real-World	<b>Knowledge: Physics and Arithmetic Word Problems =</b>	164 D
Students' Genetics Problem-Solving Strategies and	<b>Knowledge =</b>	466 D
ter-Based Tutoring of Mathematical and Scientific	<b>Knowledge =</b>	179 D
Students, Curricula and	<b>Laboratories - A Needs Assessment =</b>	168 G
t System for Undergraduate Electrical Engineering	<b>Laboratories =</b>	164 D
	<b>A Microcomputer-Based Laboratory Measurement</b>	179 D
	<b>Development of Laboratory and Lecture Materials for Oceanography Teaching =</b>	168 G
A Computer Based Annotated List of	<b>Laboratory Experiments in College Chemistry =</b>	68
Chemistry and Biology	<b>Laboratory Facilities and Curricula =</b>	A Research Evaluation of 183 E
Laboratories =	<b>Laboratory Measurement System for Undergraduate Electrical Engineering</b>	
	<b>A Microcomputer-Based Laboratory Modules for the Blind =</b>	
	<b>Graphic Biology Laboratory Settings =</b>	
Scientific Reasoning Ability in Naturalistic and		

Rotated Title Index FY 1981 and Earlier Years

		Page
on of Instructional Materials (History-of-Physics Laboratory) =	Disseminati	165 C
Middle School Microcomputer Statistics Laboratory =		52
Development of a Mobile Spectroscopy Laboratory =		149 B
Computer Graphics in a High School Mathematics Laboratory =		168 B
Assessment and Documentation of a Children's Computer Laboratory =	Asse	190 F
Sequencing Language and Activities in Teaching High School Chemistry and Physics =		135
LOGO (A Computer Language) Methods in Science Education Using Low Cost Home Computers =		161 A
Format Variables and Learner Characteristics in Mathematical Problem Solving =		122
Learner-Controlled Instructional Strategies: An Empirical Investigation =		149 E
Early Learning (Grades 2-3) of Geometry and Logic Using Microcomputers =		149 C
Science Activities for Informal Learning (SAIL) (Age 11-14) =		61
Research to Promote Science Learning Among Blind Students in Colleges and Universities =		108
Research to Promote Science Learning Among Blind Students in Colleges and Universities =		182 A
Effects of Elaboration Procedures on Learning and Retention of Scientific Principles =		186 A
Experimental Model = Learning and Teaching Whole Numbers: An Interdisciplinary Study of an		186 G
Classroom Processes, Sex Differences, and Autonomous Learning Behaviors in Mathematics =	Clas	145
Strategies for Learning Emphasizing the Nature and Role of Concepts =		193 E
A Computer Graphics Learning Environment for High School Trigonometry =		95
Factors Related to Life-Long Learning for Scientists and Engineers: A Feasibility Study =		193 G
Learning From Science and Mathematics Textbooks: Text Structure, Readability, and		198 D
Learning in Biology = An Investigation		123
Increasing the Productivity of Science Learning in Early Adolescents =		187 F
An Information Processing Analysis of Learning in Geometry =		137
Teaching and Learning in Graduate Geography =		154 G
A Meta-Analysis of Productive Factors in Science Learning in Grades 6 Through 12 =		187 G
Instruction by Mapping: Processes of Learning Mathematics Through Models =		140
Development of Computer-Based Learning Models in Secondary School Science and Mathematics =		85
The Representation and Learning of Knowledge Structures in Experimental Psychology =		197 C
The Role of Cognitive Style in the Learning of Mathematics: A Research Study =		182 F
Manipulative Aids, Representational Systems, and the Learning of Rational Numbers =	Construct Analysis, Man	120
The Role of Manipulative Aids in the Learning of Rational Numbers =		187 A
Individual and Group Behavior in Computer-Based Learning of Scientific Reasoning =		112
Family and Individual Influences on Commitment to and Learning of Science Among Adolescent Students =	School, Famil	133
Family and Individual Influences on Commitment to and Learning of Science Among Adolescent Students =	School, Famil	194 E
Measurement for Learning Outcomes in Continuing Education for Scientists and Engineers =		174 A
An Investigation Into Learning Patterns of Adults in Alternative Modes of Continuing Education =		173 D
Use of Microcomputers for Learning Science =		158 D
Learning Science in Bilingual Classrooms: Interaction and Social Status =		183 A
Science Education for Families in Informal Learning Settings =		62
Scientists = Learning Styles in the Continuing Education of Graduate Engineers and		185 E
The Relationship of Learning to Experiment =		150 A
A Science Course for Youth in Informal Settings: Learning: A Study of Information Processing =	Psychol.	192 G
Development of Pilot Astronomy Activities for Informal Learning =	Devel	151 C
Classroom: A Cost-Effective Approach to Inventive Learning =	The Interactive	169 C
Investigation on the Effect of Field Trips on Science Learning =	An Inve	190 A
of the Cognitive Effects of Games on Mathematics Learning =	Systematic Investigation	196 G
Development of Laboratory and Lecture Materials for Oceanography Teaching =		164 D
Graphing in High School Level Algebra and Trigonometry for Adults =		171 D
Learning Mathematics for Pueblo Indian Upper-Elementary Level Students =	Computer Storytelli	164 E
University Level, Computer-Assisted Instruction (CAI) and Computer-Generated Speech =		150 F
Identifying Different Levels of Understanding Attained by Physics Students =		191 B
Adaptable Microcomputer Graphics for Undergraduate Life Science Instruction =	A	152 D
Factors Related to Life-Long Learning for Scientists and Engineers: A Feasibility Study =		193 G
An Interactive Conversational Computer Model for Linear Programming =	Development of	156 A
Exhibit Development Including a Linguistic Display Area =		149 F
A Computer Based Annotated List of Laboratory Experiments in College Chemistry =		166 D
Study of Courses in Computer Literacy and the Impact of Computers on Society =		165 B
Computer Literacy Guides for Elementary and Junior High Schools =		102
Computer Literacy Guides for Elementary and Junior High Schools =		171 C
A Study of Computer Use and Literacy in Science Education =		192 B
Acquisition of Science Literacy In- and Out-of-School: Emphasis on Sex-Differences =		110
Computer Awareness and Literacy of Adolescent and Early Adolescent Students: An Empirical Assessment =		130
Computer Awareness and Literacy of Adolescent and Early Adolescent Students: An Empirical Assessment =		192 A
Research Studies on the Scientific Literacy of the Attentive Public =		187 B
ComputerTown, USA - Bringing Computer Literacy to the Entire Community =		150 B
Role of the Family in the Promotion of Science Literacy =		125
Instructional Materials for Computer Literacy =		162 F
Inquiry into the Nature and Goals of Scientific Literacy =	A	190 B
Survey of Recent East European Literature in School and College Mathematics =		157 B
Survey of Recent East European Mathematical Literature =		63
Local Assessment of Science Education in the Two-Year College =		176 C
Local Assessment of Science Education in the Two-Year College =		176 D
Local Assessment of Science Education in the Two-Year College =		176 F
Local Assessment of Science Education in the Two-Year College =		177 E



**Rotated Title Index FY 1981 and Earlier Years**

		Page
School Mathematics Using Microcomputer and Print	<b>Materials</b> - Application of Dimensional Analysis to Middle	160 C
Impact of Microcomputers on Teaching	<b>Math and Science to Junior High School Students</b>	77
Impact of Microcomputers on Teaching	<b>Math and Science to Junior High School Students</b>	162 A
Role Models for Adolescent Girls in Science and	<b>Math =</b>	152 B
An Analysis of Research on	<b>Mathematical Abilities =</b>	186 E
A Research Study of Computer-Based Tutoring of	<b>Mathematical and Scientific Knowledge</b>	190 E
Detailed Description of	<b>Mathematical Behaviors That Demonstrate Understanding</b>	188 A
Survey of Recent East European	<b>Mathematical Literature</b>	63
h and 12th Grade Mathematics) Using Simulation of	<b>Mathematical Modeling</b> - Microcomputer Instructional Units (for 11th	162 G
lected Undergraduate Course Materials in Applied	<b>Mathematical Modeling</b> - Development of S	167 A
metric Visualization: Dynamic Graphics to Develop	<b>Mathematical Perception and Intuition in Pre-Calculus Students</b> - Geo	172 C
Format Variables and Learner Characteristics in	<b>Mathematical Problem Solving</b>	122
Analysis and Synthesis of	<b>Mathematical Problem-Solving Processes of Early Adolescents</b>	188 F
Expert and Novice	<b>Mathematical Problem Solving</b>	193 F
	<b>Mathematical Reasoning Improvement Study (MRIS)</b>	109
ometric Word Problems	<b>Mathematical Representations of Real-World Knowledge: Physics and Art</b>	195 E
Survey of Undergraduate Education in the	<b>Mathematical Sciences, 1980-81</b>	118 A
Career-Oriented Degree Programs in the	<b>Mathematical Sciences with Emphasis on Practical Experience</b>	149 D
An Alternative in Higher Education in the	<b>Mathematical Sciences</b>	169 E
Survey of Undergraduate Education in the	<b>Mathematical Sciences, 1980-81</b>	185 F
The Logical,	<b>Mathematical, and Psychological Structure of Counting and of Early Num</b>	197 D
Modules for the Development of Reasoning in	<b>Mathematics (Grades 7-9)</b>	151 D
A Study of Priorities in School	<b>Mathematics (PRISM)</b>	195 A
atial Visualization and Confidence to Male/Female	<b>Mathematics Achievement in Grades 6-8</b> Research on Relationship of Sp	144
atial Visualization and Confidence in Male/Female	<b>Mathematics Achievement in Grades 6 t</b> Research on Relationship of Sp	196 F
Modules and Monographs in Undergraduate	<b>Mathematics and Its Applications Project (UMAP)</b>	160 A
ceptual, Motor and Cognitive Skills as Related to	<b>Mathematics and Science</b> Sex Differences in Per	183 B
Visual Geometry and	<b>Mathematics Cognition for Beginning College Science Students</b>	152 E
Fundamental	<b>Mathematics Concepts for Physically Handicapped Students</b>	71
Teachers, Parents and the Public	<b>Elementary Mathematics Concepts with Calculators: Microcomputer-Based Modules for</b>	151 G
rs Influencing Female Selection of First Optional	<b>Mathematics Courses</b> Research into Important Facto	185, D
nic Technology: Implications for Secondary School	<b>Mathematics Curricula</b> Microelectro	73
Interactive Videodisc Applications to Elementary	<b>Mathematics Education</b>	83
Evaluation and Needs Assessment for	<b>Mathematics Education</b>	181 E
nning Phase of the 1980 International Congress of	<b>Mathematics Education</b> Support of the Pla	185 G
Computer Storytelling	<b>Mathematics for Pueblo Indian Upper-Elementary Level Students</b>	164 F
	<b>Mathematics in Society: Multimedia Materials for 8th-10th Grade Studen</b>	59
Microcomputer Applications of	<b>Mathematics in High School Management Science</b>	65
men and Minorities (High School and Undergradua	<b>Mathematics in Biology: Computer-Controlled Videodisc Materials for Wo</b>	105
	<b>Mathematics in Society: Multimedia Materials for 8th-10th Grade Studen</b>	155 A
Microcomputer-Based Strategies for	<b>Mathematics in Junior High and High School</b>	156 B
Instructional Modules in Applied	<b>Mathematics in Higher Education (UMAP)</b>	159 G
Interest Worlds: Precollege	<b>Mathematics in a Computer Culture</b>	160 G
Computer-Based Approach to Improving High School	<b>Mathematics Instruction</b> A Modular	57
The Use of Microcomputers for	<b>Mathematics Instruction in Grades 1-4</b>	167 E
Computer Graphics in a High School	<b>Mathematics Laboratory</b>	168 B
investigation of the Cognitive Effects of Games on	<b>Mathematics Learning</b> Systematic I	196 G
Microcomputer and Video-Based	<b>Mathematics Modules for High School Women and Minority Students</b>	51
Students	<b>Mathematics Network Curriculum Project for Middle School Teachers and</b>	150 E
	<b>Mathematics Participation of Highly Able Mexican-American Adolescents</b>	181 G
Factors Influencing	<b>Mathematics Project Emphasizing Problem Solving</b>	78
Middle Grades	<b>Mathematics Problem-Solving Instruction</b>	115
Synthesis of Research Related to	<b>Mathematics Program at S.D. Bishop State Junior College</b>	176 E
Assessment of	<b>Mathematics Students</b> Problem Solving Pro	114
cesses of Upper Elementary and Junior High School	<b>Mathematics Students</b> Problem Solving Pro	182 E
cesses of Upper Elementary and Junior High School	<b>Mathematics Textbooks: Text Structure, Reading Strategies and Comprehe</b>	198 D
Learning From Science and	<b>Mathematics Through Computer Graphics</b>	88
Improving Spatial Skills in Pre-College	<b>Mathematics Through Models</b>	140
Instruction by Mapping: Processes of Learning	<b>Mathematics Through Computer Graphics</b>	166 F
Improving Spatial Skills in Pre-College	<b>Mathematics to Science</b>	154 B
Secondary School Course in Applications of	<b>Mathematics Training for Re-entry Women</b>	50
Intensive Computer-Based	<b>Mathematics Using Computer Games</b>	113
Development of Estimation Skills in	<b>Mathematics Using Microcomputer and Print Materials</b> App	160 C
lication of Dimensional Analysis to Middle School	<b>Mathematics Using Simulation of Mathematical Modeling</b> Microcomp	162 G
uter Instructional Units (for 11th and 12th Grade	<b>Mathematics, Science, and Social Studies</b>	136
Correlates of Attitudes Toward	<b>Mathematics: A Research Study</b>	182 F
The Role of Cognitive Style in the Learning of	<b>Mathematics: An Ethnographic, Experimental, and Psychometric Inquiry</b>	191 D
The Ecology of Failure in Ninth Grade General	<b>Mathematics</b>	47
Modules for the Development of Reasoning in	<b>Mathematics</b>	79
Using Problem Solving in Junior High	<b>Mathematics</b> A C	81
computational Estimation Program for Middle Grades	<b>Mathematics</b> Development of Computer Base	85
d Learning Models in Secondary School Science and	<b>Mathematics</b> Coordinated Use of Microcomputer	90
s in High School Chemistry, Physics, Biology, and	<b>Mathematics</b>	119
Conceptual Systems and Decisionmaking in Teaching	<b>Mathematics</b> Classroom Processes, Sex	145
Differences, and Autonomous Learning Behaviors in	<b>Mathematics</b>	

Rotated Title Index FY 1981 and Earlier Years

			Page
Instruction (CAI) and Computer-Generated Speech in	Mathematics	University Level, Computer-Assisted I	150 F
Role Models for Adolescent Girls in Science and	Mathematics		152 C
Problem Solving Using the Microcomputer in High School	Mathematics	Instruction for Probl	155 D
in East European Literature in School and College	Mathematics	Survey of Recc	157 B
Master of Science Degree in Applied	Mathematics		166 E
Computer-Generated Graphic Displays in the Undergraduate	Mathematics	Guidebook for the Implementation and the Use of Compute	169 B
Service-Oriented Options in	Mathematics		172 B
Teacher Training Needs of Two-Year College Teachers of	Mathematics	An Inquiry into the Gradua	181 F
Early Adolescent Student Reasoning in	Mathematics		183 C
Problem Solving Processes in Middle School	Mathematics	The Microcomput	186 C
Research of Solving Routine Problems in Pre-College	Mathematics	A Review of Re	187 C
Applied Problem-Solving in Middle-School	Mathematics		187 D
Research on Thought Processes Used in 7th to 10th Grade	Mathematics	Resear	188 B
Specific Instructional Variables in Eighth Grade	Mathematics	Effects of Topic	188 D
Integrated Teaching Programs in Physics, Chemistry, and	Mathematics	Research on Gifted Children in Acceler	189 G
Effects of Processing Style on Problem Solving in	Mathematics		192 F
Five Reports of the Second National Assessment in	Mathematics	Interpre	196 E
Conceptual Transformations in Understanding Science and	Mathematics	The Role of Preconceptions & Representatf	197 G
The Modular Course in Electronic Instrumentation (ME) Final Phase	ME) Final Phase		161 B
Investigation of Instructional Strategies to Enhance	Meaningful Learning in Biology	An Inv	123
Increasing the	Meaningfulness of Technical Information for Novices		184 B
	Measurement and Analysis of Patterns of Logical Thinking		189 C
	Measurement for Learning Outcomes in Continuing Education for Scientists		174 A
	Measurement System for Undergraduate Electrical Engineering Laboratory	Research on I	168 G
	Mechanics		139
	Medium-Size Planetariums		151 B
	Mental Arithmetic		134
	Mental Errors in Arithmetic Skills: Their Diagnosis and Remediation in	A Study Comparin	171 B
	Mental Representations		191 A
	Meta-Analysis of Productive Factors in Science Learning in Grades 6 Th		187 G
	Meta-Analysis of Evaluation Studies		194 B
	Meta-Analysis of Major Facets of Science Education		185 A
	Meteorology		172 D
	Method of Identifying Continuing Education Needs of Engineers		175 B
	Method of Instruction for Professionals in Engineering		173 C
	Methodologies Potentially Transferable to CISE		176 B
	Methods in Science Education Using Low Cost Home Computers		161 A
	Mexican American Adolescents	Factors Int	181 G
	Microbiology for Community and Junior Colleges		154 D
	Microbiology for Community and Junior Colleges		154 F
	Microbiology		154 E
	Microcomputer and Video-Based Mathematics Modules for High School		51
	Microcomputer Applications of Mathematics in High School Management Sc		65
	Microcomputer Applications in Science Education		76
	Microcomputer and Print Materials*	Application of Dimens	160 C
	Microcomputer Applications in Science Education		161 F
	Microcomputer and Problem Solving Processes in Middle School Mathemat		186 C
	Microcomputer Courseware for Teaching High School Algebra		157 C
	Microcomputer Courseware to Develop Insight into Arithmetic Using Perc		165 G
	Microcomputer Graphics	Females' Acquisi	64
	Microcomputer Graphics for Undergraduate Life Science Instruction		152 D
	Microcomputer in High School Mathematics		155 D
	Microcomputer Instructional Units (for 11th and 12th Grade Mathematics)		162 G
	Microcomputer Network and Courseware for Teaching Chemical Engineering		159 F
	Microcomputer Statistics Laboratory		52
	Microcomputer Based Instructional Materials		75
	Microcomputer Based Continuing Education Courses in Control Engineering		82
	Microcomputer Based Modules for Teachers, Parents and the Public		151 G
	Microcomputer Based Strategies for Mathematics in Junior High and High		156 B
	Microcomputer Based Laboratory Measurement System for Undergraduate I		168 G
	Microcomputers on Teaching Math and Science to Junior High School Stud		77
	Microcomputers in High School Chemistry, Physics, Biology, and Mathema		90
	Microcomputers to Teach Social Science in Junior and Senior High Schoo		157 F
	Microcomputers for Learning Science		158 D
	Microcomputers on Teaching Math and Science to Junior High School Stud		162 A
	Microcomputers for Mathematics Instruction in Grades 1-4		167 F
	Microcomputers	Early I	149 C
	Microelectronic Technology: Implications for Secondary School Mathemat		73
	Middle Grades Mathematics Project Emphasizing Problem Solving		78
	Middle Grades Mathematics		81
	Middle Grades		66
	Middle Grades		157 G
	Middle School Microcomputer Statistics Laboratory		52
	Middle School Mathematics Using Microcomputer and Print Materials		160 C

**Rotated Title Index FY 1981 and Earlier Years**

		Page
	he Microcomputer and Problem Solving Processes in Middle School Mathematics =	186 C
	Reasoning Development: In-Service Training for Middle School Science Teachers =	161 C
	Planning and Teaching Middle School Science =	191 E
	Wait Time and Questioning Skills of Middle School Science Teachers =	194 C
	Mathematics Network Curriculum Project for Middle School Teachers and Students =	150 E
	The Status of Middle School/Junior High School Science =	184 C
	Career-Oriented Science Topics for Elementary and Middle Schools =	69
	ree-Year Integrated Human Sciences Curriculum for Middle Schools =	COMETS II - 152 G
	Applied Problem-Solving in Middle-School Mathematics =	Human Sciences Program (HSP): A Th 187 D
	Self-Paced Tutorial Courses for Mineral Science-Metallurgy Departments =	163 G
	High School Minicourse on Chronobiology =	163 B
	uter-Controlled Videodisc Materials for Women and Minorities (High School and Undergradua	Mathematics in Biology: Comp 105
	A Longitudinal Study of Women and Minorities in Science and Engineering =	182 D
se)	Science Careers for Women and Minorities--In-Service Materials for Teachers of Grades 4-9 (Final Pha	91
	sed Mathematics Modules for High School Women and Minority Students =	Microcomputer and Video-Ba 51
	lopment of Science Materials for Early Adolescent Minority Students =	Deve 161 E
	Science Education for Women, Minorities, and the Physically Handicapped Students in Community College	182 B
	Misconceptions of Novice Computer Programmers =	117
	Development of a Mobile Spectroscopy Laboratory =	149 B
and Engineering	A Model Computer-Based Interpretive System for Science Museums =	168 D
	A Model Continuing Education Needs Assessment/Response System in Science =	175 D
	Science, Society, and the Senior Citizen: A Model Educational Program =	53
	Science, Society and the Senior Citizen: A Model Educational Program =	153 G
	A World Model for Classroom Use =	56
	lopment of an Interactive Conversational Computer Model for Linear Programming =	Deve 156 A
	An Evaluation Model for State of the Art Programs for Professional Engineers =	173 B
	A World Model for Undergraduate College Classroom Use =	154 A
	An Instructional Model in Human Genetics for High School Students =	152 F
terials	A Model Program for Continuing Education in Chemical Engineering =	160 F
	Model System for Dissemination of Microcomputer Based Instructional Ma	75
	An Urban Extension Service Model =	152 D
	rs: An Interdisciplinary Study of an Experimental Model =	Learning and Teaching Whole Numbe 186 G
	ade Mathematics) Using Simulation of Mathematical Modeling =	Microcomputer Instructional Units (for 11th and 12th Gr 162 G
	graduate Course Materials in Applied Mathematical Modeling =	Development of Selected Under 167 A
	Role Models for Adolescent Girls in Science and Math =	152 B
	Role Models for Adolescent Girls in Science and Mathematics =	152 C
	Educational Computer-Based Models for Socio-Economic Technological Situations (E COMSE: IS)	168 F
	Development of Computer-Based Learning Models in Secondary School Science and Mathematics =	85
	ow Undergraduate Engineering Materials -- Computer Models in the Context of Competing Social Values =	Ne 84
	New Undergraduate Engineering Materials--Computer Models in the Context of Competing Social Values =	164 C
	Research on Process Models of Basic Arithmetic Skills =	197 A
	Problem Solving in Physics: Models, Experiments, and Instruction =	183 G
	apping: Processes of Learning Mathematics Through Models =	Instruction by M 140
	s Technology as a Visualization Tool for Teaching Modern Optical Theory in High School and College Ph	Computer Graphic 156 F
	n Into Learning Patterns of Adults in Alternative Modes of Continuing Engineering Education as Compare	An Investigatio 173 D
	Multimedia User-Controlled Modes of Continuing Education in Chemistry =	173 F
nstruction	A Modular Computer Based Approach to Improving High School Mathematics I	57
hmen and Sophomores	The Modular Course in Electronic Instrumentation (ME) Final Phase =	161 B
	Development of Modular Courses in Science, Technology and Society for University Fres	168 F
	Modular Materials on Socio Technological Problems and Issues =	167 B
	Assessment of a Change to a Modularized Approach to Science Instruction =	177 G
ns Project (UMAP)	Modules and Monographs in Undergraduate Mathematics and Its Applicatio	160 A
	Educational Modules Development for the Nuclear Fuel Cycle =	158 F
	Microcomputer and Video-Based Mathematics Modules for High School Women and Minority Students =	51
	Issue-Oriented Instructional Modules for Introductory College Physics Classes =	164 G
	Development and Distribution of Print Modules for Manufacturing Productivity Education =	158 A
	Educational Modules for Materials Science and Engineering: FMMSF =	94
	Educational Modules for Materials Science and Engineering (FMMSF) =	169 A
	es Concepts with Calculators: Microcomputer-Based Modules for Teachers, Parents and the Public =	Elementary Mathemat 151 G
	Modules for the Development of Reasoning in Mathematics =	47
	Graphic Biology Laboratory Modules for the Blind =	68
	Computer Enhanced Statistics Modules for the Upper Elementary Grades =	80
	Modules for the Development of Reasoning in Mathematics (Grades 7-9) =	151 D
aining Education (C ACHI)	The Development of Modules for the Undergraduate Chemical Engineering Curriculum and Cont	170 C
	Instructional Modules in Applied Mathematics in Higher Education (UMAP) =	159 G
	Continuing Education and College Instructional Modules in Chemical Engineering =	100
	Continuing Education and College Instructional Modules in Chemical Engineering =	170 F
	Computer-Oriented Teaching Modules in Geochemistry =	170 F
	Decision-Making Modules on Public Policy Issues of Science and Technology =	153 D
	Development of Instructional Modules on the Environment =	150 C
	Societal Issue Oriented Physics Modules Project =	165 A
	Career Oriented Modules to Explore Topics in Science (COMETS)	158 G
	graduate Physical Sciences Through Concept-Based Modules =	Preparation for Unde 106
	ntaged Students in Sciences Through Concept-Based Modules =	Preparing Academically Disadv 172 A

## Rotated Title Index FY 1981 and Earlier Years

		Page
UMAP)	Modules and Monographs in Undergraduate Mathematics and Its Applications Project (	160 A
	ted Instruction in the Social Science Division of Monterey Pen = An Investigation of the Applicability of Computer-Assis	177 B
	igation of Conceptual Development in the Study of Motion = Invest	196 D
	Psychological Problem Space and Motivation in Adolescent Learning: A Study of Information Processing =	192 G
	anagement Practices and Organizational Climate on Motivation of Scientific Engineering Personnel = Impact of M	173 A
	Relationships Among Individual Motivation, Work Environment and Updating in Engineering =	175 C
	Sex Differences in Perceptual, Motor and Cognitive Skills as Related to Mathematics and Science =	183 B
	Education Materials on Mount Saint Helens =	93
	Pre-College Science Education Materials on Mount Saint Helens' 1980 Eruption =	167 G
	Mathematical Reasoning Improvement Study ( MRIS) =	109
	Demo-Graphics: Teaching Population Dynamics in a Multidisciplinary Framework with Interactive Visual Graphics	157 D
	Mathematics in Society: Multimedia Materials for 8th-10th Grade Students =	59
	Mathematics in Society: Multimedia Materials for 8th-10th Grade Students =	155 A
	Mathematics in Society: Multimedia User-Controlled Modes of Continuing Education in Chemistry =	173 E
	Interactive Science Museum Exhibits for Preschool Children =	156 F
	el Computer-Based Interpretive System for Science Museums = A Mod	168 D
	The Feasibility of Using the National Assessment Science Data for Secondary Analysis :	187 E
	Interpretive Reports of the Second National Assessment in Mathematics =	196 E
	Determining the Impact of a National Educational Computing Conference	189 E
	University Consortium to Increase National Effectiveness of Continuing Education for Engineers	155 F
	University Consortium to Increase National Effectiveness of Continuing Education for Engineers	173 F
	fluence Scientific Reasoning Among Adolescents in Natural Settings Factors Which In	183 F
	Comparing Formal Algebraic Representations with "Natural" Mental Representations A Study	191 A
	rch Evaluation of Scientific Reasoning Ability in Naturalistic and Laboratory Settings A Resea	183 E
	An Inquiry into the Nature and Goals of Scientific Literacy	190 B
	Strategies for Learning Emphasizing the Nature and Role of Concepts	193 E
	ranslation and Feasibility Study of Ranger Rick's Nature Magazine Spanish T	60
	Analysis of Student Skills, Needs and Goals	179 B
	ts and Engineers Employed in Small, Geographical Needs Assessment of Continuing Education Delivery Systems for Scientis	175 A
	A Model Continuing Education Needs Assessment Response System in Science and Engineering	175 D
	Science Education in the Non-Campus College: A Needs Assessment	177 A
	Students, Curricula and Laboratories - A Needs Assessment	179 C
	Evaluation and Needs Assessment for Mathematics Education	181 E
	Illinois Central College: An Assessment of Science Needs for Community College Science for the Non-Science Student at I	178 A
	nterpretive Consolidation of Research Identifying Needs in Precollege Science Education Project Synthesis: An I	185 B
	ent of Scientists/Engineers' Continuing Education Needs in Small, Geographically-Dispersed Industries Assessm	176 A
	CF-XY: A Tool for Assessing Regional CE Needs in XY Coordinates	175 F
	Assessing the Biological Science Needs of Community College Freshman	180 A
	Continuing Education Needs of Engineers/Scientists in the Three-State/Ozark Region	174 D
	es - A Method of Identifying Continuing Education Needs of Engineers Behavior Anchored Scal	175 B
	Assessment of Placement Needs of Students	180 D
	An Inquiry into the Graduate Training Needs of Two-Year College Teachers of Mathematics	181 F
	cial Science Education: Priorities, Practices and Needs Social Studies/So	184 G
	Development of a Microcomputer Network and Courseware for Teaching Chemical Engineering Design	159 E
	Scientific Instrumentation Information Network and Curricula (Project SIINC)	103
	Scientific Instrumentation Information Network and Curricula (Project SIINC)	171 E
	Mathematics Network Curriculum Project for Middle School Teachers and Students	150 E
	college Instruction Network for Educating Teachers of Science in Applying Computers to Pre	49
	The Brain and Education: A Study of Neuroscience, Cognitive Science, and Education	132
	earch on Instruction of Problem-Solving Skills in Newtonian Mechanics Res	139
	The Next Step: A Computer Facilities Master Plan for Saddleback	177 C
	ychometric Inquiry The Ecology of Failure in Ninth Grade General Mathematics: An Ethnographic, Experimental, and Ps	191 D
	Science Education in the Non-Campus College: A Needs Assessment	177 A
	Using Non-Formal Contexts to Teach Children Science	170 D
	nce Needs for Community College Science for the Non-Science Student at Illinois Central College: An Assessment of Scie	178 A
	s' Acquisition of 8th Grade Geometry Concepts via Non-Verbal Microcomputer Graphics Female	64
	nt A Survey of Continuing Education for Nonacademic Scientists and Engineers Provided by Industry and Governme	174 G
	for Scientists and Engineers: Delivery Systems in North Carolina Continuing Education	174 F
	Misconceptions of Novice Computer Programmers	117
	Expert and Novice Mathematical Problem Solving	193 F
	g the Meaningfulness of Technical Information for Novices	184 B
	Administrative Activities Related to NSF-Supported Curriculum Materials	160 B
	Educational Modules Development for the Nuclear Fuel Cycle	158 F
	Psychological Structure of Counting and of Early Number Concepts The Logical, Mathematical, and	197 D
	Learning and Teaching Whole Numbers: An Interdisciplinary Study of an Experimental Model	186 G
	sentational Systems, and the Learning of Rational Numbers Construct Analysis, Manipulative Aids; Repre	120
	Children's Understanding of Decimal Numbers	124
	Analysis of the Child's Construction of Whole Numbers	186 F
	of Manipulative Aids in the Learning of Rational Numbers The Role	187 A
	Outdoor Biology Instructional Strategies ( OBIS)	151 F
	velopment of Laboratory and Lecture Materials for Oceanography Teaching De	164 D
	Computing and Higher Education: Issues and Opportunities	196 C
	ology as a Visualization Tool for Teaching Modern Optical Theory in High School and College Ph	156 E
	ant Factors Influencing Female Selection of First Optional Mathematics Courses Computer Graphics Techn	185 D
		Research into Import

## Rotated Title Index FY 1981 and Earlier Years

		Page
	Service-Oriented <b>Options in Mathematics</b>	172 B
	Structure of Knowledge and Cognitive Processes in <b>Organic Chemistry</b>	194 G
ience	Problem Comprehension: Studies in Knowledge <b>Organization</b>	Expert-Novice Differences in Computer Sc 182 G
el =	Impact of Management Practices and <b>Organizational</b> Climate on Motivation of Scientific Engineering Personn	173 A
	g Education: Longitudinal Analyses in Engineering <b>Organizations</b>	Factors Determining the Effectiveness of Continuin 174 E
	Career <b>Oriented</b> Modules to Explore Topics in Science (COMETS)	158 G
	Physical Science Activities in <b>Out-of-School</b> Settings for Early Adolescents and Their Families	150 G
	Acquisition of Science Literacy In- and <b>Out-of-School: Emphasis on Sex-Differences</b>	110
	Measurement for Learning <b>Outcomes</b> in Continuing Education for Scientists and Engineers	174 A
	<b>Outdoor</b> Biology Instructional Strategies (OBIS)	151 F
	<b>Outlines</b> in Microbiology for Community and Junior Colleges	154 D
	Needs of Engineers/Scientists in the Three-State <b>Ozark Region</b>	Continuing Education 174 D
	Coherent Series of Participatory Exhibits for the <b>Palace of Arts and Science Foundation</b> Exploratorju	Development of a 150 A
	lators: Microcomputer-Based Modules for Teachers, <b>Parents and the Public</b>	Elementary Mathematics Concepts with Calculu 151 G
	for Pre-Adolescent/Adolescent Children and Their <b>Parents</b>	Out of School Science 163 A
exploratoriu	Factors Influencing Mathematics <b>Participation</b> of Highly Able Mexican American Adolescents	181 G
	Development of a Coherent Series of <b>Participatory</b> Exhibits for the Palace of Arts and Science Foundation E	150 A
	XPRT-Experimental <b>Partnership</b> for the Reorientation of Teaching	168 C
ation as Compare	Logical Competencies and Activity Selection <b>Patterns</b> in Early Adolescents: A Longitudinal Study	184 D
	An Investigation Into Learning <b>Patterns</b> of Adults in Alternative Modes of Continuing Engineering Educ	173 D
	Measurement and Analysis of <b>Patterns</b> of Logical Thinking	189 C
	A Computer Conferencing System for <b>Peer</b> Evaluation and Commentary on Essay Tests	157 E
	uction in the Social Science Division of Monterey <b>Pen</b>	An Investigation of the Applicability of Computer Assisted Instr 177 B
	urware to Develop Insight into Arithmetic Using <b>Perceivable</b> Algorithms	Microcomputer Co 165 G
ience	ization: Dynamic Graphics to Develop <b>Perception</b> and Intuition in Pre-Calculus Students	Geometric Visual 172 C
	Sex Differences in <b>Perceptual</b> , Motor and Cognitive Skills as Related to Mathematics and S	183 B
	Determinants of Student Entry and <b>Performance</b> in the Sciences	194 F
	<b>Personal</b> Computers and Cross Age Instruction	153 F
	Climate on Motivation of Scientific Engineering <b>Personnel</b>	Impact of Management Practices and Organizational 173 A
	Comparative Perspectives of Decision Making and R & D <b>Personnel</b>	New Directions in Continuing Education: Comp 174 C
ication for Women's Career Behavior	A Cognitive <b>Perspective</b> on Women Students' Experience with Science Education: Impl	126
	w Directions in Continuing Education: Comparative <b>Perspectives</b> of Decision Making and R & D Personnel	Ne 174 C
	livery Systems for an Undergraduate Curriculum in <b>Pest</b> Management for Plant Protection	Instruction Materials and De 161 G
	gree Curriculum in Solar Engineering Technology <b>Phase II</b>	An Associate De 170 A
	Support of the Planning <b>Phase</b> of the 1980 International Congress of Mathematics Education	185 G
	ervice Materials for Teachers of Grades 4-9 (Final <b>Phase</b> )	Science Careers for Women and Minorities: In Se 91
	r Course in Electronic Instrumentation (ME) Final <b>Phase</b>	The Modula 161 B
	of Problem Solving Instructional Material: Final <b>Phase</b>	Creation, Testing and Dissemination 167 F
	Preparation for Undergraduate <b>Physical</b> Processes in Terrestrial and Aquatic Ecosystems	171 G
ents and Their Families	<b>Physical</b> Sciences Through Concept Based Modules	106
	<b>Physical</b> Science Activities in Out-of-School Settings for Early Adoles	150 G
	<b>Physically</b> Handicapped Students	71
	<b>Physically</b> Handicapped Students in Community Colleges	182 B
	Science Education for Women, Minority, and the <b>Physics</b> and Algebra	Cogn 198 A
	itive Processes and the Structure of Knowledge in <b>Physics</b> and Arithmetic Word Problems	Math 195 E
	ematical Representations of Real-World Knowledge <b>Physics</b> Classes	Issue Orient 164 G
	ed Instructional Modules for Introductory College <b>Physics</b> Instruction	162 B
	Problem Oriented College <b>Physics</b> Instruction	162 C
	Problem Oriented <b>Physics</b> Instruction	164 F
	Tutorial Review: Articles to Update Collegiate <b>Physics</b> Modules Project	165 A
	rocesses and Knowledge Structures Used in Solving <b>Physics</b> Problems	Cognitive P 196 A
	ing Different Levels of Understanding Attained by <b>Physics</b> Students	Identify 191 B
	Conceptual Understanding of <b>Physics</b> Students and Identification of Influencing Factors	196 B
	d Use of Microcomputers in High School Chemistry, <b>Physics, Biology, and Mathematics</b>	Coordinate 90
	ted Children in Accelerated Teaching Programs in <b>Physics, Chemistry, and Mathematics</b>	Research on Ci 189 G
	Development of Problem Solving Skills in <b>Physics: Electrostatics</b>	153 E
	Problem Solving in <b>Physics: Models, Experiments, and Instruction</b>	183 G
	Activities in Teaching High School Chemistry and <b>Physics</b>	Sequencing Language and 135
	Investigation of Student Knowledge in Introductory <b>Physics</b>	An Empirical I 142
	se of Complex Knowledge: Knowing and Reasoning in <b>Physics</b>	The Representation and U 189 F
s and Engineers	Development of <b>Pilot</b> Astronomy Activities for Informal Learning	151 C
	Assessment of <b>Pilot</b> Study of Continuing Environmental Health Education for Scientist	174 B
	The Next Step: A Computer-Facilities Master <b>Placement</b> Needs of Students	180 D
	The Worcester Polytechnic Institute <b>Plan</b> for Saddleback	177 C
	ned Education Programs for Small- and Medium-Size <b>Plan</b>	161 D
	<b>Planetariums</b>	Activity Ba 151 B
	<b>Planning</b> and Teaching of Intermediate Science	129
	<b>Planning</b> and Teaching Middle School Science	191 F
tion	Support of the <b>Planning</b> Phase of the 1980 International Congress of Mathematics Educa	185 G
	n Undergraduate Curriculum in Pest Management for <b>Plant</b> Protection	Instruction Materials and Delivery Systems for a 161 G
	Decision-Making Modules on Public <b>Policy</b> Issues of Science and Technology	153 D
	pective Engineers in Technology Related Public <b>Policy</b>	Educating P 171 F
	Undergraduate Education Improvement in <b>Political</b> Science: Innovation in Instructional Materials	154 C
	High School Students: The Concept of Variables in <b>Polynomials</b>	Using a Visual Technique to Teach 169 F

## Rotated Title Index FY 1981 and Earlier Years

		Page
	The Worcester Polytechnic Institute Plan =	161 D
Visual Graphics	Demo-Graphics: Teaching Population Dynamics in a Multidisciplinary Framework with Interactive	157 D
	Study of CLE Methodologies Potentially Transferable to CESE =	176 B
	Practical Experience = Career-Oriented Degree Progr	149 D
	Social Studies/Social Science Education: Priorities, Practices and Needs =	184 G
Learning Personnel	Impact of Management Practices and Organizational Climate on Motivation of Scientific Engin	173 A
	Out of School Science for Pre-Adolescent/Adolescent Children and Their Parents =	163 A
	Develop Mathematical Perception and Intuition in Pre-Calculus Students = Geometric Visualization: Dynamic Graphics to	172 C
	Improving Spatial Skills in Pre-College Mathematics Through Computer Graphics	88
	Improving Spatial Skills in Pre-College Mathematics Through Computer Graphics =	166 F
Option	Review of Research of Solving Routine Problems in Pre-College Mathematics	A 187 C
	Pre-College Science Education Materials on Mount Saint Helens' 1980 Er	167 G
	Pre-College Students Mental Errors in Arith	171 B
	Precollege Instruction Network for Educa	49
	Interest Worlds: Precollege Mathematics in a Computer Culture	160 G
	Precollege Science Education Project Synthesis: An Interpreti	185 B
Science and Mathematics	The Role of Preconceptions & Representational Transformations in Understanding Sci	197 G
Modules	Preparation for Undergraduate Physical Sciences Through Concept-Based	106
Qual Research, Grades 8-10	The Preparation of Supplemental Instructional Units Based on Current Crust	163 D
Self-Based Modules	Preparing Academically Disadvantaged Students in Sciences Through Conc	172 A
	Interactive Science Museum Exhibits for Preschool Children	156 F
	A College Level Introduction to Computing Principles Through Text Processing	55
	Procedures on Learning and Retention of Scientific Principles	186 A
	Middle School Mathematics Using Microcomputer and Print Materials	Application of Dimensional Analysis to 160 C
	Development and Distribution of Print Modules for Manufacturing Productivity Education	158 A
	A Study of Priorities in School Mathematics (PRISM)	195 A
	Social Studies Social Science Education: Priorities, Practices and Needs	184 G
	A Study of Priorities in School Mathematics (PRISM)	195 A
	Underlying Heuristic and Formal Structures of Probabilistic Thought	197 B
	Expert Novice Differences in Computer Science Problem Comprehension: Studies in Knowledge Organization	182 G
	Middle Grades Mathematics Project Emphasizing Problem Solving	78
	Using Problem Solving in Junior High Mathematics	79
	Abilities and Learner Characteristics in Mathematical Problem Solving	Format Vari 122
Teachers	The Guided Design Approach to Problem Solving A Program for Training Junior High School Science Tea	150 D
	Development of Problem Solving Skills in Physics Electrostatics	151 E
	Instruction for Problem Solving Using the Microcomputer in High School Mathematics	155 D
	Creation, Testing and Dissemination of Problem Solving Instructional Material Final Phase	167 F
	The Microcomputer and Problem Solving Processes in Middle School Mathematics	183 G
	The Use of Heuristics in Problem Solving An Expository Study	186 D
	Facilitating Problem Solving in High School Chemistry	188 E
	for High School Students to Stimulate Scientific Problem Solving	Computer Biology Simulations 189 B
	Effects of Processing Style on Problem Solving in Mathematics	192 F
ation Processing	Expert and Novice Mathematical Problem Solving	193 F
	Psychological Problem Space and Motivation in Adolescent Learning: A Study of Inform	192 G
	Chemistry in the Community A Problem Focused Course for High Schools	58
	Problem-Oriented College Physics Instruction	162 B
Mathematics Students	Problem-Oriented Physics Instruction	162 C
	Problem Solving Processes of Upper Elementary and Junior High School M	114
	Synthesis of Research Related to Mathematics Problem Solving Instruction	115
	Research on Instruction of Problem Solving Skills in Newtonian Mechanics	139
Mathematics Students	High School Students' Genetics Problem Solving Strategies and Knowledge	146
	An Expert Novice Information Processing Study of Problem Solving Processes of Upper Elementary and Junior High School M	182 E
	Applied Problem Solving in Genetics	184 F
	Analysis and Synthesis of Mathematical Problem Solving in Middle School Mathematics	187 D
	Calculator Use and Problem Solving Processes of Early Adolescents	188 F
	Learning Cognitive Processes in Using and Extending Problem Solving Strategies of Early Adolescents	189 A
	Modular Materials on Socio-Technological Problem Solving Skills	Scientific Reas 192 C
	A Review of Research of Solving Routine Problems and Issues	167 B
	Identification of Cognitive Representation in Estimation Problems in Pre College Mathematics	187 C
	Real World Knowledge: Physics and Arithmetic Word Problems	Development and Facil 190 C
	and Knowledge Structures Used in Solving Physics Problems	Mathematical Representations of 195 E
	Effects of Elaboration Procedures on Learning and Retention of Scientific Principles	Cognitive Processes 196 A
	System for Teaching Elementary School Arithmetic Procedures	186 A
	Techniques for Teaching Statistical Concepts and Procedures	Development of an Articulate Instructional 74
	Structure and Process in Children's Mental Arithmetic	Graphic 159 B
	Research on Process Models of Basic Arithmetic Skills	134
Science Programs	Classroom Process Variables in Urban Integrated Junior High School Individualize	197 A
	Using the Teams Games Tournaments Instructional Process	194 D
	Cognitive Processes and Knowledge Structures Used in Solving Physics Problems	Developing Science Curriculum Unit 159 C
	The Microcomputer and Problem Solving Processes and the Structure of Knowledge in Physics and Algebra	196 A
	Structure of Knowledge and Cognitive Processes in Middle School Mathematics	198 A
	Structure of Knowledge and Cognitive Processes in Organic Chemistry	186 C
	Structure of Knowledge and Cognitive Processes in Organic Chemistry	194 G

Rotated Title Index FY 1981 and Earlier Years

		Page
	Physical Processes in Terrestrial and Aquatic Ecosystems	171 G
	Scientific Reasoning: Cognitive Processes in Using and Extending Problem-Solving Skills	192 C
Analysis and Synthesis of Mathematical Problem-Solving	Processes of Early Adolescents	188 F
	Instruction by Mapping: Processes of Learning Mathematics Through Models	140
Problem-Solving	Processes of Upper Elementary and Junior High School Mathematics Studies	114
Problem-Solving	Processes of Upper Elementary and Junior High School Mathematics Studies	182 F
Elementary School Science	Processes Program: Meta-Analysis of Evaluation Studies	194 B
Research on Thought	Processes Used in 7th to 10th Grade Mathematics	188 B
Classroom	Processes, Sex Differences, and Autonomous Learning Behaviors in Mathematics	145
Program of Applied Research on Scientific Reasoning	Processes	191 C
An Information	Processing Analysis of Learning in Geometry	137
An Expert-Novice Information	Processing Study of Problem Solving in Genetics	184 F
Psychology of Equation Solving: An Information	Processing Study	198 C
	Effects of Processing Style on Problem Solving in Mathematics	192 F
Introduction to Computing Principles Through Text	Processing	55
on in Adolescent Learning: A Study of Information	Processing	A College-Level 192 G
Television: Guidelines for Program Evaluation and	Production	Psychological Problem Space and Motivation 155 F
	A Meta-Analysis of Productive Factors in Science Learning in Grades 6 Through 12	187 G
d Distribution of Print Modules for Manufacturing	Productivity Education	Development and 158 A
Increasing the	Productivity of Science Learning in Early Adolescents	187 F
ation of the Continuing Education Achievement of	Professional Competencies Development in the Undergraduate Engineering	165 F
valuation Model for State of the Art Programs for	Professional Engineers	166 A
Workshop on Continuing Education for Industry,	Professional Engineers	An F 173 B
uation of Short Course Method of Instruction for	Professional Societies and Universities	172 G
Conservation Classroom	Professionals in Engineering	173 C
Human Sciences	Program (Advanced)	155 B
Assessment of Mathematics	Program (HSP): A Three Year Integrated Human Sciences Curriculum for Middle Schools	152 G
Classroom Instructional Television: Guidelines for	Program at S. D. Bishop State Junior College	176 F
A Model	Program Evaluation and Production	Toward Improved Candid C 155 F
A Computational Estimation	Program for Continuing Education in Chemical Engineering	160 F
A Strategy/Action	Program for Middle Grades Mathematics	81
The Guided Design Approach to Problem Solving: A	Program for Re-Entry of Women in Science	166 B
Development of a Cooperative Graduate	Program for Training Junior High School Science Teachers	150 D
Self Instructional In Service	Program in Engineering and Public Administration	166 C
	Program in Science Careers: Teachers of Grades 4-9	167 C
On Using	Program of Applied Research on Scientific Reasoning Processes	191 C
Elementary School Science Processes	Program Verifiers in Elementary Computer Programming Instruction	165 F
ety, and the Senior Citizen: A Model Educational	Program: Meta-Analysis of Evaluation Studies	194 B
ety and the Senior Citizen: A Model Educational	Program	Science, Soc 53
trial of an Integrated Undergraduate Science Major	Program	Science, So 153 G
Sociotechnical Systems Design	Program	Development and I 156 G
Misconceptions of Novice Computer	Program	172 F
On Using Program Verifiers in Elementary Computer	Programmers	117
School Course Integrating Statistics and Computer	Programming Instruction	165 F
eractive Conversational Computer Model for Linear	Programming	107
Development of Teaching Materials for Computer	Programming	A High 107
Science Intervention	Programming	Development of an Int 156 A
An Evaluation Model for State of the Art	Programs for Girls: Follow up Study and Evaluation Kit	167 D
Activity Based Education	Programs for Professional Engineers	149 G
Interdisciplinary Master's	Programs for Small and Medium Size Planetariums	173 B
search on Gifted Children in Accelerated Teaching	Programs in Building Studies	151 B
Career Oriented Degree	Programs in Physics, Chemistry, and Mathematics	168 A
A Study of Science Instructional	Programs in the Mathematical Sciences with Emphasis on Practical Exper	Re 189 G
entory of Computing Activities and Related Degree	Programs in Two Year Colleges	149 B
entory of Computing Activities and Related Degree	Programs in U.S. Higher Education	182 C
egrated Junior High School Individualized Science	Programs in U.S. Higher Education Dissemination	Inv 163 F
in Undergraduate Mathematics and Its Applications	Programs	Inv 192 F
Middle Grades Mathematics	Project (UMAP)	Classroom Process Variables in Urban D 194 D
Mathematics Network Curriculum	Project Emphasizing Problem Solving	Modules and Monographs 160 A
Instrumentation Information Network and Curricula (	Project for Middle School Teachers and Students	78
Instrumentation Information Network and Curricula (	Project SIINC)	150 F
ng Needs in Precollege Science Education	Project SIINC)	103
	Project Synthesis: An Interpretive Consolidation of Research Identifi	Scientific I 171 F
	Extension of TVCAI	185 B
Digital System Educational Materials (DISEM	Project)	170 G
Societal Issue Oriented Physics Modules	Project	153 B-
Suomi College Science Education Assessment	Project	165 A
	Research to Promote Science Learning Among Blind Students in Colleges and Univers	179 F
	Research to Promote Science Learning Among Blind Students in Colleges and Univers	108
	Role of the Family in the Promotion of Science Literacy	182 A
e Associate Degree Curriculum to Train Solar	A Proposal to Design, Develop, Implement, Test, Evaluate, and Disseminat	125
	Analysis of the Development of Propositional Reasoning	99
Improving Students' Comprehension of Science	Prove	197 F
	Educating Prospective Engineers in Technology Related Public Policy	184 A
		171 F

Rotated Title Index FY 1981 and Earlier Years

		Page
graduate Curriculum in Pest Management for Plant	<b>Protection</b>	161 G
	<b>Instruction Materials and Delivery Systems for an Undergraduate</b>	157 C
	<b>Prototype Microcomputer Courseware for Teaching High School Algebra</b>	155 G
	<b>A Prototype System to Deliver Continuing Education to Engineers</b>	174 G
Education for Nonacademic Scientists and Engineers	<b>Provided by Industry and Government</b>	A Survey of Continuing Education
	<b>Psychacoustic Demonstration Tapes</b>	160 D
Study of Information Processing	<b>Psychological Problem Space and Motivation in Adolescent Learning: A Study</b>	192 G
	<b>Psychological Structure of Counting and of Early Number Concepts</b>	197 D
	<b>Psychology for Junior High Schools</b>	159 A
	<b>Psychology of Equation Solving: An Information Processing Study</b>	198 C
	<b>Psychology - The Representation and</b>	197 C
Learning of Knowledge Structures in Experimental Mathematics: An Ethnographic, Experimental, and a Cooperative Graduate Program in Engineering and	<b>Psychometric Inquiry</b>	The Ecology of Failure in Ninth Grade General Education
	<b>Public Administration</b>	Development of
A Critical Examination of Factors Associated with The Role of Television Entertainment in Decision-Making Modules on Training Prospective Engineers in Technology-Related Studies on the Scientific Literacy of the Attentive Computer Based Modules for Teachers, Parents and the Computer Storytelling Mathematics for The Development of	<b>Public Attention to Science</b>	121
	<b>Public Education About Science</b>	138
	<b>Public Policy Issues of Science and Technology</b>	153 D
	<b>Public Policy</b>	171 F
	<b>Public</b>	Research Studies
	<b>Public Elementary Mathematics Concepts with Calculators: Microcomputer</b>	151 G
	<b>Pueblo Indian Upper Elementary Level Students</b>	164 E
	<b>Quantification Concepts: A Synthesis</b>	190 G
	<b>Quantitative Understanding to Enhance Social Science Teaching</b>	153 C
	<b>Questioning Skills of Middle School Science Teachers</b>	194 C
	<b>Questions, New Directions</b>	184 E
	<b>Ranger Rick's Nature Magazine</b>	60
	<b>Rational Numbers</b>	Construct Analysis, Manipulative Aids
	<b>Rational Numbers</b>	187 A
	<b>Re-Entry of Women in Science</b>	166 B
	<b>Re-entry Women</b>	50
	<b>Reading from Computer Screens: Learner Control</b>	111
	<b>Reading Strategies and Comprehension</b>	Learning From Science
	<b>Real-World Knowledge: Physics and Arithmetic Word Problems</b>	195 F
	<b>Reasoning Ability in Naturalistic and Laboratory Settings</b>	183 F
	<b>Reasoning Among Adolescents in Natural Settings</b>	183 F
	<b>Reasoning Development: In-Service Training for Middle School Science Teachers</b>	161 C
	<b>Reasoning Improvement Study (MRIS)</b>	109
	<b>Reasoning in Mathematics</b>	47
	<b>Reasoning in Mathematics (Grades 7-9)</b>	151 D
	<b>Reasoning in Mathematics</b>	183 C
	<b>Reasoning in Physics</b>	The Representation
	<b>Reasoning Processes</b>	189 F
	<b>Reasoning Skills in Early Adolescence</b>	191 C
	<b>Reasoning Skills in Early Adolescence</b>	48
	<b>Reasoning, with Applications to Instruction in Geometry</b>	152 A
	<b>Reasoning: Cognitive Processes in Using and Extending Problem Solving</b>	127
	<b>Reasoning</b>	Individual and Group
	<b>Reasoning</b>	192 C
	<b>Reasoning</b>	117 E
	<b>Recent East European Mathematical Literature</b>	63
	<b>Recent East European Literature in School and College Mathematics</b>	157 B
	<b>Region</b>	Continuing Education Needs
	<b>Regional CE Needs in XY Coordinates</b>	174 D
	<b>Regional Workshop for Continuing Education of Working-Level Scientists</b>	175 F
	<b>Related Degree Programs in U.S. Higher Education</b>	172 F
	<b>Related Degree Programs in U.S. Higher Education-Dissemination</b>	163 F
	<b>Related to Life Long Learning for Scientists and Engineers: A Feasibility Study</b>	192 E
	<b>Related to Mathematics Problem Solving Instruction</b>	193 G
	<b>Related to Mathematics and Science</b>	115
	<b>Related to NSF-Supported Curriculum Materials</b>	Sex Differences
	<b>Relationship Between Continuing Education and Career Development of Scientists and Engineers</b>	183 B
	<b>Relationship Between Student Attitudes Toward the Science Curriculum and Mathematics Achievement in Grades 6-8</b>	160 B
	<b>Relationship of Spatial Visualization and Confidence to Male/Female Mathematics Achievement in Grades 6-8</b>	194 A
	<b>Relationship of Learning Styles to the Continuing Education of Graduate Engineers and Scientists</b>	195 C
	<b>Relationships Among Individual Motivation, Work Environment and Updating in Engineering</b>	144
	<b>Relationships Among Individual Motivation, Work Environment and Updating in Engineering</b>	185 E
	<b>Remediation in Pre-College Students</b>	196 F
	<b>Reorientation of Teaching</b>	175 C
	<b>Reports of the Second National Assessment in Mathematics</b>	171 B
	<b>Representation and Use of Complex Knowledge: Knowing and Reasoning in Development and Facilitation of Cognitive</b>	168 C
	<b>Representation and Learning of Knowledge Structures in Experimental Psychology</b>	196 E
	<b>Representational Systems, and the Learning of Rational Numbers</b>	189 F
	<b>Representational Transformations in Understanding Science and Mathematics</b>	190 C
	<b>Representations with "Natural" Mental Representations</b>	197 G
	<b>Representations of Real World Knowledge: Physics and Arithmetic Word Problems</b>	191 A
	<b>Representations</b>	191 A
	<b>Representations</b>	A Study Comparing Formal
	<b>Representations</b>	195 F

Rotated Title Index FY 1981 and Earlier Years

		Page
d Laboratory Settings	A Research Evaluation of Scientific Reasoning Ability in Naturalistic and Science: A Detailed Description of Formative Research for 3-2-1 CONTACT Children, Television	183 E 193 C
	Object Synthesis: An Interpretive Consolidation of Research Identifying Needs in Precollege Science Education	Pr 185 B
	Teaching Bayesian Statistics and Applications for Research in Science Education: New Questions, New Directions	184 E
	Improving Access and Guidance in Engineering, Research in Science Education: Computer Assisted Data Analysis (CADA) for Research into Contributing Factors =	189 D 188 G
Optional Mathematics Courses	Research into Important Factors Influencing Female Selection of First	185 D
Ability	A Review of Research of Solving Routine Problems in Pre-College Mathematics	187 C
s, Chemistry, and Mathematics	Research on Changes in Intellectual Development and Critical Thinking	143
	Synthesis of Research on Gifted Children in Accelerated Teaching Programs in Physics	189 G
	Research on Individualized Science Teaching in Secondary Schools	191 G
	Research on Instruction of Problem-Solving Skills in Newtonian Mechanics	139
	An Analysis of Research on Mathematical Abilities	186 E
Female Mathematics Achievement in Grades 6-8	Research on Process Models of Basic Arithmetic Skills	197 A
Female Mathematics Achievement in Grades 6-8	Research on Relationship of Spatial Visualization and Confidence to Mathematics	144
	Research on Relationship of Spatial Visualization and Confidence in Mathematics	196 F
	Program of Applied Research on Scientific Reasoning Processes	191 C
	Research on Thought Processes Used in 7th to 10th Grade Mathematics	188 B
	Synthesis of Research Related to Mathematics Problem-Solving Instruction	115
	Statistical Analysis of Research Results in College Science Teaching	191 F
	Research Studies on the Scientific Literacy of the Attentive Public	187 B
Knowledge	A Research Study of Computer Based Tutoring of Mathematical and Scientific	190 E
and Universities	Cognitive Style in the Learning of Mathematics: A Research Study	The Role of 182 F
and Universities	Research to Promote Science Learning Among Blind Students in Colleges	108
	Research to Promote Science Learning Among Blind Students in Colleges	182 A
	Instructional Units Based on Current Crustal Research, Grades 8-10	The Preparation of Supplement 163 D
	Dissemination of Logo-Based Educational Research	159 D
	Findings on Sex Differences in Science Education Research	A Synthesis of 188 C
	Development of Resource Material for Instruction in Use of Underground Space	163 E
	Statistical Analysis of Research Results in College Science Teaching	191 F
	Effects of Elaboration Procedures on Learning and Retention of Scientific Principles	186 A
	Tutorial Review Articles to Update Collegiate Physics Instruction	164 F
	A Review of Research of Solving Routine Problems in Pre-College Mathematics	187 C
	Spanish Translation and Feasibility Study of Ranger Rick's Nature Magazine	Sp 60
	Instructional Films in Ethology "Behavior of the Ring Dove"	Development of 165 D
	Role Models for Adolescent Girls in Science and Math	152 B
	Role Models for Adolescent Girls in Science and Mathematics	152 C
	The Role of Cognitive Style in the Learning of Mathematics: A Research Study	182 F
	Strategies for Learning Emphasizing the Nature and Role of Concepts	S 193 E
	The Role of Manipulative Aids in the Learning of Rational Numbers	187 A
	The Role of Preconceptions & Representational Transformations in Understanding	197 G
	The Role of Television Entertainment in Public Education About Science	138
	The Role of the Family in the Promotion of Scientific Literacy	125
	A Review of Research of Solving Routine Problems in Pre-College Mathematics	187 C
	Assessment of Mathematics Program at S. D. Bishop State Junior College	176 F
	Next Step: A Computer Facilities Master Plan for Saddleback	The 177 C
	Science Activities for Informal Learning (SAII) (Age 11-14)	61
	Pre-College Science Education Materials on Mount Saint Helens' 1980 Eruption	167 G
	Education Materials on Mount Saint Helens	93
	Behavior Anchored Scales - A Method of Identifying Continuing Education Needs of Engineers	175 B
Lotype Microcomputer Courseware for Teaching High School Algebra	School Algebra	Pro 157 C
n Tool for Teaching Modern Optical Theory in High School and College Physics	School and College Physics	Computer Graphics Technology as a Visualization 156 F
Survey of Recent East European Literature in School and College Mathematics	School and College Mathematics	157 B
Ideological Materials for Women and Minorities (High School and Undergraduate Mathematics in Biology)	School and Undergraduate Mathematics in Biology	Computer Controlled V 105
late Instructional System for Teaching Elementary School Arithmetic Procedures	School Arithmetic Procedures	Development of an Artificial 74
Coordinated Use of Microcomputers in High School Chemistry, Physics, Biology, and Mathematics	School Chemistry, Physics, Biology, and Mathematics	90
quencing Language and Activities in Teaching High School Chemistry and Physics	School Chemistry and Physics	Se 135
Facilitating Problem Solving in High School Chemistry	School Chemistry	188 E
Family Involving Science Education for Elementary School Children	School Children	136 C
	High School Computer Science Education	97
	High School Computer Science Education	169 G
	A High School Course Integrating Statistics and Computer Programming	107
	Secondary School Course in Applications of Mathematics to Science	154 B
Process Variables in Urban Integrated Junior High School Individualized Science Programs	School Individualized Science Programs	Classroom 194 D
Graphing in High School Level Algebra and Trigonometry for Adults	School Level Algebra and Trigonometry for Adults	171 D
Microcomputer Applications of Mathematics in High School Management Science	School Management Science	65
Modular Computer Based Approach to Improving High School Mathematics Instruction	School Mathematics Instruction	A 57
Electronic Technology Implications for Secondary School Mathematics Curricula	School Mathematics Curricula	Micro 73
Learning Processes of Upper Elementary and Junior High School Mathematics Students	School Mathematics Students	Problem Solv 114
Problem Solving Using the Microcomputer in High School Mathematics	School Mathematics	Instruction for 155 D
Application of Dimensional Analysis to Middle School Mathematics Using Microcomputer and Print Materials	School Mathematics Using Microcomputer and Print Materials	160 C
Computer Graphics in a High School Mathematics Laboratory	School Mathematics Laboratory	168 B
Learning Processes of Upper Elementary and Junior High School Mathematics Students	School Mathematics Students	Problem Solv 182 F
Microcomputer and Problem Solving Processes in Middle School Mathematics	School Mathematics	The Micro 186 C

## Rotated Title Index FY 1981 and Earlier Years

	Page
A Study of Priorities in School Mathematics (PRISM)	195 A
Middle School Microcomputer Statistics Laboratory	52
High School Minicourse on Chronobiology	163 B
Development of Computer-Based Learning Models in Secondary School Science and Mathematics	85
Problem Solving: A Program for Training Junior High School Science Teachers	150 D
Learning Development: In Service Training for Middle School Science Teachers	161 C
Out of School Science for Pre-Adolescent/Adolescent Children and Their Parents	163 A
Elementary School Science Processes Program: Meta-Analysis of Evaluation Studies	194 B
Wait Time and Questioning Skills of Middle School Science Teachers	194 C
The Status of Middle School/Junior High School Science	184 C
Planning and Teaching Middle School Science	191 E
Factors on Teaching Math and Science to Junior High School Students	77
Impact of Microcomputer-Based Instruction on High School Students' Genetics Problem Solving Strategies and Knowledge	146
An Instructional Model in Human Genetics for High School Students	152 F
Factors on Teaching Math and Science to Junior High School Students	162 A
Using a Visual Technique to Teach High School Students the Concept of Variables in Polynomials	169 F
Computer Biology Simulations for High School Students to Stimulate Scientific Problem Solving	189 B
Mathematics Network Curriculum Project for Middle School Teachers and Students	150 F
A Computer Graphics Learning Environment for High School Trigonometry	95
Technology and the Individual: A School TV Series for Adolescents	159 E
Microcomputer-Based Instruction and Video-Based Mathematics Modules for High School Women and Minority Students	51
Impact of Science Among Adolescent Students	133
Impact of Science Among Adolescent Students	194 F
School, Family, and Individual Influences on Commitment to and Learning in	184 C
The Status of Middle School Junior High School Science	72
Ethical Knowledge: An Instructional TV Unit for High School	156 B
Strategies for Mathematics in Junior High and High School	86
Semester A Televised Course on Energy Involving Schools of Continuing Education	58
Chemistry in the Community: A Problem Focused Course for High Schools	69
COMETS II: Career-Oriented Science Topics for Elementary and Middle Schools	96
TV Series in Technology and Society for Secondary Schools	102
Teacher Literacy Guides for Elementary and Junior High Schools	149 A
Scientist in Residence in Eskimo Indian High Schools	152 G
Human Sciences Program (HSP): A Three Year Integrated Human Sciences Curriculum for Middle Schools	157 F
Using Microcomputers to Teach Social Science in Junior and Senior High Schools	159 A
Applications in Experimental Psychology for Junior High Schools	171 C
Teacher Literacy Guides for Elementary and Junior High Schools	191 G
Synthesis of Research on Individualized Science Teaching in Secondary Schools	193 A
Geometric Thinking Among Adolescents in Inner City Schools	153
Innovation: The Social Consequences of Science and Technology	152 G
Human Sciences Program (HSP): A Three Year Integrated Human Sciences Curriculum for Middle Schools	152 G
Human Sciences Program (HSP): A Three Year Integrated Human Sciences Curriculum for Middle Schools	106
Preparation for Undergraduate Physical Sciences Through Concept-Based Modules	172 A
Preparing Academically Disadvantaged Students in Career Oriented Degree Programs in the Mathematical Sciences Through Concept-Based Modules	149 D
Sciences with Emphasis on Practical Experience	Ca
Sciences, 1980-81	118
Sciences, 1980-81	185 F
Sciences	169 E
Sciences	194 F
Sciences	173 A
Sciences	103
Sciences	171 E
Sciences	72
Sciences	180 E
Sciences	187 B
Sciences	190 B
Sciences	186 A
Sciences	189 B
Sciences	112
Sciences	183 E
Sciences	181 F
Sciences	191 C
Sciences	192 C
Sciences	197 F
Sciences	149 A
Sciences	172 F
Sciences	174 A
Sciences	174 B
Sciences	174 F
Sciences	174 G
Sciences	175 A
Sciences	193 G
Sciences	194 A
Sciences	176 A
Sciences	185 E

SIINC )  
SIINC )



Rotated Title Index FY 1981 and Earlier Years

		Page
Conceptual Change in Children and in Adult Scientists		190 D
Dynamic Reading from Computer Screens Learner Control		111
Interpretive Reports of the Second National Assessment in Mathematics		96 E
of Using the National Assessment Science Data for Secondary Analysis	The Feasibility	187 E
Microelectronic Technology Implications for Secondary School Mathematics Curricula		73
Development of Computer Based Learning Models in Secondary School Science and Mathematics		85
Instructional TV Series in Technology and Society for Secondary Schools	You, Me and Technology An Inst	96
of Research on Individualized Science Teaching in Secondary Schools	Synthesis	154 B
Development of Selected Undergraduate Course Materials in Applied Mathematical Model		167 A
Student Attitudes Toward the Science Curriculum and the Selected Variables	The Relationship Between St	195 C
Research into Important Factors Influencing Female Selection of First Optional Mathematics Courses	R	185 D
Logical Competencies and Activity Selection Patterns in Early Adolescents: A Longitudinal Study		184 D
Triton Comprehensive Self Assessment of Science Education		178 B
Self Instructional In Service Program in Science Careers Teachers of		167 C
Self Paced Tutorial Courses for Mineral Science Metallurgy Departments		163 G
Semantics of Arithmetic Teaching Understanding and Computational Skill		195 G
Semester A Televised Course on Energy Involving Schools of Continuing		86
Science, Society, and the Senior Citizen A Model Educational Program		53
Science, Society and the Senior Citizen A Model Educational Program		153 G
Microcomputers to Teach Social Science in Junior and Senior High Schools	Using Mic	157 E
Technology and the Individual A School TV Series for Adolescents		135
You, Me and Technology An Instructional TV Series in Technology and Society for Secondary Schools		96
Foundation Exploratory Development of a Coherent Series of Participatory Exhibits for the Palace of Arts and Science Fo		150 A
An Urban Extension Service Model		152 D
Diagnostic and Instructional Service Oriented Options in Mathematics		172 B
Physical Science Activities in Out of School Services for Undergraduate Students of Statistics		164 B
A Science Course for Youth in Informal Settings for Early Adolescents and Their Families		150 G
Reasoning Ability in Naturalistic and Laboratory Settings Learning to Experiment		150 A
Scientific Reasoning Among Adolescents in Natural Settings	A Research Evaluation of Scientific	183 F
Science Literacy In and Out of School Emphasis on Factors Which Influence		183 F
Curricular Materials in Computer Aided Acquisition of Sc		110
Evaluation of Short Course Method of Instruction for Professionals in Engineering		173 C
Information Network and Curricula (Project Scientific Instrumen		103
Information Network and Curricula (Project Scientific Instrumen		171 E
Units for 11th and 12th Grade Mathematics) Using Microcomputer Instructional		162 G
Computer Biology Simulations for High School Students to Stimulate Scientific Problem Sol		189 B
ter Based Models for Socio Economic Technological Educational Compu		168 E
Arithmetic Teaching Understanding and Computational Semantics of Ar		195 G
Sex Differences in Perceptual, Motor and Cognitive Skills as Related to Mathematics and Science	S	183 B
Development of Reasoning Skills in Early Adolescence		48
Development of Reasoning Skills in Early Adolescence		152 A
Development of Estimation Skills in Mathematics Using Computer Games		113
Research on Instruction of Problem Solving Skills in Newtonian Mechanics		139
Development of Problem Solving Skills in Physics Electrostatics		153 F
Improving Spatial Skills in Pre College Mathematics Through Computer Graphics		88
Improving Spatial Skills in Pre College Mathematics Through Computer Graphics		166 F
Wait Time and Questioning Skills of Middle School Science Teachers		194 C
Analysis of Student Skills, Needs and Goals		179 B
Mental Errors in Arithmetic Skills Their Diagnosis and Remediation in Pre College Students		171 B
Processes in Using and Extending Problem Solving Skills Scientific Reasoning Cognitive		192 C
Research on Process Models of Basic Arithmetic Skills		197 A
Systems for Scientists and Engineers Employed in Needs Assessment of Continuing Education Delivery		175 A
Scientists Engineers' Continuing Education Needs in Assessment of		176 A
Activity Based Education Programs for Small, Geographically Dispersed Industries		151 B
Innovations The Social and Medium Size Planetariums		153 A
Quantitative Understanding to Enhance Social Consequences of Science and Technology		153 C
Using Microcomputers to Teach Social Science Teaching		157 F
Feasibility of Computer Assisted Instruction in the Social Science in Junior and Senior High Schools		177 B
Science in Bilingual Classrooms Interaction and Social Science Division of Monterey Pen	An Investigation of the Appl	183 A
Level of Attitudes Toward Mathematics, Science, and Social Status	Learning	184 G
Use of Computer Models in the Context of Competing Social Studies Social Science Education Priorities, Practices and Need	Correla	136
Use of Computer Models in the Context of Competing Social Values	New Undergraduate Engineering Materia	84
Continuing Education for Industry, Professional Societal Issue Oriented Physics Modules Project	New Undergraduate Engineering Mater	164 C
Science, Society and the Senior Citizen A Model Educational Program		165 A
ogy An Instructional TV Series in Technology and Society for Secondary Schools	Workshop o	172 G
ent of Modular Courses in Science, Technology and Society for University Freshmen and Sophomores	You, Me and Technol	96
Science, Society, and the Senior Citizen A Model Educational Program	Developm	168 F
Mathematics in Society Multimedia Materials for 8th 10th Grade Students		53
		59

## Rotated Title Index FY 1981 and Earlier Years

	Page
Mathematics in Society: Multimedia Materials for 8th-10th Grade Students =	155 A
Computer Literacy and the Impact of Computers on Society =	165 B
Educational Computer-Based Models for Socio-Economic-Technological Situations (E-COMSETS) =	168 E
Modular Materials on Socio-Technological Problems and Issues =	167 B
Curriculum and Instructional Material in Applied Sociology =	Development of 169 D
Sociotechnical Systems Design Program =	172 E
An Associate Degree Curriculum in Solar Engineering Technology - Phase II =	170 A
Disseminate Associate Degree Curriculum to Train Solar =	A Proposal to Design, Develop, Implement, Test, Evaluate, and 99
Facilitating Problem Solving in High School Chemistry =	188 E
Using Problem Solving in Junior High Mathematics =	79
Effects of Processing Style on Problem Solving in Mathematics =	192 F
Creation, Testing and Dissemination of Problem Solving Instructional Material--Final Phase =	183 G
ognitive Processes and Knowledge Structures Used in Solving Physics Problems =	167 F
The Microcomputer and Problem Solving Processes in Middle School Mathematics =	Cog 196 A
A Review of Research of Solving Routine Problems in Pre-College Mathematics =	186 C
Development of Problem Solving Skills in Physics/Electrostatics =	187 C
Instruction for Problem Solving Using the Microcomputer in High School Mathematics =	153 E
The Guided Design Approach to Problem Solving: A Program for Training Junior High School Science Teachers =	155 D
The Use of Heuristics in Problem Solving: An Expository Study =	150 D
Psychology of Equation Solving: An Information Processing Study =	186 D
le Grades Mathematics Project Emphasizing Problem Solving =	198 C
d Learner Characteristics in Mathematical Problem Solving =	Mid 78
h School Students to Stimulate Scientific Problem Solving =	Format Variables an 122
Expert and Novice Mathematical Problem Solving =	Computer Biology Simulations for Hig 189 B
chnology and Society for University Freshmen and Sophomores =	Development of Modular Courses in Science, T 168 F
Psychological Problem Space and Motivation in Adolescent Learning: A Study of Information Pr	192 G
ce Material for Instruction in Use of Underground Space =	Space-Centered Activity Kit for Junior High Science Instruction = 156 D
zine =	Development of Resour 163 E
Improving Spatial Skills in Pre-College Mathematics Through Computer Graphics =	Spanish Translation and Feasibility Study of Ranger Rick's Nature Maga 60
Research on Relationship of Spatial Visualization and Confidence to Male/Female Mathematics Achiev	88
Research on Relationship of Spatial Visualization and Confidence in Male/Female Mathematics Achiev	166 F
Development of a Mobile Spectroscopy Laboratory =	144
Conversion of Text to Speech for Computer-Aided Instruction =	196 F
Assisted Instruction (CAI) and Computer-Generated Speech in Mathematics =	University Level, Computer- 149 B
Assessment of Mathematics Program at S.D. Bishop State Junior College =	160 E
An Evaluation Model for State of the Art Programs for Professional Engineers =	150 F
Graphic Techniques for Teaching Statistical Concepts and Procedures =	176 E
Cognitive Structures Underlying Statistical Inference =	173 B
A High School Course Integrating Statistics and Computer Programming =	Statistical Analysis of Research Results in College Science Teaching = 191 F
isted Data Analysis (CADA) for Teaching Bayesian Statistics and Applications for Research in Science Educ =	Computer As 189 D
Middle School Microcomputer Statistics Laboratory =	52
Computer-Enhanced Statistics Modules for the Upper Elementary Grades =	80
Instructional Services for Undergraduate Students of Statistics =	Diagnostic and Ins 164 B
ce in Bilingual Classrooms: Interaction and Social Status =	Status of Middle School/Junior High School Science = 184 C
r Biology Simulations for High School Students to Stimulate Scientific Problem Solving =	Learning Scienc 183 A
Outdoor Biology Instructional Strategies (OBIS) =	177 C
High School Students' Genetics Problem-Solving Strategies and Knowledge =	The Next Step: A Computer Facilities Master Plan for Saddleback = 189 B
nd Mathematics Textbooks: Text Structure, Reading Strategies and Comprehension =	Learning From Science a 198 D
Microcomputer-Based Strategies for Mathematics in Junior High and High School =	156 B
Calculator Use and Problem-Solving Strategies of Early Adolescents =	193 E
An Investigation of Instructional Strategies to Enhance Meaningful Learning in Biology =	189 A
Learner-Controlled Instructional Strategies: An Empirical Investigation =	123
An Investigation of the Structure and Dynamics of Classroom Communication of Science =	149 E
The Logical, Mathematical, and Psychological Structure of Counting and of Early Number Concepts =	166 B
Cognitive Processes and the Structure of Knowledge in Physics and Algebra =	193 B
ning From Science and Mathematics Textbooks: Text Structure, Reading Strategies and Comprehension =	134
The Representation and Learning of Knowledge Structures in Experimental Psychology =	197 D
Underlying Heuristic and Formal Structures of Probabilistic Thought =	194 G
Cognitive Structures Underlying Statistical Inference =	198 A
Cognitive Processes and Knowledge Structures Used in Solving Physics Problems =	Lear 198 D
Science for the Non-Science Student at Illinois Central College: An Assessment of Science Needs fo	197 C
	193 D
	197 B
	128
	196 A
	178 A

**Rotated Title Index FY 1981 and Earlier Years**

		Page
	The Relationship Between Student Attitudes Toward the Science Curriculum and Selected Variables	195 C
	Determinants of Student Entry and Performance in the Sciences =	194 F
	Curriculum Analysis, Student Interrogation and Information System =	98
	Curriculum Analysis, Student Interrogation and Information System =	170 B
	An Empirical Investigation of Student Knowledge in Introductory Physics =	142
	Early Adolescent Student Reasoning in Mathematics =	183 C
	Analysis of Student Skills, Needs and Goals =	179 B
	Conceptual Understanding of Physics Students and Identification of Influencing Factors =	196 B
	Research to Promote Science Learning Among Blind Students in Colleges and Universities =	108
	Research to Promote Science Learning Among Blind Students in Colleges and Universities =	182 A
	Women, Minority, and the Physically Handicapped Students in Community Colleges = Science Education fo	182 B
	Preparing Academically Disadvantaged Students in Sciences Through Concept-Based Modules =	172 A
	Diagnostic and Instructional Services for Undergraduate Students of Statistics = Diagno	164 B
	Using a Visual Technique to Teach High School Students the Concept of Variables in Polynomials =	169 F
	Computer Biology Simulations for High School Students to Stimulate Scientific Problem Solving =	189 B
	Improving Students' Comprehension of Science Prose =	184 A
career Behavior =	A Cognitive Perspective on Women Students' Experience with Science Education: Implication for Women's, C	126
	High School Students' Genetics Problem-Solving Strategies and Knowledge =	146
	Students, Curricula and Laboratories - A Needs Assessment =	179 C
	Skills and Literacy of Adolescent and Early Adolescent Students: An Empirical Assessment = Computer Awareness	130
	Skills and Literacy of Adolescent and Early Adolescent Students: An Empirical Assessment = Computer Awareness	192 A
	Mathematics Modules for High School Women and Minority Students = Microcomputer and Video-Based Mathe	51
	Society: Multimedia Materials for 8th-10th Grade Students = Mathematics in	59
	Mathematics Concepts for Physically Handicapped Students = Fundamenta	71
	Teaching Math and Science to Junior High School Students = Impact of Microcomputers o	77
	Upper Elementary and Junior High School Mathematics Students = Problem-Solving Processes of Up	114
	Content and Learning of Science Among Adolescent Students = School, Family, and Individual Influences on Commi	133
	Curriculum Project for Middle School Teachers and Students = Mathematics Network	150 E
	Mathematics Cognition for Beginning College Science Students = Visual Geometry and Ma	152 E
	Instructional Model in Human Genetics for High School Students = An Inst	152 F
	Society: Multimedia Materials for 8th-10th Grade Students = Mathematics in	155 A
	Development of Science Materials for Early Adolescent Minority Students = Development o	161 E
	Teaching Math and Science to Junior High School Students = Impact of Microcomputers o	162 A
	Mathematics for Pueblo Indian Upper-Elementary Level Students = Computer Storytelling Mat	164 E
	Students: Their Diagnosis and Remediation in Pre-College Students = Mental Errors in Arithmetic Skill	171 B
	Assessment of Placement Needs of Students =	180 D
	Upper Elementary and Junior High School Mathematics Students = Problem-Solving Processes of Up	182 E
	Identified Levels of Understanding Attained by Physics Students = Identifying Diff	191 B
	Content and Learning of Science Among Adolescent Students = School, Family, and Individual Influences on Commi	194 E
	Mathematical Perception and Intuition in Pre-Calculus Students = Geometric Visualization: Dynamic Graphics to Develop Math	172 C
	Global Studies in Geography for the Middle Grades =	66
	Differences in Computer Science Problem Comprehension: Studies in Knowledge Organization = Expert-Novice Diff	182 G
	Research Studies on the Scientific Literacy of the Attentive Public =	187 B
	Social Studies/Social Science Education: Priorities, Practices and Needs	184 G
	Attitudes Toward Mathematics, Science, and Social Studies = Correlates of	136
	Interdisciplinary Master's Programs in Building Studies =	168 A
	Science Processes Program: Meta-Analysis of Evaluation Studies = Elementary School Scien	194 B
	Mathematical Reasoning Improvement Study (MRIS) =	109
	Science Intervention Programs for Girls: Follow-up Study and Evaluation Kit = S	149 G
Representations	A Study Comparing Formal Algebraic Representations with "Natural" Mental	191 A
	and Teaching Whole Numbers: An Interdisciplinary Study of an Experimental Model = Learning	186 G
	Study of CLE Methodologies Potentially Transferable to CESE =	176 B
Age	A Research Study of Computer-Based Tutoring of Mathematical and Scientific Knowle	190 E
	A Study of Computer Use and Literacy in Science Education =	192 B
Engineers	Pilot Study of Continuing Environmental Health Education for Scientists and	174 B
society	Study of Courses in Computer Literacy and the Impact of Computers on S	165 B
	Chem Space and Motivation in Adolescent Learning: A Study of Information Processing = Psychological Probl	192 G
	Investigation of Conceptual Development in the Study of Motion =	196 D
	The Brain and Education: A Study of Neuroscience, Cognitive Science, and Education =	132
	A Study of Priorities in School Mathematics (PRISM) =	195 A
	An Expert-Novice Information Processing Study of Problem-Solving in Genetics =	184 F
	Spanish Translation and Feasibility Study of Ranger Rick's Nature Magazine =	60
	Study of Science Education in Two-Year Colleges =	179 A
	A Study of Science Instructional Programs in Two-Year Colleges =	182 C
of Science Concepts in Adolescents	A Study of the Use of Time-Series Designs for Assessing the Development =	195 B
	A Longitudinal Study of Women and Minorities in Science and Engineering =	182 D
	Electronics Industry Continuing Education Effectivity Study = U.S. Elec	173 G
	Style in the Learning of Mathematics: A Research Study = The Role of Cognitive	182 F
	Learning Patterns in Early Adolescents: A Longitudinal Study = Logical Competencies and Activity Select	184 D
	Use of Heuristics in Problem Solving: An Expository Study = The Us	186 D
	Training for Scientists and Engineers: A Feasibility Study = Factors Related to Life-Long Lea	193 G
	Psychology of Equation Solving: An Information Processing Study = Psycholo	198 C
	The Role of Cognitive Style in the Learning of Mathematics: A Research Study =	182 F
	Effects of Processing Style on Problem Solving in Mathematics =	192 F

## Rotated Title Index FY 1981 and Earlier Years

		Page
Continuing Education	The Relationship of Learning Styles to the Continuing Education of Graduate Engineers and Scientists	185 E
	Sunrise Semester: A Televised Course on Energy Involving Schools of Co	86
	Suomi College Science Education Assessment Project =	179 E
	Supervisors = Regional Workshop for Continuin	172 F
Grades 8-10	The Preparation of Supplemental Instructional Units Based on Current Crustal Research, Gr	163 D
	Support Centers for Microcomputer Applications in Science Education =	76
	Support Centers for Microcomputer Applications in Science Education =	161 F
Thematics Education	Support of the Planning Phase of the 1980 International Congress of Ma	185 G
As Provided by Industry and Government	A Survey of Continuing Education for Nonacademic Scientists and Engineer	174 G
	Survey of Recent East European Mathematical Literature =	63
	Survey of Recent East European Literature in School and College Mathem	157 B
	Survey of Science Understanding and Attitudes =	131
	Survey of Science Understanding and Attitudes =	192 D
	Survey of Undergraduate Education in the Mathematical Sciences, 1980-8	118
	Survey of Undergraduate Education in the Mathematical Sciences, 1980-8	185 F
Integration of Women in Science	The Synthesis of Evidence and Theoretical Explanations of the Underrepres	116
	A Synthesis of Findings on Sex Differences in Science Education Research	188 C
Analysis and	Synthesis of Mathematical Problem-Solving Processes of Early Adolescenc	188 F
on =	Synthesis of Research Related to Mathematics Problem-Solving Instructi	115
Schools	Synthesis of Research on Individualized Science Teaching in Secondary	191 G
in Precollege Science Education	Project Synthesis: An Interpretive Consolidation of Research Identifying Needs	185 B
	The Development of Quantification Concepts: A Synthesis =	190 G
	Digital System Educational Materials (DISEM Project) =	153 B
	Model System for Dissemination of Microcomputer-Based Instructional Material	75
	A Computer Conferencing System for Peer Evaluation and Commentary on Essay Tests =	157 F
	A Model Computer-Based Interpretive System for Science Museums =	168 D
	Development of an Articulate Instructional System for Teaching Elementary School Arithmetic Procedures =	74
	A Microcomputer-Based Laboratory Measurement System for Undergraduate Electrical Engineering Laboratories =	168 G
el Continuing Education Needs Assessment/Response	System in Science and Engineering =	A Mod 175 D
	A Prototype System to Deliver Continuing Education to Engineers =	155 G
	An Intelligent Videodisc System: Evaluation in Developmental Biology =	101
	An Intelligent Videodisc System: Evaluation in Developmental Biology =	171 A
m Analysis, Student Interrogation and Information	System	Curriculu 98
	Individualized Science Instructional System	155 C
m Analysis, Student Interrogation and Information	System	Curriculu 170 B
to Include Demonstration of Intelligent Videodisc	System	Extension of TVCAI Project 170 G
ies Learning	Systematic Investigation of the Cognitive Effects of Games on Mathemat	196 G
	Conceptual Systems and Decisionmaking in Teaching Mathematics =	119
	Sociotechnical Systems Design Program	172 E
rotection	Instruction Materials and Delivery Systems for an Undergraduate Curriculum in Pest Management for Plant P	161 G
	Needs Assessment of Continuing Education Delivery Systems for Scientists and Engineers Employed in Small, Geographica	175 A
	Development of Video Systems for Teaching Meteorology	172 D
	Education for Scientists and Engineers: Delivery Systems in North Carolina	Continuing 174 F
uct Analysis, Manipulative Aids, Representational	Systems, and the Learning of Rational Numbers	Constr 120
n Male/Female Mathematics Achievement in Grades 6 t	Research on Relationship of Spatial Visualization and Confidence	196 F
	Psychoacoustic Demonstration Tapes	160 D
	Using Non-Formal Contexts to Teach Children Science	170 D
	Using a Visual Technique to Teach High School Students the Concept of Variables in Polynomials	169 F
	Using Microcomputers to Teach Social Science in Junior and Senior High Schools	157 E
ties Network Curriculum Project for Middle School	Teachers and Students	Mathema 150 E
or Women and Minorities-In-Service Materials for	Teachers of Grades 4-9 (Final Phase)	Science Careers f 91
tructional In-Service Program in Science Careers:	Teachers of Grades 4-9	Self-Ins 167 C
o the Graduate Training Needs of Two-Year College	Teachers of Mathematics	An Inquiry int 181 F
	Network for Educating Teachers of Science in Applying Computers to Precollege Instruction	49
with Calculators: Microcomputer-Based Modules for	Teachers, Parents and the Public	Elementary Mathematics Concepts 151 G
A Program for Training Junior High School Science	Teachers	The Guided Design Approach to Problem Solving: 150 D
nt: In-Service Training for Middle School Science	Teachers	Reasoning Developme 161 C
e and Questioning Skills of Middle School Science	Teachers	Wait Tim 194 C
	Teaching and Learning in Graduate Geography	154 G
Computer Assisted Data Analysis (CADA) for	Teaching Bayesian Statistics and Applications for Research in Science	189 D
ent of a Microcomputer Network and Courseware for	Teaching Chemical Engineering Design	Developm 159 E
lppment of an Articulate Instructional System for	Teaching Elementary School Arithmetic Procedures	Deve 74
Sequencing Language and Activities in	Teaching High School Chemistry and Physics	135
Prototyp Microcomputer Courseware for	Teaching High School Algebra	157 C
Synthesis of Research on Individualized Science	Teaching in Secondary Schools	191 G
	Teaching Materials in Microbiology	154 E
	Teaching Materials in Microbiology for Community and Junior Colleges	154 F
	Teaching Materials for Computer Programming	167 D
Development of	Teaching Math and Science to Junior High School Students	77
Impact of Microcomputers on	Teaching Math and Science to Junior High School Students	162 A
Impact of Microcomputers on	Teaching Mathematics	119
Conceptual Systems and Decisionmaking in	Teaching Meteorology	172 D
Development of Video Systems for	Teaching Middle School Science	191 E
Planning and	Teaching Modern Optical Theory in High School and College Ph	Compute 156 F
r Graphics Technology as a Visualization Tool for		

## Rotated Title Index FY 1981 and Earlier Years

		Page
	Computer-Oriented Teaching Modules in Geochemistry =	170 F
	Planning and Teaching of Intermediate Science =	129
eractive Visual Graphics =	Demo-Graphics: Teaching Population Dynamics in a Multidisciplinary Framework with Int	157 D
	Research on Gifted Children in Accelerated Teaching Programs in Physics, Chemistry, and Mathematics =	189 G
	Graphic Techniques for Teaching Statistical Concepts and Procedures =	159 B
	Semantics of Arithmetic: Teaching Understanding and Computational Skill Via Computer =	195 G
Model =	Learning and Teaching Whole Numbers: An Interdisciplinary Study of an Experimental	186 G
	Intuitive Understanding to Enhance Social Science Teaching =	153 C
	Laboratory and Lecture Materials for Oceanography Teaching =	164 D
	Experimental Partnership for the Reorientation of Teaching =	168 C
	Analysis of Research Results in College Science Teaching =	191 F
	Developing Science Curriculum Units Using the Teams-Games-Tournaments Instructional Process	159 C
	Increasing the Meaningfulness of Technical Information for Novices =	184 B
	Factors That Influence the Technical Updating of Engineers =	195 F
	Development of a General Engineering Technician Curriculum =	163 C
ynomials	Using a Visual Technique to Teach High School Students the Concept of Variables in Po	169 F
	Graphic Techniques for Teaching Statistical Concepts and Procedures	159 B
	Associate Degree Curriculum in Solar Engineering Technology - Phase II	170 A
	Me and Technology: An Instructional TV Series in Technology and Society for Secondary Schools	96
	Technology and the Individual - A School TV Series for Adolescents	159 F
	Development of Modular Courses in Science, Technology and Society for University Freshmen and Sophomores	168 F
in High School and College Ph	Computer Graphics Technology as a Visualization Tool for Teaching Modern Optical Theory	156 E
	Educating Prospective Engineers in Technology-Related Public Policy	171 F
econdary Schools	You, Me and Technology: An Instructional TV Series in Technology and Society for S	96
	Microelectronic Technology: Implications for Secondary School Mathematics Curricula	73
	Innovations: The Social Consequences of Science and Technology	153 A
	ng Modules on Public Policy Issues of Science and Technology	153 D
	Sunrise Semester: A Televised Course on Energy Involving Schools of Continuing Education	86
or 3-2-1 CONTACT	Children, Television and Science: A Detailed Description of Formative Research f	193 C
	The Role of Television Entertainment in Public Education About Science	138
	Toward Improved Candid Classroom Instructional Television: Guidelines for Program Evaluation and Production	155 E
	Science Understanding in Adults Through Television	186 B
	Physical Processes in Terrestrial and Aquatic Ecosystems	171 G
olar	A Proposal to Design, Develop, Implement, Test, Evaluate, and Disseminate Associate Degree Curriculum to Train S	99
inal Phase	Création, Testing and Dissemination of Problem Solving Instructional Material--F	167 F
	ystem for Peer Evaluation and Commentary on Essay Tests	157 F
	Level Introduction to Computing Principles Through Text Processing	55
	Learning From Science and Mathematics Textbooks: Text Structure, Reading Strategies and Comprehension	198 D
	Conversion of Text to Speech for Computer-Aided Instruction	160 E
	Learning From Science and Mathematics Textbooks: Text Structure, Reading Strategies and Comprehension	198 D
	The Synthesis of Evidence and Theoretical Explanations of the Underrepresentation of Women in Science	116
	a Visualization Tool for Teaching Modern Optical Theory in High School and College Ph Computer Graphics Technology as	156 E
	Changes in Intellectual Development and Critical Thinking Ability	143
	Geometric Thinking Among Adolescents in Inner City Schools	193 A
	The Development of Applied Scientific Thinking in Children and Adolescents	197 F
	Measurement and Analysis of Patterns of Logical Thinking	189 C
	Research on Thought Processes Used in 7th to 10th Grade Mathematics	188 B
	Heuristic and Formal Structures of Probabilistic Thought	197 B
	ng Education Needs of Engineers/Scientists in the Three-State Ozark Region	174 D
	Human Sciences Program (HSP): A Three Year Integrated Human Sciences Curriculum for Middle Schools	152 G
	Wait Time and Questioning Skills of Middle School Science Teachers	194 C
in Adolescents	A Study of the Use of Time Series Designs for Assessing the Development of Science Concepts	195 B
	CEXY: A Tool for Assessing Regional CE Needs in XY Coordinates	175 F
	Computer Graphics Technology as a Visualization Tool for Teaching Modern Optical Theory in High School and College Ph	156 E
	Effects of Topic Specific Instructional Variables in Eighth Grade Mathematics	188 D
	(COMETS II) Career Oriented Science Topics for Elementary and Middle Schools	69
	Career Oriented Modules to Explore Topics in Science (COMETS)	158 G
for Program Evaluation and Production	Toward Improved Candid Classroom Instructional Television: Guidelines	155 E
	Correlates of Attitudes Toward Mathematics, Science, and Social Studies	136
	The Relationship Between Student Attitudes Toward the Science Curriculum and Selected Variables	195 C
	e, and Disseminate Associate Degree Curriculum to Train Solar	99
	Reasoning Development: In Service Training for Middle School Science Teachers	161 C
	Intensive Computer Based Mathematics Training for Re-entry Women	50
	Design Approach to Problem Solving: A Program for Training Junior High School Science Teachers	150 D
	An Inquiry into the Graduate Training Needs of Two Year College Teachers of Mathematics	181 F
	Study of CIE Methodologies Potentially Transferable to CIE-SI	176 B
	The Role of Preconceptions & Representational Transformations in Understanding Science and Mathematics	197 G
	Spanish Translation and Feasibility Study of Ranger Rick's Nature Magazine	60
	Development and Trial of an Integrated Undergraduate Science Major Program	156 G
	Graphing in High School Level Algebra and Trigonometry for Adults	171 D
ter Graphics Learning Environment for High School	Trigonometry	95
	An Investigation on the Effect of Field Trips on Science Learning	190 A
	Self Paced Triton's Comprehensive Self Assessment of Science Education	178 B
	Self Paced Tutorial Courses for Mineral Science Metallurgy Departments	163 G

## Rotated Title Index FY 1981 and Earlier Years

	Page
Tutorial Review Articles to Update Collegiate Physics Instruction =	164 F
A Research Study of Computer-Based Tutoring of Mathematical and Scientific Knowledge =	190 E
Technology and the Individual - A School TV Series for Adolescents =	159 F
You, Me and Technology: An Instructional TV Series in Technology and Society for Secondary Schools =	96
Local Uses of Scientific Knowledge: An Instructional TV Unit for High School =	Ethic 72
Extension of TVCAI Project to Include Demonstration of Intelligent Videodisc System	170 G
Local Assessment of Science Education in the Two-Year College =	176 C
Local Assessment of Science Education in the Two-Year College =	176 D
Local Assessment of Science Education in the Two-Year College =	176 F
Local Assessment of Science Education in the Two-Year College =	Confere 177 D
Local Assessment of Science Education in the Two-Year College =	177 E
Local Assessment of Science Education in the Two-Year College =	177 F
Local Assessment of Science Education in the Two-Year College =	178 C
Local Assessment of Science Education in the Two-Year College =	178 E
Local Assessment of Science Education in the Two-Year College =	178 F
Local Assessment of Science Education in the Two-Year College =	178 G
Local Assessment of Science Education in the Two-Year College =	179 A
Local Assessment of Science Education in the Two-Year College =	179 F
Local Assessment of Science Education in the Two-Year College =	179 G
Local Assessment of Science Education in the Two-Year College =	180 B
Local Assessment of Science Education in the Two-Year College =	180 C
Local Assessment of Science Education in the Two-Year College =	180 E
Local Assessment of Science Education in the Two-Year College =	180 F
Local Assessment of Science Education in the Two-Year College =	180 G
Local Assessment of Science Education in the Two-Year College =	181 A
Local Assessment of Science Education in the Two-Year College =	181 B
Local Assessment of Science Education in the Two-Year College =	181 C
Local Assessment of Science Education in the Two-Year College =	181 D
Local Assessment of Science Education in the Two-Year College =	181 F
An Inquiry into the Graduate Training Needs of Two-Year College Teachers of Mathematics	182 C
A Study of Science Instructional Programs in Two-Year Colleges =	173 G
Computing Activities and Related Degree Programs in U.S. Higher Education =	Inventory of Co 163 F
Computing Activities and Related Degree Programs in U.S. Higher Education-Dissemination	Inventory of Co 192 E
Modules in Applied Mathematics in Higher Education (UMAP) =	Instructional Mod 159 G
Graduate Mathematics and Its Applications Project (UMAP) =	Modules and Monographs in Underg 160 A
Materials for Women and Minorities (High School and Undergraduate Mathematics in Biology: Computer-Controlled Videodisc Materials)	105
A World Model for Undergraduate College Classroom Use =	154 A
Instruction Materials and Delivery Systems for an Undergraduate Curriculum in Pest Management for Plant Protection =	161 G
Development of Selected Undergraduate Course Materials in Applied Mathematical Modeling =	167 A
The Development of Modules for the Undergraduate Chemical Engineering Curriculum and Continuing Education	170 C
(CACHE) New Undergraduate Engineering Materials -- Computer Models in the Context	84
of Competing Social Values Survey of Undergraduate Education in the Mathematical Sciences, 1980-81 =	118
Instructional Materials Undergraduate Education Improvement in Political Science: Innovation i	154 C
Competing Social Values New Undergraduate Engineering Materials--Computer Models in the Context of	164 C
Professional Competencies Development in the Undergraduate Engineering Curriculum =	165 E
Microcomputer Based Laboratory Measurement System for Undergraduate Electrical Engineering Laboratories =	A Micr 168 G
Survey of Undergraduate Education in the Mathematical Sciences, 1980-81	185 F
Adaptable Microcomputer Graphics for Undergraduate Life Science Instruction =	152 D
Modules and Monographs in Undergraduate Mathematics and Its Applications Project (UMAP) =	160 A
Use of Computer Generated Graphic Displays in the Undergraduate Mathematics Guidebook for the Implementation and the	169 B
Preparation for Undergraduate Physical Sciences Through Concept-Based Modules =	106
Development and Trial of an Integrated Undergraduate Science Major Program =	156 G
Diagnostic and Instructional Services for Undergraduate Students of Statistics =	164 B
Content of Resource Material for Instruction in Use of Underground Space =	Developme 163 E
Cognitive Structures Underlying Heuristic and Formal Structures of Probabilistic Thought =	197 B
Survey of Evidence and Theoretical Explanations of the Underlying Statistical Inference =	128
Survey of Science Underrepresentation of Women in Science =	The Synthesi 116
Identifying Different Levels of Understanding and Attitudes =	131
Survey of Science Understanding Attained by Physics Students =	191 B
Semantics of Arithmetic: Teaching Understanding and Attitudes =	192 D
Strategies and Structures in Understanding and Computational Skill Via Computer =	195 G
Science Understanding Geometry =	193 D
Invention and Understanding in Adults Through Television =	186 B
Children's Understanding in the Acquisition of Computation =	198 B
Investigation of Critical Barriers to the Understanding of Decimal Numbers =	124
Conceptual Understanding of Science =	Identifica 141
Conceptual Understanding of Science =	185 C
Conceptual Understanding of Physics Students and Identification of Influencing Factors	196 B
Concepts & Representational Transformations in Understanding Science and Mathematics =	The Role of Pre 197 G
Quantitative Understanding to Enhance Social Science Teaching =	153 C
Identification of Mathematical Behaviors That Demonstrate Understanding =	Detailed Descr 188 A
Local Uses of Scientific Knowledge: An Instructional TV Unit for High School	Ethical 72
Microcomputer Instructional Units (for 11th and 12th Grade Mathematics) Using Simulation of Mathematics	162 G
The Preparation of Supplemental Instructional Units Based on Current Curricular Research, Grades 8-10 =	163 D

**Rotated Title Index FY 1981 and Earlier Years**

		Page
	Developing Science Curriculum Units Using the Teams-Games-Tournaments Instructional Process	159 C
	Research Learning Among Blind Students in Colleges and Universities	108
	Education for Industry, Professional Societies and Universities	172 G
	Research Learning Among Blind Students in Colleges and Universities	182 A
Education for Engineers =	University Consortium to Increase National Effectiveness of Continuing	155 F
Education for Engineers =	University Consortium to Increase National Effectiveness of Continuing	173 F
	University Freshmen and Sophomores Development of Modul	168 F
Integrated Speech in Mathematics	University Level, Computer-Assisted Instruction (CAI) and Computer-Gen	150 F
	Update Collegiate Physics Instruction	164 F
Among Individual Motivation, Work Environment and	Updating in Engineering Relationships	175 C
Factors That Influence the Technical	Updating of Engineers	195 F
Computer Enhanced Statistics Modules for the	Upper Elementary Grades	80
Problem-Solving Processes of	Upper Elementary and Junior High School Mathematics Students	114
Problem-Solving Processes of	Upper Elementary and Junior High School Mathematics Students	182 E
Computer Storytelling Mathematics for Pueblo Indian	Upper-Elementary Level Students	164 E
	An Urban Extension Service Model	152 D
	Urban Integrated Junior High School Individualized Science Programs	194 D
Classroom Process Variables in	USA - Bringing Computer Literacy to the Entire Community	150 B
Computer Town, Use		56
A World Model for Classroom	Use	154 A
A World Model for Undergraduate College Classroom	Use	188 B
Research on Thought Processes	Used in 7th to 10th Grade Mathematics	196 A
Cognitive Processes and Knowledge Structures	Used in Solving Physics Problems	173 E
Multimedia	User-Controlled Modes of Continuing Education in Chemistry	72
Ethical	Uses of Scientific Knowledge: An Instructional TV Unit for High School	169 F
Variables in Polynomials	Using a Visual Technique to Teach High School Students the Concept of	192 C
Scientific Reasoning: Cognitive Processes in	Using and Extending Problem-Solving Skills	113
Development of Estimation Skills in Mathematics	Using Computer Games	161 A
A Computer Language Methods in Science Education	Using Low Cost Home Computers	149 C
Early Learning (Grades 2-3) of Geometry and Logic,	Using Microcomputers	157 E
Schools	Using Microcomputers to Teach Social Science in Junior and Senior High	160 C
Dimensional Analysis to Middle School Mathematics	Using Microcomputer and Print Materials	170 D
Inter Courseware to Develop Insight into Arithmetic	Using Non-Formal Contexts to Teach Children Science	165 G
	Using Perceivable Algorithms	79
	Using Problem Solving in Junior High Mathematics	165 F
On	Using Program Verifiers in Elementary Computer Programming Instruction	162 G
ional Units (for 11th and 12th Grade Mathematics)	Using Simulation of Mathematical Modeling	155 D
Instruction for Problem Solving	Using the Microcomputer in High School Mathematics	187 E
The Feasibility of	Using the National Assessment Science Data for Secondary Analysis	159 C
Developing Science Curriculum Units	Using the Teams-Games-Tournaments Instructional Process	166 A
Teachers	Validation of the Continuing Education Achievement of Professional Eng	84
Computer Models in the Context of Competing Social	Values	164 C
Computer Models in the Context of Competing Social	Values	122
Format	Variables and Learner Characteristics in Mathematical Problem Solving	188 D
Effects of Topic-Specific Instructional	Variables in Eighth Grade Mathematics	169 F
Technique to Teach High School Students the Concept of	Variables in Polynomials	194 D
Classroom Process	Variables in Urban Integrated Junior High School Individualized Science	195 C
Attitudes Toward the Science Curriculum and Selected	Variables	165 F
On Using Program	Verifiers in Elementary Computer Programming Instruction	172 D
Development of	Video Systems for Teaching Meteorology	51
Microcomputer and	Video-Based Mathematics Modules for High School Women and Minority Stu	83
Interactive	Videodisc Applications to Elementary Mathematics Education	164 A
Low Cost Approach to	Videodisc Education	105
Mathematics in Biology: Computer-Controlled	Videodisc Materials for Women and Minorities (High School and Undergra	101
An Intelligent	Videodisc System: Evaluation in Developmental Biology	170 G
Project to Include Demonstration of Intelligent	Videodisc System	171 A
An Intelligent	Videodisc System: Evaluation in Developmental Biology	152 F
Students	Visual Geometry and Mathematics Cognition for Beginning College Science	157 D
In a Multidisciplinary Framework with Interactive	Visual Graphics	169 F
Using a	Visual Technique to Teach High School Students the Concept of Variable	144
Visual in Polynomials	Visualization and Confidence to Male/Female Mathematics Achievement in	196 F
Grades 6-8	Visualization and Confidence in Male/Female Mathematics Achievement in	156 E
Grades 6-1	Visualization Tool for Teaching Modern Optical Theory in High School a	172 C
and College Ph	Visualization: Dynamic Graphics to Develop Mathematical Perception and	194 C
Intuition in Pre Calculus Students	Wait Time and Questioning Skills of Middle School Science Teachers	186
	Whole Numbers: An Interdisciplinary Study of an Experimental Model	87
	Whole Numbers	87
	Wildlife Inquiry Through Zoo Education (WIZE)	87
	Wildlife Inquiry Through Zoo Education (WIZE)	87
Video Based Mathematics Modules for High School	Women and Minority Students	51
(Final Phase)	Science Careers for Women and Minorities In Service Materials for Teachers of Grades 4-9	105
ogy Computer Controlled Videodisc Materials for	Women and Minorities (High School and Undergradua	182 D
A Longitudinal Study of	Women and Minorities in Science and Engineering	116
etical Explanations of the Underrepresentation of	Women in Science	166 B
A Strategy: Action Program for Re-Entry of	Women in Science	

## Rotated Title Index FY 1987 and Earlier Years

	Page
Women's Career Behavior	126
Experience with Science Education: Implication for Women's Career Behavior = A Cognitive Perspective on Women Students' Experience with Science Education: Implication for Women's Career Behavior = A Cognitive Perspective on Women Students' Experience with Science Education: Implication for Women's Career Behavior =	126 E
Colleges	182 B
Computer-Based Mathematics Training for Re-entry Women = Intensive	50
The Worcester Polytechnic Institute Plan =	161 D
Use of Real-World Knowledge: Physics and Arithmetic Word Problems = Mathematical Representation	195 E
Relationships Among Individual Motivation, Work Environment and Updating in Engineering =	175 C
Regional Workshop for Continuing Education of Working-Level Scientists and Their Supervisors =	172 F
Regional Workshop for Continuing Education of Working-Level Scientists and Their Supervisors =	172 G
First World Conference on Continuing Engineering Education =	175 G
A World Model for Classroom Use =	56
A World Model for Undergraduate College Classroom Use =	154 A
Interest Worlds: Precollege Mathematics in a Computer Culture	160 G
XPRT-Experimental Partnership for the Reorientation of Teaching	168 C
CEXY: A Tool for Assessing Regional CE Needs in XY Coordinates	175 F
Society for Secondary Schools You, Me and Technology: An Instructional TV Series in Technology and Science	96
A Science Course for Youth in Informal Settings: Learning to Experiment	150 A

**Key Word/Phrase Index  
Fiscal Year 1981 only**

## Key Word / Phrase Index FY 1981 Awards

- Abstract Reasoning 48, 79  
 Achievement 133  
 ACT Model 137  
 Addition 134, 140  
 Adolescents 59, 61, 109, 110, 112, 114  
 Adult Students 86  
 Adults 121, 128  
 Alloglyphs 57  
 Algorithms 74  
 Amphibians 62  
 Animal Life 62  
 Apple II Computer 85  
 Aptitude Tests 110  
 Aptitudes 122  
 Arithmetic 134  
 Astronomy 106  
 Atari Computer 85  
 Atomic Molecular Model 106  
 Atomic Structure 106  
 Attitude Change 53, 125  
 Attitude Measures 121, 133  
 Attitude Tests 136  
 Audiovisual Aids 74, 93  
 Autonomous Learning Behavior 145  
 Biochemistry 132  
 Biological Sciences 68, 87  
 Biology 60, 68, 85, 90, 101, 105, 111, 123, 143  
 Blind College Students 108  
 Blind Post-Secondary School Students 108  
 Blindness 47, 68, 71, 108  
 Brain Functions 132  
 CAD/CAM (Computer Aided Design/Computer-Aided Manufacturing) 104  
 Career Awareness 69, 91  
 Career Choice 59, 116, 126  
 Career Development 55  
 Career Education 59, 69, 71  
 Career Exploration 91  
 Career Planning 59, 61  
 Careers 59  
 Case Studies 84, 119, 129  
 CBMS 118  
 Chemical Analysis 103  
 Chemical Engineering Curriculum 100  
 Chemistry 58, 75, 85, 90, 106  
 Chemistry Instruction 135  
 Class Activities 91  
 Classroom Techniques 145  
 Cognitive Development 114  
 Cognitive Measurement 110, 117, 122, 124, 125, 126, 129, 134, 142  
 Cognitive Objectives 113, 132, 139  
 Cognitive Processes 108, 109, 112, 115, 123, 127, 128, 135, 139, 140, 143, 144, 145, 146  
 Cognitive Science 132, 137  
 Cognitive Tests 134  
 Cognitive/Affective Measures 133  
 College Curriculum 67  
 College Mathematics 118  
 College Programs 53  
 College Students 99, 106, 111, 117, 126, 128, 139, 142  
 Colleges 118  
 Columbia Broadcasting System/ New York University (CBS/NYU) 86  
 Commodore PET Computer 85  
 Community Involvement 58  
 Comparative Analysis 129  
 Comparative Education 63  
 Comprehension 130  
 Computation 74, 81, 134  
 Computer Assisted Instruction 48, 49, 50, 51, 52, 56, 57, 64, 65, 67, 73, 74, 75, 76, 77, 79, 80, 82, 83, 84, 85, 88, 94, 95, 99  
 Computer Assisted Instruction 100, 101, 103, 104, 105, 107, 111, 112, 113, 117  
 Computer Conferencing 76  
 Computer Control 82  
 Computer Graphics 64, 82, 85, 88, 90, 95, 97, 101  
 Computer Literacy 130  
 Computer Models 56  
 Computer Oriented Programs 55, 67, 97, 102, 104  
 Computer Programs 56, 97, 100, 104, 105, 107, 117  
 Computer Science 73  
 Computer Science Education 55, 63, 107, 130  
 Computer Science Instruction 97  
 Computers 73  
 Concept Formation 58, 64, 71, 78, 106, 123, 141, 142  
 Concept Mapping 123  
 Concept Teaching 58, 141  
 Conceptual Knowledge 146  
 Conditional Probabilities 128  
 Conference Board of the Mathematical Sciences 118  
 Conferences 132  
 Consortia 104  
 Construct Analysis 120  
 Continuing Education 50, 82, 86  
 Continuous Progress Plan 100  
 Control Engineering 82  
 Control Systems 82  
 Course Descriptions 82  
 Critical Thinking 143  
 Cross Sectional Studies 81, 122  
 Curriculum 97  
 Curriculum Design 100  
 Curriculum Development 50, 67, 72, 87, 99, 102, 104, 106, 122, 129  
 Curriculum Enrichment 47, 58, 89, 93, 94  
 Curriculum Evaluation 67, 94  
 Curriculum Modules 87  
 Curriculum Planning 98  
 Cybernetics 63  
 Data Analysis 117, 118  
 Data-Base Management System 98  
 Decimal Fractions 124, 140  
 Decimals 83  
 Decision Making 65, 131  
 Decision Making Skills 119  
 Deduction 127  
 Deductive Reasoning 127  
 Demography 131  
 Design Requirements 84  
 Dial Access Information Systems 75, 98  
 Disabilities 68, 71, 108  
 Disadvantaged Youth 106  
 Discussion (Teaching Technique) 114  
 Dynamic Programming 57  
 Dynamic Reading 111  
 Earth Science 85, 93  
 East-European Nations 63  
 ECAM 67  
 Ecology 87  
 Education 123  
 Education Commission of the States (ECS) 131  
 Educational Games 113  
 Educational Media 123  
 Educational Planning 98  
 Educational Psychology 128  
 Educational Research 115, 130, 132  
 Educational Technology 67, 76, 103, 104  
 Educational Television 96  
 Electricity 106  
 Electronic Equipment 75  
 Elementary Education 60  
 Elementary School Curriculum 102  
 Elementary School Mathematics 71, 74, 80, 83, 120

**Key Word / Phrase Index FY 1981 Awards**

- Elementary School Mathematics 122, 124, 134, 140
- Elementary School Science 91
- Elementary School Students 113, 134
- Energy Conservation 99
- Energy Education 86
- Engineering 82
- Engineering Education 67, 82, 94, 100, 104
- Engineering Technology 84
- Environment 87
- Estimation 81
- Estimation Skills 113
- Ethical Instruction 72
- Ethics 143
- Ethics and Values in Science and Technology (EVIST) 72
- Evaluation 81
- Evaluation Methods 108, 116
- Experimental Teaching 89
- Experiments 127
- Family Attitudes 125
- Family Involvement 62, 125
- Family School Relationship 125
- Feasibility Studies 60
- Females 50, 51, 59, 64, 69, 77, 91, 105, 116, 126, 133, 144, 145
- Films 72, 93
- Foods Instruction 61
- Foreign Countries 63
- Four Year Colleges 118
- Fractions 83
- Fundamental Concepts 141
- Futures (of Society) 56
- Game Theory 65
- Genetics 146
- Geography Instruction 66
- Geology 93
- Geometric Concepts 64
- Geometry 64, 127, 137
- Global Interdependence 56
- Global Perspective 66
- Glyphs 57
- Gowin's V 123
- Graph Theory 57
- Graphic Arts 68
- Guidelines 91
- Handicapped 47, 68, 71, 108
- Heat 106
- High School Instructional Enrichment 93
- High School Students 58, 72, 88, 95, 97, 101, 107, 121, 135, 141
- Higher Education 53
- Hispanic Americans 50, 60
- Hypothesis Testing 114
- Individual Factors 121
- Individualized Curriculum 48
- Individualized Instruction 140
- Induction 127
- Informal Learning 61
- Information Dissemination 67, 75, 76, 94, 138
- Information Networks 49, 103
- Information Processing 137
- Information Science 63
- Information Systems 76, 98
- Information Utilization 98, 146
- Inservice Education 91
- Instruction 127
- Instructional Aids 94
- Instructional Development 78
- Instructional Improvement 108
- Instructional Innovation 89, 112, 139
- Instructional Materials 47, 50, 51, 53, 56, 62, 67, 68, 72, 78, 81, 84, 85, 87, 90, 93, 100, 102, 103, 104, 106, 113, 120, 123, 129
- Instructional Technology 104
- Instrumentation 103
- Intellectual Development 143
- Intelligence 130
- Interaction 62, 145
- Interactive Computer Programs 56, 82
- Interdisciplinary Approach 56, 96
- Intermediate Grades 78, 81, 120, 129
- International Programs 63
- International Relations 56
- Interviews 108, 112, 119, 142
- Junior High School Students 47, 79
- Junior High Schools 102
- Knowledge Level 142
- Laboratories 106
- Language Arts 69
- Language Skills 135
- Learning 121, 146
- Learning Activities 89
- Learning Aids 123
- Learning Cycle Model 135
- Learning Disabled 122
- Learning Modules 58, 64, 75, 84, 106, 140
- Learning Motivation 145
- Learning Problems 108
- Learning Processes 123, 127
- Learning Theories 48, 113, 119, 132, 139
- Legally Blind Students 71
- Life Sciences 87
- Linear Programming 65
- Literature Reviews 116
- Logical Thinking 127
- Longitudinal Studies 114, 120, 121, 122, 124, 133, 144, 145
- Loop Constructs 117
- Magnetism 106
- Males 145
- Management Development 65
- Manipulative Materials 71, 120
- Manufacturing 67, 104
- Manufacturing Engineering 67
- Markov Chains 65
- Material Development 55, 57, 58, 62, 65, 71, 79, 81, 84, 85, 88, 91, 94, 101, 103, 105, 106, 112, 113, 140
- Materials Science and Engineering (MSE) 94
- Materials Testing 71
- Mathematical Applications 52, 57, 65, 74
- Mathematical Reasoning 47, 109
- Mathematics 47, 59, 90, 134, 137, 144
- Mathematics Anxiety 50, 105, 110, 144
- Mathematics Curriculum 50, 63, 73, 78, 80, 95
- Mathematics Education 63, 73, 114, 116, 136, 137
- Mathematics Instruction 47, 51, 52, 57, 65, 71, 77, 78, 79, 81, 83, 88, 90, 102, 105, 107, 109, 112, 113, 115, 118, 119, 120, 122, 124, 141, 145
- Mathematics Materials 140
- Mathematics Teachers 57
- Matrix Theory 65
- Matter 106
- MAWIS (Mathematics at Work in Society) 59
- Measurement Techniques 83
- Mechanics (Physics) 139
- Memorization 134
- Meta-Analysis 116
- Microcomputers 49, 50, 51, 52, 55, 64, 65, 76, 77, 79, 82, 85, 90, 95, 102, 105, 113
- Microelectronic Technology 73
- Middle Schools 52, 119
- Minorities 51, 91, 133
- Minority Group Children 77

## Key Word / Phrase Index FY 1981 Awards

- Minority Groups 59, 60, 106, 109, 126  
 Minority Testing Problems 130  
 Models 68, 133  
 Moral Values 72  
 Motivation Techniques 57, 61  
 Mount St. Helens 93  
 Multimedia Instruction 96  
 Multimedia Materials 59  
 National Assessment of Education Progress/Science 131  
 Negative Numbers 140  
 Network Theory 65  
 Neuroscience 132  
 Newsletters 50  
 Newtonian Mechanics 139  
 Non-science Majors 55  
 Nontraditional Students 53  
 Number Concepts 74, 81, 120, 140  
 Numerical Inequality Judgments 134  
 Observation 112, 145  
 Older Adults 53  
 Orientation Training 88  
 Out of School Environments 110  
 Out of School Science Materials 61  
 Outreach Programs 86  
 Participation 62  
 Performance Factors 145  
 Perry Model 143  
 Pets 61  
 Photographs 93  
 Photomicrographs 68  
 Photoscreening 68  
 Physical Sciences 77, 106  
 Physics 85, 90, 106, 111, 139, 141, 142  
 Physics Instruction 135  
 Planning 129  
 PLATO Computer System 57  
 Predictions 133  
 Predictor Variables 136  
 Prevocational Education 69  
 Probability 128  
 Problem Solving 47, 52, 55, 58, 65, 77, 78  
     79, 80, 81, 88, 97, 107, 112  
     113, 114, 115, 120, 122, 134, 139  
     140, 142, 144, 146  
 Professional Continuing Education 84  
 Professional Education 82  
 Program Effectiveness 114  
 Programmed Instruction 49, 64  
 Programmed Instructional Materials 49, 75, 95  
 Programming 50, 55, 97, 117  
 Programming Bugs 117  
 Programming Languages 117  
 Protocols 114  
 Prototype Curriculum Development 135  
 Q Methodology 125  
 Qualitative Analysis 139  
 Quantitative Tests 109  
 Queuing Theory 57  
 Radiation 99  
 Raised-line Reproductions 68  
 Randomness 128  
 Ranger Rick's Nature Magazine 60  
 Rational Numbers 120  
 Re-entry Women 50  
 Readability 111  
 Reading Research 111  
 Reasoning Patterns 47  
 Reasoning Tasks 109  
 Reptiles 62  
 Research Projects 144  
 Resource Centers 76  
 Response Style (Tests) 130  
 Retention (Psychology) 111  
 Role Models 69  
 Role Perception 69  
 Role Theory 116  
 Sampling 128  
 School Surveys 118  
 Science Achievement 131  
 Science Activities 61, 89  
 Science Activities for Informal Learning (SAIL) 61  
 Science Attentiveness 121  
 Science Careers 69, 91  
 Science Course Improvement Projects 94  
 Science Curriculum 89, 133, 141  
 Science Education 53, 116, 136  
 Science Instruction 49, 52, 58, 68, 75, 76, 77  
     85, 99, 101, 102, 111, 112, 129  
     141, 142  
 Science Interests 69  
 Science Materials 76  
 Science Programs 53, 61, 86, 125  
 Science Teachers 49, 57, 91, 129  
 Science Understanding 131  
 Science, Technology, and Society Interaction 66  
 Science/Society Interactions 56  
 Scientific Attitudes 61, 110, 126, 133  
 Scientific Concepts 108, 110, 111, 112, 138, 141, 142  
 Scientific Enterprise 72  
 Scientific Literacy 53, 58, 60, 61, 86, 96, 108  
     110, 121, 125, 131, 132, 133, 138  
 Scientific Methodology 112  
 Scientific Reasoning 112  
 Secondary Analysis 121  
 Secondary School Curriculum 102  
 Secondary School Mathematics 57, 59, 65, 71, 85  
     105  
 Secondary School Science 85, 89, 91, 96, 141  
 Secondary School Students 51, 57, 93  
 Sex Bias 110, 145  
 Sex Differences 64, 88, 110, 121, 144, 145  
 Sex Stereotypes 69  
 Sex, Minority Testing Problems 130  
 Simulation 56, 68  
 Skill Analysis 109  
 Skill Development 47, 81, 113, 137  
 Skills 137  
 Slides 93  
 Small Group Instruction 112  
 Social Change 89, 96  
 Social Factors 131  
 Social Influences 96  
 Social Science 136  
 Social Science Research 125  
 Social Studies 96, 102  
 Socioeconomic Influences 125  
 Sociological Factors 121  
 Software 105  
 Solar Energy 99  
 Soviet Union 63, 114  
 Space Sciences 85  
 Spanish Speaking 60  
 Spatial Perception 64, 88  
 State-of-the-Art Reviews 118  
 Statistical Analysis 128  
 Statistics 52, 80, 107  
 Student Attitudes 57, 69, 131, 136, 145  
 Student Interests 69  
 Student Teacher Relationship 145  
 Subtraction 140  
 Surveys 63, 116  
 Synthesis of Research 116  
 Syracuse Rating Group 143  
 Tactile Adaptation 71  
 Teacher Attitudes 57, 119, 136  
 Teacher Education 49  
 Teacher Effectiveness 129  
 Teacher Workshops 49

## Key Word / Phrase Index FY 1981 Awards

Teachers' Conceptual Systems 119  
Teaching Guides 129  
Teaching Methods 117, 129  
Teaching Skills 49  
Technical Education 73  
Technological Advancement 55, 89, 96  
Technology 58, 72, 86, 91, 96  
Technology Transfer 99, 103  
Telecommunications 86  
Telecourses 96  
Television 72, 83  
Television Curriculum 86  
Television Films 72  
Television Research 138  
Television Viewing 138  
Temperature 106  
Test Bias 130  
Testing 130  
Text Processing Language 55  
Textbook Research 111  
Thematic Approach 66  
Theorem-proving Skills 137  
Theoretical Models 131  
Thinking Processes 127  
Training Methods 109  
Translation 60  
Trend Analysis 118, 131  
Trigonometry 95  
Two Year College Students 101  
Two Year Colleges 99, 118  
Undergraduate Study 118  
Unit Fraction Approach 120  
Universities 101, 118  
Upper-elementary Science 129  
Video Equipment 101  
Videodisc Recordings 83, 101, 105  
Videotape Cassettes 51  
Videotape Recordings 72, 93, 96  
Videotapes 50, 78  
Visual Impairments 47, 68, 71, 108  
Visual Perception 144  
Visualization 88  
Volcanic Activity 93  
Wildlife Management 87  
Women's Education 50, 51, 59, 69, 105, 116  
Workshops 75  
World Affairs 56  
World Geography 66  
World Problems 56  
Young Adults 121  
Zoo Education 87  
Zoology 60, 62  
Zoos 62, 87

## **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; Informa-  
tion 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 Mathe-  
matics; 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; Adoles-  
cents; 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   
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; Photo-micrographs; 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; Micro-  
computers; 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 able 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 experimental 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; Tech-  
nology; 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; Cur-  
riculum; 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 developed 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 para-professionals, and as supplements to science and engineering standards 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; Univer-  
sities; 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 Cur-  
riculum; 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 under-emphasized 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: \$149,561  
AWARDED: 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

12

## **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; Educa-  
tional 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 Behavior**

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

13,

# **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

130

## 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

111

## 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.

140

## **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

147

## 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 under-representation 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

150

## **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

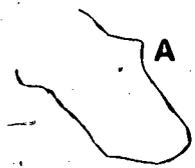
- Development of a Coherent Series of Participatory Exhibits for the Palace of Arts and Science Foundation Exploratorium in San Francisco  
Frank Oppenheimer  
Palace of Arts & Science Foundation  
San Francisco, California 94123 **A**
- ComputerTown, USA - Bringing Computer Literacy to the Entire Community  
Ramon M. Zamora  
People's Computer Company  
P.O. Box E  
1263 El Camino Real  
Menlo Park, California 94025 **B**
- Development of Instructional Modules on the Environment  
John J. Holleman  
Peralta Community College District  
Oakland, California 94610 **C**
- The Guided Design Approach to Problem Solving: A Program for Training Junior High School Science Teachers  
Bernard Coyle  
San Francisco State University  
Frederic Burk Foundation for Education  
1640 Holloway Avenue  
San Francisco, California 94132 **D**
- Mathematics Network Curriculum Project for Middle School Teachers and Students  
Jose E. Gutierrez  
San Francisco State University  
1640 Holloway Avenue  
San Francisco, California 94132 **E**
- University Level, Computer-Assisted Instruction (CAI) (CAI) and Computer-Generated Speech in Mathematics  
Patrick Suppes  
Stanford University  
Stanford, California 94305 **F**
- Physical Science Activities in Out-of-School Settings for Early Adolescents and Their Families  
Alan J. Friedman  
University of California/Berkeley  
Berkeley, California 94720 **G**

- 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

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



Digital System Educational Materials (DISEM Project)

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

B

Quantitative Understanding to Enhance Social Science Teaching

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

C

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

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

D

Development of Problem Solving Skills in Physics/Electrostatics

Neil Ashby  
University of Colorado/Boulder  
Boulder, Colorado 80309

E

Personal Computers and Cross-Age Instruction

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

F

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

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

G

A World Model for Undergraduate College Classroom Use

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

A

Secondary School Course in Applications of Mathematics to Science

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

B

Undergraduate Education Improvement in Political Science:  
Innovation in Instructional Materials

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

C

Outlines in Microbiology for Community and Junior Colleges

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

D

Teaching Materials in Microbiology

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

E

Teaching Materials in Microbiology for Community and Junior Colleges

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

F

Teaching and Learning in Graduate Geography

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

G

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

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

A

Conservation Classroom Program (Advanced)

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

B

Individualized Science Instructional System

Ernest Burkman  
Florida State University  
Tallahassee, Florida 32306

C

Instruction for Problem Solving Using the Microcomputer  
in High School Mathematics

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

D

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

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

E

University Consortium to Increase National Effectiveness  
of Continuing Education for Engineers

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

F

A Prototype System to Deliver Continuing Education to  
Engineers

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

G

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 **B**  
College Mathematics  
Izaak Wirszup  
University of Chicago  
Department of Mathematics  
Chicago, Illinois 60637

Prototype Microcomputer Courseware for Teaching **C**  
High School Algebra  
Sharon Dugdale  
University of Illinois  
Urbana, Illinois 61801

Demo-Graphics: Teaching Population Dynamics in a **D**  
Multidisciplinary Framework with Interactive Visual  
Graphics  
Paul Handler  
University of Illinois  
57 Coordinated Science Laboratory  
Urbana, Illinois 61801

Using Microcomputers to Teach Social Science in Junior **E**  
and Senior High Schools  
Paul Handler  
University of Illinois  
57 Coordinated Science Laboratory  
Urbana, Illinois 61801

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

Joseph El Gomayel  
Purdue University  
West Lafayette, Indiana 47907

A

Engineering Education Materials for Computer Aided  
Manufacturing (ECAM)

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

B

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

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

C

Use of Microcomputers for Learning Science

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

D

Computer-Assisted Data Analysis

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

E

Educational Modules Development for the Nuclear  
Fuel Cycle

N. Dean Eckoff  
Kansas State University  
Manhattan, Kansas 66506

F

Career Oriented Modules to Explore Topics in Science  
(COMETS)

Walter S. Smith  
University of Kansas  
Lawrence, Kansas 66054

G

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

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

A

Problem-Oriented College Physics Instruction

Peter Signell  
Michigan State University  
East Lansing, Michigan 48824

B

Problem-Oriented Physics Instruction

Peter Signell  
Michigan State University  
East Lansing, Michigan 48824

C

Adaptable Microcomputer Graphics for Undergraduate  
Life Science Instruction

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

D

Curricular Materials in Computer-Aided Ship Design

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

E

Instructional Materials for Computer Literacy

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

F

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

Lynn Arthur Steen  
St. Olaf College  
Northfield, Minnesota 55057

G

163

- 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. Stoeber  
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

Robert G. Fuller  
University of Nebraska  
Lincoln, Nebraska 68508

A

Diagnostic and Instructional Services for Undergraduate Students of Statistics

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

B

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

John M. Mulvey  
Princeton University  
Princeton, New Jersey 08540

C

Development of Laboratory and Lecture Materials for Oceanography Teaching

Harvey M. Sachs  
Princeton University  
Princeton, New Jersey 08540

D

Computer Storytelling Mathematics for Pueblo Indian Upper-Elementary Level Students

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

E

Tutorial Review Articles to Update Collegiate Physics Instruction

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

F

Issue-Oriented Instructional Modules for Introductory College Physics Classes

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

G

Societal Issue-Oriented Physics Modules Project

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

A

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

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

B

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

Samuel Devons  
Barnard College  
New York, New York 10027

C

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

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

D

Professional Competencies Development in the  
Undergraduate Engineering Curriculum

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

E

On Using Program Verifiers in Elementary Computer  
Programming Instruction

Robert L. Constable  
Cornell University  
Ithaca, New York 14850

F

Microcomputer Courseware to Develop Insight into  
Arithmetic Using Perceivable Algorithms

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

G

Validation of the Continuing Education Achievement of  
Professional Engineers

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

A

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

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

B

Development of a Cooperative Graduate Program in  
Engineering and Public Administration

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

C

A Computer Based Annotated List of Laboratory  
Experiments in College Chemistry

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

D

Master of Science Degree in Applied Mathematics

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

E

Improving Spatial Skills in Pre-College Mathematics  
Through Computer Graphics

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

F

Computer Graphics in Engineering Education

Michael Wozny  
Rensselaer Polytechnic Institute  
Troy, New York 12181

G

- 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

Educational Modules for Materials Science and Engineering  
(EMMSE)

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

A

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

B

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

C

Development of Curriculum and Instructional Material in  
Applied Sociology

Burkart Holzner  
University of Pittsburgh  
Pittsburgh, Pennsylvania 15260

D

An Alternative in Higher Education in the Mathematical  
Sciences

Clayton V. Aucoin  
Clemson University  
Clemson, South Carolina 29631

E

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

F

High School Computer Science Education

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

G

An Associate Degree Curriculum in Solar Engineering  
Technology - Phase II

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

A

Curriculum Analysis, Student Interrogation and  
Information System

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

B

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

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

C

Using Non-Formal Contexts to Teach Children Science

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

D

Continuing Education and College Instructional Modules  
in Chemical Engineering

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

E

Computer-Oriented Teaching Modules in Geochemistry

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

F

Extension of TVCAI Project to Include Demonstration of  
Intelligent Videodisc System

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

G

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

Lillian C. McDermott  
University of Washington  
Seattle, Washington 98195

A

Service-Oriented Options in Mathematics

Donald Bushaw  
Washington State University  
Pullman, Washington 99163

B

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

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

C

Development of Video Systems for Teaching Meteorology

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

D

Sociotechnical Systems Design Program

Gerald Nadler  
University of Wisconsin  
Madison, Wisconsin 53706

E

### **CONTINUING EDUCATION FOR SCIENTISTS AND ENGINEERS**

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

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

F

Workshop on Continuing Education for Industry,  
Professional Societies and Universities

Sonja S. Marchand  
California State University  
Northridge, California 91330

G

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

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

A

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

Martha Maxwell  
University of California/Berkeley  
Berkeley, California 94720

B

Evaluation of Short Course Method of Instruction for  
Professionals in Engineering

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

C

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

Bernard N. Samers  
Cooper and Company  
Stamford, Connecticut 06905

D

Multimedia User-Controlled Modes of Continuing Education  
in Chemistry

Moses Passer  
American Chemical Society  
Washington, DC 20036

E

University Consortium to Increase National Effectiveness of  
Continuing Education for Engineers

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

F

U.S. Electronics Industry Continuing Education Effectivity  
Study

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

G

Measurement for Learning Outcomes in Continuing  
Education for Scientists and Engineers

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

A

Pilot Study of Continuing Environmental Health  
Education for Scientists and Engineers

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

B

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

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

C

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

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

D

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

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

E

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

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

F

A Survey of Continuing Education for Nonacademic  
Scientists and Engineers Provided by Industry and  
Government

Girard W. Levy  
Battelle Memorial Institute  
Columbus, Ohio 43201

G

Needs Assessment of Continuing Education Delivery Systems  
for Scientists and Engineers Employed in Small,  
Geographically Dispersed Plants

Lawrence G. Welling  
Battelle Memorial Institute  
Columbus, Ohio 43201

A

Behavior Anchored Scales - A Method of Identifying  
Continuing Education Needs of Engineers

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

B

Relationships Among Individual Motivation, Work Environment  
and Updating in Engineering

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

C

A Model Continuing Education Needs Assessment/Response  
System in Science and Engineering

John W. Zemp  
Medical University of South Carolina  
Charleston, South Carolina 29403

D

Continuing Education for Employed Clinical Engineers

Cesar A. Caceres  
AAMI Foundation  
Arlington, Virginia 22209

E

CXY: A Tool for Assessing Regional CE Needs in XY  
Coordinates

Robert Ehrlich  
George Mason University  
Fairfax, Virginia 22030

F

First World Conference on Continuing Engineering Education

John P. Klus  
American Society for Engineering Education  
Continuing Education Studies Division  
432 N. Lake Street  
Madison, Wisconsin 53706

G

2  
Assessment of Scientists/Engineers' Continuing Education Needs in Small, Geographically-Dispersed Industries  
W. Sam Adams  
University of Wisconsin  
Oshkosh, Wisconsin 54901

A

Study of CLE Methodologies Potentially Transferable to CESE  
Robert J. Smith  
Department of Engineering & Applied Science  
University of Wisconsin-Ext.  
Madison, Wisconsin 53706

B

### ASSESSMENT OF SCIENCE EDUCATION IN THE TWO-YEAR COLLEGE

Local Assessment of Science Education in the Two-Year College

Lena Dexter  
James H. Faulkner State Junior College  
Bay Minette, Alabama 36507

C

Local Assessment of Science Education in the Two-Year College

G. Elliott Tyler  
John C. Calhoun State Community College  
Decatur, Alabama 35602

D

Assessment of Mathematics Program at S.D. Bishop State Junior College

Roy Daigle  
S.D. Bishop State Junior College  
351 North Broad Street  
Mobile, Alabama 36603

E

Local Assessment of Science Education in the Two-Year College

Janan M. Hayes  
American River College  
Los Rios Community College District  
4700 College Oak Drive  
Sacramento, California 95841

F

Appraisal of Current Science Education at a Developing Community College

Richard A. Dodge  
Cerro Coso Community College  
College Heights Boulevard  
Ridgecrest, California 93555

G

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

Thomas C. Campbell  
Illinois Central College  
Box 2400  
East Peoria, Illinois 61635

A

Triton's Comprehensive Self-Assessment of Science  
Education

William Collien  
Triton College  
2000 Fifth Avenue  
River Grove, Illinois 60171

B

Local Assessment of Science Education in the Two-Year  
College

Robert Ernst  
Kirkwood Community College  
P.O. Box 2068  
Cedar Rapids, Iowa 52406

C

Assessment of Science Education at Cowley County  
Community College

Mike Watters  
Cowley County Community College  
125 South Second Street  
Arkansas City, Kansas 67005

D

Local Assessment of Science Education in the Two-Year  
College

William J. Lembeck  
Louisiana State University  
Eunice, Louisiana 70535

E

Local Assessment of Science Education in the Two-Year  
College

Robert L. Sawyer  
Catonsville Community College  
800 South Rolling Road  
Catonsville, Maryland 21228

F

Local Assessment of Science Education in the Two-Year  
College

William F. Hibschan  
Harford Community College  
401 Thomas Run Road  
Bel Air, Maryland 21014

G

- 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

Donald S. Emmeluth  
Fulton-Montgomery Community College  
Route 67  
Johnstown, New York 12095

A

Local Assessment of Science Education in the Two-Year  
College

John T. Collins  
John N. Sarrubbo  
Westchester Community College  
75 Grasslands Roads  
Walhalla, New York 10595

B

Local Assessment of Science Education in the Two-Year  
College

Bobbie Jean Nicholson  
Brevard College  
Brevard, North Carolina 28712

C

Assessment of Placement Needs of Students

Donna E. Scott  
Southeastern Community College  
Whiteville, North Carolina 28472

D

Local Assessment of Science Education in the Two-Year  
College

Timothy I. Edwards  
Wake Technical Institute  
Route 10 Box 200  
Raleigh, North Carolina 27605

E

Local Assessment of Science Education in the Two-Year  
College

Everett G. House  
Nashville State Technical Institute  
120 White Bridge Road  
Nashville, Tennessee 37209

F

Local Assessment of Science Education in the Two-Year  
College

Edward A. Ochoa  
El Paso County Community College  
6601 Dyer Street  
El Paso, Texas 79904

G

Local Assessment of Science Education in the Two-Year  
College,

Clifford D. Miller  
Mountain View College  
4849 W. Illinois  
Dallas, Texas 75211

A

Local Assessment of Science Education in the Two-Year  
College

Martha W. Sellars  
Northern Virginia Community College  
8333 Little River Turnpike  
Annandale, Virginia 22003

B

Local Assessment of Science Education in the Two-Year  
College

George G. West  
Northern Virginia Community College  
Alexandria, Virginia 22311

C

Local Assessment of Science Education in the Two-Year  
College

John S. DiYorio  
Wytheville Community College  
1000 East Main Street  
Wytheville, Virginia 24382

D

Evaluation and Needs Assessment for Mathematics  
Education

William J. Bonini  
Western Wyoming Community College  
Box 428  
Rock Springs, Wyoming 82901

E

### RESEARCH IN SCIENCE EDUCATION

An Inquiry Into the Graduate Training Needs of Two-Year  
College Teachers of Mathematics

Robert McKelvey  
Rocky Mountain Mathematics Consortium  
c/o Arizona State University  
Tempe, Arizona 85281

F

Factors Influencing Mathematics Participation of Highly  
Able Mexican-American Adolescents

Linda M. Oldaker  
Arizona State University  
Tempe, Arizona 85281

G

- 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  
Richard E. Mayer  
University of California/Santa Barbara  
Santa Barbara, California 93106

A

Increasing the Meaningfulness of Technical Information  
for Novices

Richard E. Mayer  
University of California/Santa Barbara  
Santa Barbara, California 93106

B

The Status of Middle School/Junior High School Science  
Paul DeHart Hurd  
Biological Sciences Curriculum Study Company  
P.O. Box 930  
Boulder, Colorado 80306

C

Logical Competencies and Activity Selection Patterns in  
Early Adolescents: A Longitudinal Study,  
James T. Robinson  
Biological Sciences Curriculum Study Company  
P.O. Box 930  
Boulder, Colorado 80306

D

Research in Science Education: New Questions, New  
Directions

James T. Robinson  
Biological Sciences Curriculum Study Company  
Center for Educational Research and Evaluation  
P.O. Box 930  
Boulder, Colorado 80306

E

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

Richard R. Tolman  
Biological Sciences Curriculum Study Company  
Center for Educational Research and Evaluation  
P.O. Box 930  
Boulder, Colorado 80306

F

Social Studies/Social Science Education: Priorities,  
Practices and Needs

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

G

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

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

A

Project Synthesis: An Interpretive Consolidation of  
Research Identifying Needs in Precollege Science  
Education

Norris Harms  
University of Colorado  
Boulder, Colorado 80309

B

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

C

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

Alma E. Lantz  
University of Denver  
Denver Research Institute  
Denver, Colorado 80210

D

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

E

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

F

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

G

Effects of Elaboration Procedures on Learning and Retention of Scientific Principles

Robert M. Gagne  
Florida State University  
414 Education Building  
Tallahassee, Florida 32306

A

Science Understanding in Adults Through Television

Robert M. Gagne  
Florida State University  
414 Education Building  
Tallahassee, Florida 32306

B

The Microcomputer and Problem Solving Processes in Middle School Mathematics

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

C

The Use of Heuristics in Problem Solving: An Expository Study

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

D

An Analysis of Research on Mathematical Abilities

Jeremy Kilpatrick  
University of Georgia  
Athens, Georgia 32609

E

Analysis of the Child's Construction of Whole Numbers

Leslie P. Steffe  
University of Georgia  
Department of Mathematics Education  
Athens, Georgia 30602

F

Learning and Teaching Whole Numbers: An Interdisciplinary Study of an Experimental Model

Leslie P. Steffe  
University of Georgia  
Department of Mathematics Education  
Athens, Georgia 30602

G

The Role of Manipulative Aids in the Learning of Rational Numbers

Merlyn J. Behr  
Northern Illinois University  
DeKalb, Illinois 60115

A

Research Studies on the Scientific Literacy of the Attentive Public

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

B

A Review of Research of Solving Routine Problems in Pre-College Mathematics

Larry Sowder  
Northern Illinois University  
DeKalb, Illinois 60115

C

Applied Problem-Solving in Middle-School Mathematics

Richard Lesh  
Northwestern University  
Evanston, Illinois 60201

D

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

E

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

F

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

G

Detailed Description of Mathematical Behaviors That  
Demonstrate Understanding

Robert B. Davis  
University of Illinois/Urbana  
Curriculum Laboratory  
1210 W. Springfield Avenue  
Urbana, Illinois 61801

A

Research on Thought Processes Used in 7th to 10th Grade  
Mathematics

Robert B. Davis  
University of Illinois/Urbana  
Curriculum Laboratory  
1210 W. Springfield Avenue  
Urbana, Illinois 61801

B

A Synthesis of Findings on Sex Differences in Science  
Education Research

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

C

Effects of Topic-Specific Instructional Variables in Eighth  
Grade Mathematics

Kenneth J. Travers  
University of Illinois/Urbana  
395 Education  
Urbana, Illinois 61801

D

Facilitating Problem Solving in High School Chemistry

Dorothy L. Gabel  
Indiana University  
School of Education, Room 204  
Bloomington, Indiana 47401

E

Analysis and Synthesis of Mathematical Problem-Solving  
Processes of Early Adolescents

Gerald Kulm  
Purdue University  
West Lafayette, Indiana 47907

F

Improving Access and Guidance in Engineering: Research  
into Contributing Factors

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

G

Calculator Use and Problem-Solving Strategies of Early Adolescents

Grayson H. Wheatley  
Purdue University  
West Lafayette, Indiana 47907

A

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

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

B

Measurement and Analysis of Patterns of Logical Thinking

Frederick P. DeLuca  
Iowa State University  
Ames, Iowa 50011

C

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

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

D

Determining the Impact of a National Educational Computing Conference

Theodore J. Sjoerdsma  
University of Iowa  
Department of Computer Science  
Iowa City, Iowa 52242

E

The Representation and Use of Complex Knowledge: Knowing and Reasoning in Physics

Bert F. Green, Jr.  
Johns Hopkins University  
School of Arts and Sciences  
Charles and 34th Streets  
Baltimore, Maryland 21218

F

Research on Gifted Children in Accelerated Teaching Programs in Physics, Chemistry, and Mathematics

Julian C. Stanley  
Johns Hopkins University  
Baltimore, Maryland 21218

G

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

A

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

B

Development and Facilitation of Cognitive Representation in Estimation Problems

Alexander W. Siegel  
Education Development Center, Inc.  
55 Chapel Street  
Newton, Massachusetts 02160

C

Conceptual Change in Children and in Adult Scientists

Susan Carey  
Massachusetts Institute of Technology  
77 Massachusetts Avenue  
Cambridge, Massachusetts 02139

D

A Research Study of Computer-Based Tutoring of Mathematical and Scientific Knowledge

Ira P. Goldstein  
Massachusetts Institute of Technology  
Cambridge, Massachusetts 02139

E

Assessment and Documentation of a Children's Computer Laboratory

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

F

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

G

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

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

**A**

**Identifying Different Levels of Understanding Attained by  
Physics Students**

Frederick W. Byron, Jr.  
University of Massachusetts-Amherst,  
Amherst, Massachusetts 01003

**B**

**Program of Applied Research on Scientific Reasoning  
Processes**

Jack Lochhead  
University of Massachusetts-Amherst  
Amherst, Massachusetts 01003

**C**

**The Ecology of Failure in Ninth Grade General Mathematics:  
An Ethnographic, Experimental, and Psychometric Inquiry**

Perry E. Lanier  
Michigan State University  
East Lansing, Michigan 48824

**D**

**Planning and Teaching Middle School Science**

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

**E**

**Statistical Analysis of Research Results in College Science  
Teaching**

James A. Kulik  
University of Michigan  
Center for Research on Learning and Teaching  
109 E. Madison Street  
Ann Arbor, Michigan 48109

**F**

**Synthesis of Research on Individualized Science Teaching  
in Secondary Schools**

James A. Kulik  
University of Michigan  
Center for Research on Learning and Teaching  
109 E. Madison Street  
Ann Arbor, Michigan 48109

**G**

- 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**

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

**A**

**Elementary School Science Processes Program: Meta-  
Analysis of Evaluation Studies**

Theodore A. Bredderman  
State University of New York/Albany  
Albany, New York 12222

**B**

**Wait Time and Questioning Skills of Middle School  
Science Teachers**

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

**C**

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

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

**D**

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

Ronald D. Simpson  
North Carolina State University  
326 Poe Hall  
Raleigh, North Carolina 27650

**E**

**Determinants of Student Entry and Performance in  
the Sciences**

George H. Dunteman  
Research Triangle Institute  
Research Triangle Park, North Carolina 27709

**F**

**Structure of Knowledge and Cognitive Processes in  
Organic Chemistry**

John E. Gordon  
Kent State University  
Kent, Ohio 44242

**G**

- 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**

Gordon S. Novak, Jr.  
University of Texas  
Austin, Texas 78712

A

**Conceptual Understanding of Physics Students and  
Identification of Influencing Factors**

James A. Minstrell  
Mercer Island School District #400  
4160 86th Avenue, SE  
Mercer Island, Washington 98040

B

**Computing and Higher Education: Issues and Opportunities**

Robert G. Gillespie  
University of Washington  
Seattle, Washington 98195

C

**Investigation of Conceptual Development in the Study  
of Motion**

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

D

**Interpretive Reports of the Second National Assessment  
in Mathematics**

Thomas Carpenter  
[National Council of Teachers of Mathematics]  
University of Wisconsin  
Department of Curriculum and Instruction  
Madison, Wisconsin 53706

E

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

Elizabeth Fennema  
University of Wisconsin  
Department of Curriculum & Instruction  
Madison, Wisconsin 53706

F

**Systematic Investigation of the Cognitive Effects of Games  
on Mathematics Learning**

John G. Harvey  
University of Wisconsin  
Madison, Wisconsin 53706

G

**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

**Cognitive Processes and the Structure of Knowledge  
in Physics and Algebra**

Herbert A. Simon  
Carnegie-Mellon University  
Pittsburgh, Pennsylvania 15213

A

**Invention and Understanding in the Acquisition of  
Computation**

Lauren B. Resnick  
Learning Research & Development Center  
3939 O'Hara Street  
Pittsburgh, Pennsylvania 15260

B

**Psychology of Equation Solving: An Information  
Processing Study**

L. Ray Carry  
University of Texas  
Austin, Texas 78712

C

**Learning From Science and Mathematics Textbooks:  
Text Structure, Reading Strategies and Comprehension**

James Deese  
University of Virginia  
Charlottesville, Virginia 22901

D

## **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**

**ALABAMA**

James H. Faulkner State Junior College  
 Dexter, Lena . . . . . 176C  
 John C. Calhoun State Community College  
 Tyler, G. Elliott . . . . . 176D  
 S. D. Bishop State Junior College  
 Daigle, Roy . . . . . 176E

**ALASKA**

Alaska, University of  
 Bailey, Raymond P. . . . . 149A

**ARIZONA**

Arizona State University  
 McKelvey, Robert . . . . . 181F  
 Oldaker, Linda M. . . . . 181G

**ARKANSAS**

Arkansas, University of  
 Roberts, T. D. . . . . 149B

**CALIFORNIA**

Advanced Learning Technology  
 Piestrup, Ann . . . . . 149C  
 American River College  
 Hayes, Janan M. . . . . 176F  
 California State University/Fullerton  
 Sica, Morris . . . . . 108, 182A  
 California State University/Long Beach  
 Bauer, Roger D. . . . . 172F  
 California State University/Northridge  
 Marchand, Sonja S. . . . . 172G  
 California, University of, Berkeley  
 Friedman, Alan J. . . . . 150G, 151A  
 Karplus, Robert . . . . . 151C, 151E  
 Laetsch, W. M. . . . . 151F  
 Linn, Marcia C. . . . . 110, 183F  
 Maxwell, Martha . . . . . 173B  
 Reif, Frederick . . . . . 183G  
 Lawrence Hall of Science  
 Karplus, Robert . . . . . 47, 109, 151B, 151D, 183C  
 Laetsch, W. M. . . . . 183D, 183E  
 Miller, John David . . . . . 151G  
 California, University of, Irvine  
 Bork, Alfred M. . . . . 48, 49, 111, 112, 152A  
 Butler, Michael D. . . . . 197B

California, University of, Los Angeles	
Ingersoll, Alfred C. . . . .	.173C
Permaul, Jane . . . . .	.152B, .152C
California, University of, San Diego	
Levin, James A. . . . .	.113
California, University of, Santa Barbara	
Marcus, Marvin . . . . .	.50
Mayer, Richard E. . . . .	.184A, .184B
Shapiro, Perry . . . . .	.152D
California, University of, Santa Cruz	
Hooper, Kristina . . . . .	.152E
Landesman, Edward M. . . . .	.51
Center for the Study of Community Colleges	
Cohen, Arthur M. . . . .	.182B, .182C
Cerro Coso Community College	
Dodge, Richard A. . . . .	.176G
Claremont University Center	
Spanier, Jerome . . . . .	.149D
Coastline Community College	
McGill, Jack . . . . .	.177A
Courseware, Inc.	
Merrill, M. David . . . . .	.149E
Dixie School District	
Saltinski, Ronald . . . . .	.52
Exploratorium, The	
Semper, Robert . . . . .	.149F
Higher Education Research Institute	
Scherrei, Rita A. . . . .	.182D
Mills College	
Humphreys, Sheila . . . . .	.149G
Monterey Peninsula College	
Banathy, Bela . . . . .	.177B
Palace of Arts and Science Foundation	
Oppenheimer, Frank . . . . .	.150A
People's Computer Company	
Zamora, Ramon M. . . . .	.150B
Peralta Community College District	
Holleman, John J. . . . .	.150C
Rockwell International	
Snow, William A. . . . .	.173A
Saddleback College	
Campbell, Dave . . . . .	.177C
San Diego State University	
Branca, Nicholas A. . . . .	.114, .182E
McLeod, Douglas B. . . . .	.182F
Silver, Edward A. . . . .	.115
San Francisco State University	
Coyle, Bernard . . . . .	.150D
Gutierrez, Jose E. . . . .	.150E
Science Applications, Inc.	
Atwood, Michael E. . . . .	.182G
Stanford University	
Cohen, Elizabeth G. . . . .	.183A
Pribram, Karl H. . . . .	.183B
Suppes, Patrick . . . . .	.150F, .197A

COLORADO.

Biological Sciences Curriculum Study Company:	
Hickman, Faith M. . . . .	.152F
Hurd, Paul DeHart . . . . .	.184C
Mayer, William V. . . . .	.152G, 153A
Robinson, James T. . . . .	.184D, 184E
Tolman, Richard R. . . . .	.184F
Colorado State University	
Brubaker, Thomas A. . . . .	.153B
Colorado, University of, Boulder	
Anderson, Ronald D. . . . .	.185A
Ashby, Neil . . . . .	.153E
Harms, Norris . . . . .	.185B
Hawkins, David . . . . .	.185C
Swadener, Marc . . . . .	.153F
Colorado, University of, Colorado Springs	
Larkin, Robert P. . . . .	.153G
Denver, University of	
Dorn, William S. . . . .	.55
Hughes, Barry B. . . . .	.56, 154A
Lantz, Alma E. . . . .	.185D
Eclectic Systems Research	
Lantz, Alma E. . . . .	116
Educational Resources Center, Inc.	
Morrissett, Irving . . . . .	.153C
Social Science Education Consortium, Inc.	
Morrissett, Irving . . . . .	.153D, 184G

CONNECTICUT

Central Connecticut State College	
Goodstein, Madeline P. . . . .	.154B
Cooper & Company	
Samers, Bernard N. . . . .	.173D, 185E
Yale University	
Soloway, Elliot M. . . . .	.117

DELAWARE

Delaware, University of	
Sloyer, Clifford W. . . . .	.57

DISTRICT OF COLUMBIA

American Association of Community & Junior Colleges	
Wilson, Richard E. . . . .	.177D
American Chemical Society	
Lippincott, William T. . . . .	.58
Passer, Moses . . . . .	.173E
American Political Science Association	
Mann, Sheilah K. . . . .	.154C
American Society for Microbiology	
Bishop, Helen L. . . . .	.154D, 154E, 154F
Association of American Geographers	
Pattison, William D. . . . .	.154G
Conference Board of the Mathematical Sciences	
Botts, Truman A. . . . .	.118, 185F

Mathematical Association of America, Inc.	
Jobe, John	.59, 155A
National Academy of Sciences	
Goldhaber, J. K.	.185G
National Wildlife Federation	
Bishop, E. Gerald	.60
Rosenberry, Margaret	.155B
Smithsonian Institution/Chesapeake Bay Center	
Falk, John H.	.61, 190A
Smithsonian Institution/National Zoological Park	
White, Judith	.62

#### FLORIDA

Florida State University	
Burkman, Ernest	.155C
Gagne, Robert M.	.186A, 186B
Florida, University of	
Kantowski, Mary Grace	.155D, 186C, 186D

#### GEORGIA

DeKalb Community College	
Rice, Billie Ann	.177E
Gainesville Junior College	
Hatcher, Martha T.	.177F
Georgia Institute of Technology	
Hutchinson, Charles	.155E
Jarvis, John J.	.156A
Karlovitz, Les A.	.156B
Vail, Charles R.	.155F, 173F
Waugh, J. David	.155G
Georgia, University of	
Boney, Thomas J.	.199
Kilpatrick, Jeremy	.186E
Steffe, Leslie P.	.186F, 186G

#### IDAHO

Idaho, University of	
Browne, Michael	.156C

#### ILLINOIS

Central YMCA Community College	
Perham, Faustine	.177G
Chicago, University of	
Usiskin, Zalman	.157A
Wirszup, Izaak	.63, 157B
Illinois Central College	
Campbell, Thomas C.	.156D, 178A
Illinois State University	
Manelis, Leon	.197C
Tubb, Gary W.	.64
Illinois, University of, Chicago Circle	
Walberg, Herbert J.	.187E, 187F, 187G

Illinois, University of, Urbana	
Davis, Robert B. . . . .	188A, 188B
Dagdale, Sharon . . . . .	.157C
Handler, Paul . . . . .	.157D, 157E
Maehr, Martin L. . . . .	.188C
Travers, Kenneth J. . . . .	.188D
Illinois Wesleyan University	
Wilson, Raymond G. . . . .	.156E
Museum of Science and Industry	
Ansbacher, Theodore . . . . .	.156F
National Engineering Consortium, Inc.	
Janowiak, Robert M. . . . .	.173G
Northern Illinois University	
Behr, Merlyn J. . . . .	120, 187A
Miller, Jon D. . . . .	121, 187B
Sowder, Larry . . . . .	122, 187C
Northwestern University	
Fuson, Karen C. . . . .	.197D
Lesh, Richard. . . . .	.187D
Pinsky, Mark . . . . .	.156G
Triton College	
Collien, William . . . . .	.178B

INDIANA

Ball State University	
Perham, Bernadette H. . . . .	.65
Earlham College	
Woolpy, Jerome H. . . . .	.157F
Indiana University	
Gabel, Dorothy L. . . . .	.188E
Mehlinger, Howard D. . . . .	.66, 157G
Purdue University	
Kahle, Jane Butler . . . . .	.123
El Gomayel, Joseph . . . . .	.158A
Kulm, Gerald . . . . .	.188F
LeBold, William K. . . . .	.188G
Sadowski, Randall P. . . . .	.67, 158B
Vockell, Edward. . . . .	.189B
Wheatley, Grayson H. . . . .	.189A
Wabash College	
Brooks, Austin E. . . . .	.68

IOWA

Iowa State University	
DeLuca, Frederick . . . . .	.189C
Iowa, University of	
Johnson, James W. . . . .	.158C, 158D
Novick, Melvin R. . . . .	.158E, 189D
Sjoerdsma, Theodore J. . . . .	.189E
Kirkwood Community College	
Ernst, Robert. . . . .	.178C

**KANSAS**

Cowley County Community College  
Watters, Mike . . . . .178D  
Kansas State University  
Eckoff, N. Dean . . . . .158F  
Kansas, University of  
Smith, Walter S. . . . .69, 158G  
Washburn University of Topeka  
Yaffe, Fred L. . . . .159A  
Wichita State University  
Graney, Marshall J. . . . .159B

**KENTUCKY**

American Printing House for the Blind  
Franks, Frank L. . . . .71  
Kentucky, University of  
Blythe, David K. . . . .174A  
Hiebert, James . . . . .124  
Wearne, Diana. . . . .124

**LOUISIANA**

Louisiana State University/Eunice  
Lembeck, William J. . . . .178E

**MAINE**

Southern Maine, University of  
Seymour, Richard deVillers . . . . .72

**MARYLAND**

Catonsville Community College  
Sawyer, Robert L. . . . .178F  
Chesapeake Research Consortium, Inc.  
Balling, John D. . . . .125  
Harford Community College  
Hibschman, William D. . . . .178G  
Johns Hopkins University  
Green, Bert F., Jr. . . . .189F  
Hollifield, John H. . . . .159C  
Stanley, Julian C. . . . .189G  
Maryland, University of  
Fey, James T. . . . .73  
Westat, Inc.  
Hodes, Lance . . . . .179A

**MASSACHUSETTS**

American Academy of Arts and Sciences  
Graubard, Stephen R. . . . .190B  
Bolt, Beranek & Newman, Inc.  
Feurzeig, Wallace . . . . .74, 159D  
Boston University  
Haim, Gabriel . . . . .126  
Bunker Hill Community College  
Truesdale, Frank E. . . . .179B

CACHE Corporation	
Carnahan, Brice	.159E
Clark University	
Falmagne, Rachel Joffe	127, 197E
Eastern Regional Council for Educational Television	
Galey, Minaruth	.159F
Education Development Center, Inc.	
Finney, Ross L.	159G, 160A
Murphy, Jerry D.	.160B
Schwartz, Judah L.	.160C
Siegel, Alexander W.	.190C
Harvard University	
Green, David M.	.160D
Moeller, Dade W.	.174B
Selman, Robert Louis	.197F
Massachusetts Institute of Technology	
Allen, Jonathan	.160E
Carey, Susan	.190D
Cohen, Karen C.	.160F
Goldstein, Ira P.	.190E
Papert, Seymour A.	160G, 161A, 190F
Schwartz, Judah L.	.190G
Massachusetts, University of, Amherst	
Byron, Frederick W., Jr.	191B, 197G
Konicek, Richard D.	.161C
Lochhead, Jack	.191C
Pollatsek, Alexander	.128
North Shore Community College	
Nason, Malcolm	.179C
Quinsigamond Community College	
Eagan, Edward	.179D
Southeastern Massachusetts University	
Kaput, James J.	.191A
Technical Education Research Centers	
Tinker, Robert F.	.161B
Worcester Polytechnic Institute	
Grogan, William R.	.161D

MICHIGAN

Central Michigan University	
Douglass, Claudia B.	.161E
Eastern Michigan University	
Moore, John	.75
High/Scope Educational Research Foundation	
Zinn, Karl L.	.76, 161F
Michigan State University	
Armstrong, D. L.	.161G
Hughes, Herman D.	.77, 162A
Lanier, Perry E.	.191D
Lappan, Glenda	.78
Signell, Peter	162B, 162C
Smith, Edward L.	129, 191E
Tschirley, Fred H.	.161G

Michigan Technological University	
Spain, James D. . . . .	.162D
Michigan, University of	
Kulik, James A. . . . .	.191F, 191G
Woodward, John . . . . .	.162E
Suomi College	
Wanhala, Donald. . . . .	.179E
Waterford School District	
Gross, Randy E. . . . .	.79
Wayne State University	
Camp, John S. . . . .	.80

MINNESOTA

Minnesota Educational Computing Consortium	
Anderson, Ronald E. . . . .	.130, 162F
Klassen, Daniel L. . . . .	.192A, 192B
Minnesota, University of	
Gennaro, Eugene D. . . . .	.163A
Halberg, Franz . . . . .	.163B
Johnson, Paul E. . . . .	.192C
Welch, Wayne W. . . . .	.131, 192D
St. Olaf College	
Steen, Lynn Arthur . . . . .	.162G

MISSOURI

Industrial Research Institute Research Corporation	
Schillinger, A. George . . . . .	.174C
Junior College District of St. Louis	
Mowery, Donald R. . . . .	.163C
Missouri, University of, Columbia	
Reys, Robert E. . . . .	.81
Missouri, University of, Kansas City	
Stauffer, Truman . . . . .	.163E
Missouri, University of, Rolla	
Amos, John M. . . . .	.174D
Hamblen, John W. . . . .	.163F, 192E
Mollenkamp, Robert A. . . . .	.82
Southeast Missouri State University	
Stoever, Edward C., Jr. . . . .	.163D
Washington University	
Weldon, David E. . . . .	.192F

MONTANA

Montana College of Mineral Science & Technology	
Twidwell, L. G. . . . .	.163G

NEBRASKA

Nebraska, University of	
Fuller, Robert G. . . . .	.164A
McCurdy, Donald W. . . . .	.192G

<b>NEW HAMPSHIRE</b>	
New Hampshire, University of Warren, Jerry A. . . . .	.164B
<b>NEW JERSEY</b>	
Burlington County College Allbee, Charles . . . . .	.179F
Educational Testing Service Bejar, Isaac I. . . . .	.83
Princeton University Mulvey, John M. . . . .	.84, 164C
Sachs, Harvey M. . . . .	.164D
<b>NEW MEXICO</b>	
All Indian Pueblo Council Hakes, Judith A. . . . .	.164E
<b>NEW YORK</b>	
Association for Computing Machinery, Inc. Austing, Richard H. . . . .	.165B
Barnard College Devons, Samuel . . . . .	.165C
Silver, Rae . . . . .	.165D
Cayuga County Community College Fama, Donald . . . . .	.179G
Children's Television Workshop Mielke, Keith W. . . . .	.193C
City University of New York Beilin, Harry . . . . .	.193D
City University of New York, Brooklyn College of Geddes, Dorothy . . . . .	.193A
Lemke, Jay L. . . . .	.193B
Cooper Union LeMee, Jean . . . . .	.165E
Cornell University Constable, Robert L. . . . .	.165F
Novak, Joseph D. . . . .	.193E
Educational Solutions, Inc. Gattegno, Caleb . . . . .	.165G
Fulton-Montgomery Community College Emmeluth, Donald S. . . . .	.180A
Hamilton College Schoenfeld, Alan H. . . . .	.193F
Institute of Electrical and Electronics Engineers, Inc. Mattson, Roy H. . . . .	.166A
New York, State University of/Albany Bredderman, Theodore A. . . . .	.194B
New York, State University of/Oswego Swift, J. Nathan . . . . .	.194C
New York, State University of/Stony Brook Beltrami, Edward . . . . .	.167A
Braun, Ludwig . . . . .	.85
Liao, Thomas T. . . . .	.167B
Rigden, John S. . . . .	.164F
Strassenburg, Arnold A. . . . .	.164G, 165A

New York University	
Tuttleton, Leslie	.86
New York Zoological Society	
Berkovits, Annette	.87
Polytechnic Institute of New York	
Bulkin, Bernard J.	.166B
Kaufman, Harold G.	174E, 193G, 194A
Weindling, J. I.	.166C
Rensselaer Polytechnic Institute	
Boyce, William E.	.166E
Bunce, Stanley C.	.166D
DiPrima, Richard C.	.166E
Luchins, Edith H.	.88, 166F
Wozny, Michael	.166G
Sloan, Alfred P., Foundation	
Klivington, Kenneth A.	132
Staten Island Continuum of Education, Inc.	
Cusimano, Vincent J.	.89
Syracuse University	
Hall, Vernon	.194D
Howe, Ann C.	.194D
Westchester Community College	
Collins, John T.	.180B
Sarrubbo, John N.	.180B

**NORTH CAROLINA**

Brevard College	
Nicholson, Bobbie Jean	.180C
North Carolina School of Science and Mathematics	
Davis, Carl S.	.90
North Carolina State University	
Harrell, Daniel E.	.174F
Simpson, Ronald D.	.194E
Troost, Kay M.	133
North Carolina, University of	
Parnas, David L.	.167D
Research Triangle Institute	
Dunteman, George H.	.194F
Weiss, Iris R.	.91, 167C
Southeastern Community College	
Scott, Donna E.	.180D
Wake Technical Institute	
Edwards, Timothy I.	.180E

**OHIO**

Battelle Memorial Institute	
Levy, Girard W.	.174G
Welling, Lawrence G.	.175A
Cleveland State University	
Ashcraft, Mark H.	134
Kent State University	
Gordon, John E.	.194G

Ohio State University	
Mayer, Victor J. . . . .	.195B
Osborne, Alan . . . . .	.195A
Wittenberg University	
Kraus, William H. . . . .	.167E
<b>OKLAHOMA</b>	
Oklahoma, University of	
Andree, Richard V. . . . .	.167F
Renner, John W. . . . .	.135
<b>OREGON</b>	
Oregon State System of Higher Education	
Haladyna, Thomas M. . . . .	.136, 195C
Oregon State University	
Burger, William F. . . . .	.195D
Portland State University	
Fiasca, Michael . . . . .	.93, 167G
<b>PENNSYLVANIA</b>	
Carnegie-Mellon University	
Anderson, John R. . . . .	.137
Hartkopf, Volker H. . . . .	.168A
Larkin, Jill H. . . . .	.195E
Simon, Herbert A. . . . .	.198A
Drexel University	
Staib, John H. . . . .	.168B
Woodring, Richard E. . . . .	.168C
Franklin Institute Science Museum and Planetarium	
Borun, Minda . . . . .	.168D
Lehigh University	
Schiesser, William E. . . . .	.168E
Pennsylvania State University	
Becker, Philip M. . . . .	.168F
Farr, James L. . . . .	.175B, 175C, 195F
Hulina, Paul T. . . . .	.168G
Knox, Bruce . . . . .	.94
Roy, Rustum . . . . .	.94, 169A
Pennsylvania, University of	
Gerbner, George . . . . .	.138
Porter, Gerald J. . . . .	.169B
Pittsburgh, University of	
Champagne, Audrey B. . . . .	.139
Dwyer, Thomas A. . . . .	.169C
Holzner, Burkart . . . . .	.169D
Resnick, Lauren B. . . . .	.140, 195G, 198B
Swarthmore College	
Klotz, Eugene A. . . . .	.95
Temple University	
Galey, Minaruth . . . . .	.96



**SOUTH CAROLINA**

Clemson University  
 Aucoin, Clayton V. . . . . 169E  
 South Carolina, Medical University of  
 Zemp, John W. . . . . 175D

**TENNESSEE**

Christian Brothers College  
 Baumeyer, Joel . . . . . 169F  
 Nashville State Technical Institute  
 House, Everett G. . . . . 180F  
 Tennessee, University of  
 Moshell, J. M. . . . . 97, 169G

**TEXAS**

El Paso County Community College  
 Ochoa, Edward A. . . . . 180G  
 Houston, University of  
 Henley, Ernest J. . . . . 98, 170B, 170C  
 Jones, Howard L. . . . . 170D  
 Mountain View College  
 Miller, Clifford D. . . . . 181A  
 Navarro College  
 Meyers, Arthur C. . . . . 170A  
 Orsak, Charles G., Jr. . . . . 99  
 Texas, University of, Austin  
 Carry, L. Ray . . . . . 198C  
 Himmelblau, David M. . . . . 100, 170E  
 Novak, Gordon S., Jr. . . . . 196A  
 Texas, University of, El Paso  
 Goodell, Philip C. . . . . 170F

**UTAH**

Utah, University of  
 Kadesch, Robert R. . . . . 170G  
 WICAT, Incorporated  
 Bunderson, C. Victor . . . . . 101, 171A, 171B

**VIRGINIA**

AAMI Foundation  
 Caceres, Cesar A. . . . . 175E  
 George Mason University  
 Ehrlich, Robert . . . . . 175F  
 Human Resources Research Organization (HumRRO)  
 Hunter, Beverly . . . . . 102, 171C  
 Northern Virginia Community College  
 Sellers, Martha W. . . . . 181B  
 West, George G. . . . . 181C  
 Virginia Commonwealth University  
 Morris, J. Richard . . . . . 171D  
 Virginia Military Institute  
 Settle, Frank A., Jr. . . . . 103, 171E



Virginia, University of	
Deese, James . . . . .	.198D
Gibson, John E. . . . .	104
Wytheville Community College	
DiYorio, John S. . . . .	.181D
<b>WASHINGTON</b>	
Mercer Island School District #400	
Minstrell, James A. . . . .	141, 196B
Washington State University	
Bushaw, Donald . . . . .	.172B
Washington, University of	
Chapman, Douglas G. . . . .	.171G
Gillespie, Robert G. . . . .	.196C
Hyman, Barry I. . . . .	.171F
Laffey, James M. . . . .	105
McDermott, Lillian C. . . . .	106, 142, 172A, 196D
<b>WEST VIRGINIA</b>	
West Virginia University	
Allen, Robert D. . . . .	143
<b>WISCONSIN</b>	
American Society for Engineering Education	
Klus, John P. . . . .	.175G
Carroll College	
Isaacs, Gerald L. . . . .	.172C
Racine Unified School District	
Kastenschmidt, Walter R. . . . .	107
Wisconsin, University of, Madison	
Carpenter, Thomas . . . . .	.196E
Fennema, Elizabeth . . . . .	144, 145, 196F
Harvey, John G. . . . .	.196G
Johnson, Donald R. . . . .	.172D
Nadler, Gerald . . . . .	.172E
Smith, Robert J. . . . .	.176B
Stewart, James H. . . . .	146
Wisconsin, University of, Oshkosh	
Adams, W. Sam . . . . .	.176A
<b>WYOMING</b>	
Western Wyoming Community College	
Bonini, William J. . . . .	.181E

**Appendix B**  
**Principal Investigators**

## Appendix B Principal Investigators

### A

Adams, W. Sam 176A  
 Allbee, Charles 179F  
 Allen, Jonathan 160E  
 Allen, Robert D. 143  
 Amos, John M. 174D  
 Anderson, John R. 137  
 Anderson, Ronald D. 185A  
 Anderson, Ronald E. 130, 162F  
 Andree, Richard V. 167F  
 Ansbacher, Theodore 156F  
 Armstrong, D. L. 161G  
 Ashby, Neil 153E  
 Ashcraft, Mark H. 134  
 Atwood, Michael E. 182G  
 Aucoin, Clayton V. 169E  
 Austing, Richard H. 165B

### B

Bailey, Raymond P. 149A  
 Balling, John D. 125  
 Banathy, Bela 177B  
 Bauer, Roger D. 172F  
 Baumeyer, Joél 169F  
 Becker, Philip M. 168F  
 Behr, Marilyn J. 120, 187A  
 Beilin, Harry 193D  
 Bejar, Isaac I. 83  
 Beltrami, Edward 167A  
 Berkovits, Annette 87  
 Bishop, E. Gerald 60  
 Bishop, Helen L. 154D, 154E,  
 154F  
 Blythe, David K. 174A  
 Bonini, William J. 181E  
 Bork, Alfred M. 48, 49, 111,  
 112, 152A  
 Borun, Minda 168D  
 Botts, Truman A. 118, 185F  
 Boyce, William E. 166E  
 Branca, Nicholas A. 114, 182E  
 Braun, Ludwig 85  
 Bredderman, Theodore A. 194B  
 Brooks, Austin E. 68  
 Browne, Michael E. 156C  
 Brubaker, Thomas A. 153B  
 Bulkin, Bernard J. 166B

Bunce, Stanley C. 166D  
 Bunderson, C. Victor 101, 171A,  
 171B  
 Burger, William F. 195D  
 Burkman, Ernest 155C  
 Bushaw, Donald 172B  
 Butler, Michael D. 197B  
 Byron, Frederick W., Jr. 191B,  
 197G

### C

Caceres, Cesar A. 175E  
 Camp, John S. 80  
 Campbell, Dave 177C  
 Campbell, Thomas C. 156D, 178A  
 Carey, Susan 190D  
 Carnahan, Brice 159E  
 Carpenter, Thomas 196E  
 Carry, L. Ray 198C  
 Champagne, Audrey A. 139  
 Chapman, Douglas G. 171G  
 Cohen, Arthur M. 182B, 182C  
 Cohen, Elizabeth G. 183A  
 Cohen, Karen C. 160F  
 Collien, William 178B  
 Collins, John T. 180B  
 Constable, Robert L. 165F  
 Cooney, Thomas J. 119  
 Coyle, Bernard 150D  
 Cusimano, Vincent J. 89

### D

Daigle, Roy 176E  
 Davis, Carl S. 90  
 Davis, Robert B. 188A, 188B  
 Deese, James 198D  
 DeLuca, Frederick P. 189C  
 Devons, Samuel 165C  
 Dexter, Lena 176C  
 DiPrima, Richard C. 166E  
 DiYorio, John S. 181D  
 Dodge, Richard A. 176G  
 Dorn, William S. 55  
 Douglass, Claudia B. 161E  
 Dugdale, Sharon 157C  
 Dunteman, George H. 194F  
 Dwyer, Thomas A. 169C

## E

Eagan, Edward 179D  
 Eckoff, N. Dean 158F  
 Edwards, Timothy I. 180E  
 Ehrlich, Robert 175F  
 El Gomayel, Joseph 158A  
 Emmeluth, Donald S. 180A  
 Ernst, Robert 178C

## F

Falk, John H. 61, 190A  
 Falmagne, Rachel Joffe 127,  
 197E  
 Fama, Donald 179G  
 Farr, James L. 175B, 175C,  
 195F  
 Fennema, Elizabeth 144, 145,  
 196F  
 Feurzeig, Wallace 74, 159D  
 Fey, James T. 73  
 Fiasca, Michael 93, 167G  
 Finney, Ross L. 159G, 160A  
 Franks, Frank L. 71  
 Friedman, Alan J. 150G, 151A  
 Fuller, Robert G. 164A  
 Fuson, Karen C. 197D

## G

Gabel, Dorothy L. 188E  
 Gagne, Robert M. 186A, 186B  
 Galey, Minaruth 96, 159F  
 Gattegno, Caleb 165G  
 Geddes, Dorothy 193A  
 Gennaro, Eugene D. 163A  
 Gerbner, George 138  
 Gibson, John E. 104  
 Gillespie, Robert G. 196C  
 Goldhaber, J. K. 185G  
 Goldstein, Ira P. 190E  
 Goodell, Philip C. 170F  
 Goodstein, Madeline P. 154B  
 Gordon, John E. 194G  
 Graubard, Stephen R. 190B  
 Graney, Marshall J. 159B  
 Green, Bert F., Jr. 189F  
 Green, David M. 160D  
 Grogan, William R. 161D  
 Gross, Randy E. 79  
 Gutierrez, Jose E. 150E

## H

Haim, Gabriel 126  
 Hakes, Judith A. 164E  
 Haladyna, Thomas M. 136, 195C  
 Halberg, Franz 163B  
 Hall, Vernon 194D  
 Hamblen, John W. 163F, 192E  
 Handler, Paul 157D, 157E  
 Harms, Norris 185B  
 Harrell, Daniel E. 174F  
 Hartkopf, Volker H. 168A  
 Harvey, John G. 196G  
 Hatcher, Martha T. 177F  
 Hawkins, David 185C  
 Hayes, Janan M. 176F  
 Henley, Ernest J. 98, 170B, 170C  
 Hibschan, William F. 178G  
 Hickman, Faith M. 152F  
 Hiebert, James 124  
 Himmelblau, David M. 100, 170E  
 Hodes, Lance 179A  
 Holleman, John J. 150C  
 Hollifield, John H. 159C  
 Holzner, Burkart 169D  
 Hooper, Kristina 152E  
 House, Everett G. 180F  
 Howe, Ann C. 194D  
 Hughes, Barry B. 56, 154A  
 Hughes, Herman D. 77, 162A  
 Hulina, Paul T. 168G  
 Humphreys, Sheila 149G  
 Hunter, Beverly 102, 171C  
 Hurd, Paul DeHart 184C  
 Hutchinson, Charles 155E  
 Hyman, Barry L. 171F

## I

Ingersoll, Alfred C. 173C  
 Isaacs, Gerald L. 172C

## J

Janowiak, Robert M. 173G  
 Jarvis, John J. 156A  
 Jobe, John 59, 155A  
 Johnson, Donald R. 172D  
 Johnson, James W. 158C, 158D  
 Johnson, Paul E. 192C  
 Jones, Howard L. 170D

K

Kadesch, Robert R. 170G  
 Kahle, Jane Butler 123  
 Kantowski, Mary Grace 155D,  
 186C, 186D  
 Kaput, James J. 191A  
 Karlovitz, Les A. 156B  
 Karplus, Robert 47, 109, 151B,  
 151C, 151D, 151E, 183C  
 Kastenschmidt, Walter R. 107  
 Kaufman, Harold G. 174E, 193G,  
 194A  
 Kilpatrick, Jeremy 186E  
 Klassen, Daniel L. 192A, 192B  
 Klivington, Kenneth A. 132  
 Klotz, Eugene A. 95  
 Klus, John P. 175G  
 Knox, Bruce 94  
 Konicek, Richard D. 167E  
 Kraus, William H. 167E  
 Kulik, James A. 191F, 191G  
 Kulm, Gerald 188F

L

Laetsch, W. M. 151F, 183D,  
 183E  
 Laffey, James M. 105  
 Landesman, Edward M. 51  
 Lanier, Perry E. 191D  
 Lantz, Alma E. 116, 185D  
 Lappan, Glenda 78  
 Larkin, Jill H. 195E  
 Larkin, Robert P. 53, 153G  
 LeBold, William K. 188G  
 Lembeck, William J. 178E  
 LeMee, Jean 165E  
 Lemke, Jay L. 193B  
 Lesh, Richard 187D  
 Levin, James A. 113  
 Levy, Girard W. 174G  
 Liao, Thomas T. 167B  
 Linn, Marcia C. 110, 183F  
 Lippincott, William T. 58  
 Lochhead, Jack 191C  
 Luchins, Edith H. 88, 166F

M

McCurdy, Donald W. 192G  
 McDermott, Lillian C. 106, 142,  
 172A, 196D  
 McGill, Jack 177A

McKelvey, Robert 181  
 McLeod, Douglas B. 182F  
 Maehr, Martin L. 188C  
 Manelis, Leon 197C  
 Mann, Sheilah K. 154C  
 Marchand, Sonja S. 172G  
 Marcus, Marvin 50  
 Mattson, Roy H. 166A  
 Maxwell, Martha 173B  
 Mayer, Richard E. 184A, 184B  
 Mayer, Victor J. 195B  
 Mayer, William V. 152G, 153A  
 Mehlinger, Howard 66, 157G  
 Merrill, M. David 149E  
 Meyers, Arthur C. 170A  
 Mielke, Keith W. 193C  
 Miller, Clifford D. 181A  
 Miller, John David 151G  
 Miller, Jon D. 121, 187B  
 Minstrell, James A. 141, 196B  
 Moeller, Dade W. 174B  
 Mollenkamp, Robert A. 82  
 Moore, John 75  
 Morris, J. Richard 171D  
 Morrisett, Irving 153C, 153D,  
 184G  
 Moshell, J. M. 97, 169G  
 Mowery, Donald R. 163C  
 Mulvey, John M. 84, 164C  
 Murphy, Jeffry D. 160B

N

Nadler, Gerald 172E  
 Nason, Malcolm 179C  
 Nicholson, Bobbie Jean 180C  
 Novak, Gordon S., Jr. 196A  
 Novak, Joseph D. 193E  
 Novick, Melvin R. 158E, 189D

O

Ochoa, Edward A. 180G  
 Oldaker, Linda M. 181G  
 Oppenheimer, Frank 150A  
 Orsak, Charles G., Jr. 99  
 Osborne, Alan 195A

P

Papert, Seymour A. 160G, 161A,  
 190F  
 Parnas, David L. 167D  
 Passer, Moses 173E

Pattison, William D. 154G  
Perham, Bernadette H. 65  
Perham, Faustine 177G  
Permaul, Jane 152B, 152C  
Piestrup, Ann 149C  
Pinsky, Mark 156G  
Pollatsek, Alexander 128  
Porter, Gerald J. 169B  
Pribram, Karl H. 183B

## R

Reif, Frederick 183G  
Renner, John W. 135  
Resnick, Lauren B. 140,  
195G, 198B  
Reys, Robert E. 81  
Rice, Billie Ann 177E  
Rigden, John S. 164F  
Roberts, T. D. 149B  
Robinson, James T. 184D,  
184E  
Rosenberry, Margaret 155B  
Roy, Rustum 94, 169A

## S

Sachs, Harvey M. 164D  
Sadowski, Randall P. 67, 158B  
Saltinski, Ronald 52  
Samers, Bernard N. 173D, 185E  
Sarrubbo, John N. 180B  
Sawyer, Robert L. 178F  
Scherrei, Rita A. 182D  
Schisser, William E. 168E  
Schillinger, A. George 174C  
Schoenfeld, Alan 193F  
Schwartz, Judah L. 160C, 190G  
Scott, Donna E. 180D  
Sellars, Martha W. 181B  
Selman, Robert Louis 197F  
Semper, Robert 149F  
Settle, Frank A. 103, 171E  
Seymour, Richard deVillers 72  
Shapiro, Perry 152D  
Sica, Morris 108, 182A  
Siegel, Alexander W. 190C  
Signell, Peter 162B, 162C  
Silver, Edward A. 115  
Silver, Rae 165D  
Simon, Herbert A. 198A  
Simpson, Ronald D. 194E  
Sjoerdsma, Theodore 189E

Sloyer, Clifford W. 57  
Smith, Edward L. 129, 191E  
Smith, Robert J. 176B  
Smith, Walter S. 69, 158G  
Snow, William A. 173A  
Soloway, Elliot M. 117  
Sowder, Larry F. 122, 187C  
Spain, James D. 162D  
Spanier, Jerome 149D  
Staib, John H. 168B  
Stanley, Julian C. 189G  
Stauffer, Truman 163E  
Steen, Lynn Arthur 162G  
Steffe, Leslie P. 186F, 186G  
Stewart, James H. 146  
Stoever, Edward C. 163D  
Strassenburg, Arnold A. 164G, 165A  
Suppes, Patrick 150F, 197A  
Swadener, Marc 153F  
Swift, J. Nathan 194C

## T

Tinker, Robert F. 161B  
Tolman, Richard R. 184F  
Travers, Kenneth J. 188D  
Troost, Kay M. 133  
Truesdale, Frank E. 179B  
Tschirley, Fred H. 161G  
Tubb, Gary W. 64  
Tuttleton, Leslie C. 86  
Twidwell, L. G. 163G  
Tyler, G. Elliot 176D

## U

Usiskin, Zalman 157A

## V

Vail, Charles R. 155F, 173F  
Vockell, Edward 189B

## W

Walberg, Herbert J. 187E, 187F,  
187G  
Wañhala, Donald 179E  
Warren, Jerry A. 164B  
Watters, Mike 178D  
Waugh, J. David 155G  
Wearne, Diana 124  
Weindling, J. I. 166C

Weiss, Iris R. 91, 167C  
Welch, Wayne W. 131, 192D  
Weldon, David E. 192F  
Welling, Lawrence G. 175A  
West, George G. 181C  
Wheatley, Grayson H. 189A  
White, Judith 62  
Wilson, Raymond G. 156E  
Wilson, Richard 177D  
Wirszup, Izaak 63, 157B  
Woodring, Richard E. 168C  
Woodward, John 162E  
Woolpy, Jerome H. 157F  
Wozny, Michael 166G

Y

Yaffe, Fred L. 159A

Z

Zamora, Ramon M. 150B  
Zemp, John W. 175D  
Zinn, Karl 76, 161F

**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