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ABSTRACT

The final technical report is presented on the establishment and operation of an Exchange of Information among universities, corporations and government agencies concerned with the use of the computer as an aid to the instructional process. Four modes of information dissemination are described. A monthly dissemination of information on cards comprises the first mode; data distributed includes computer-assisted instruction (CAI) research abstracts, CAI program specifications, computer-managed instruction (CMI) research abstracts, and CAI facility descriptions. Descriptions of the seven conferences making up the second mode include special topics covered: CAI languages, CAI in technical education, CAI in health professions, simulation in CAI, and instructional strategies in CAI. The third mode consisted of a three-week workshop which is considered briefly in the report. The final mode, annual integration of the data into literature surveys, is also examined. Methods of data collection (site visits and questionnaires) and classification (construction of CAI and CMI thesauri) are included. (Author/SP)

ED038862

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COMPUTER-ASSISTED INSTRUCTION
INFORMATION EXCHANGE

Final Technical Report
for the period
1 February 1965 - 31 December 1969

Project NR 154 254
of the
Personnel and Training Research Programs Office
Office of Naval Research
Contract N00014-68-C-0236
(formerly Nonr-4757(00))

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COMPUTER-ASSISTED INSTRUCTION

INFORMATION EXCHANGE

Contract Nonr-4757(00)

Contract N00014-68-C-0236

FINAL TECHNICAL REPORT

1 February 1965 - 31 December 1969

**COMPUTER-ASSISTED INSTRUCTION
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No.	KEY WORDS	LINK A		LINK B		LINK C	
		ROLE	WT	ROLE	WT	ROLE	WT
	computer						
	instruction						
	information						
	conference						
	workshop						
	thesaurus						



Abstract

This is the final technical report for contracts Nonr 4757(00) and N00014-68-C-0236 between the Office of Naval Research and ENTELEK Incorporated, whereby ENTELEK established and operated an Exchange of Information among universities, corporations and government agencies concerned with the use of the computer as an aid to the instructional process. Four modes of information exchange are described: (1) a monthly dissemination of information on cards, (2) conferences, (3) a workshop and (4) an annual integration of the data.

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I. INTRODUCTION

In 1965, to increase the flow of information in the fast-growing field of computer-assisted instruction (CAI), the Personnel and Training Branch of the Office of Naval Research initiated an exchange of information among institutions actively practicing CAI or conducting research in the field. To implement the CAI Information Exchange, ONR made contract Nonr 4757(00) with ENTELEK Incorporated. This contract was superceded in 1968 by contract N00014-68-C-0236.

At the outset, participants in the Exchange were primarily universities and other organizations under contract to ONR to do research in CAI, plus agencies of the federal government that had a need to keep abreast of the new technology. The Office of Naval Research was one of the first agencies to provide support for research in CAI. In 1965 the Personnel and Training Branch and the Information Systems Branch of ONR had CAI-related contracts with the University of Illinois, Stanford, MIT, Bolt Beranek & Newman, System Development Corporation and several other activities.

When the Exchange was established it was clear that there would be a rapid growth in the amount of CAI research and in the number of people who would want to participate in the Exchange, and that the Office of Naval Research could not justify full support of the Exchange indefinitely. Consequently, beginning in 1967, the level of ONR support was gradually reduced and the participants were asked to shoulder part of the cost, particularly the cost associated with the dissemination, as opposed to the

collection of data. At the termination of the contract in December 1969, the Exchange was self-sustaining with 250 institutions participating. The list of participants at that date is given in Appendix A.

Computer-assisted instruction has been defined by Dr. Glenn Bryan as any situation in which a student and a computer are in direct interaction with the objective of bringing about desirable behavior change, i. e., learning, in the student. A complementary use of the computer as an aid to the teacher in the process of instruction emerged in about 1968 and has come to be known as computer-managed instruction (CMI). In CMI it is the instructor who is the loop with the computer. The instructor inputs to the computer aptitude and achievement data for individual students and receives individual prescriptions for instruction.

CMI makes it easier to manage CAI and other techniques of individualized instruction, including programmed instruction. In 1969, the CAI Information Exchange was broadened to include CMI.

Dr. Albert E. Hickey was the principal investigator.

II. DESCRIPTION OF THE SERVICE

In the first year of the contract, ENTELEK project personnel met monthly with Dr. Bryan to establish the Exchange procedure. Two kinds of service emerged: 1. an exchange of information on cards and 2. conferences.

A. The Card System

1. The mainspring of the ENTELEK CAI/CMI Information Exchange is the monthly distribution of data on cards bound in book form. Each monthly book has about 190 pages of data. The user may browse through the book and then shelve it, or he may remove the cards to create a comprehensive file on CAI and CMI, as described below. Some 35 sets of data have been distributed since the Exchange began.
2. There are four kinds of data in each monthly volume of cards: (1) abstracts of the CAI literature, (2) specifications of CAI programs, (3) abstracts of the CMI literature, and (4) descriptions of CAI/CMI facilities. Each kind of data is printed on color-coded cards to permit quick classification. A sample of each type of card is shown in Appendix B.
3. A steel file cabinet complete with 100 dividers, each printed with a caption, is provided to permit easy filing of the data cards. The result is an integrated, up-to-date library tool. The organization of the file is shown in Figure 1.

4. When the user first joins the Exchange, he receives microfiche containing all the CAI/CMI data distributed since 1965. The fiche are accompanied by complete indexes to permit retrieval of data by subject, author, etc.

B. The Survey of the Literature

Since mere accumulation of data is no answer to the explosion of technical information, ENTELEK publishes an annual survey and synthesis of the data that have passed through the Exchange from its inception. Research findings are interrelated, trends identified, and obsolete information deleted. Three editions of the Survey were published during the term of the contract. Under the phasing-out agreement the third edition was published by ENTELEK in October 1968 at no cost to the contract. The first three editions were edited by Dr. Hickey. A fourth edition is currently being prepared by Cornelius Butler of Stanford University.

C. Conferences

During the contract years of 1965, 1966, 1967 and 1968 seven conferences on CAI were sponsored by ONR under the ENTELEK contract. Three of the meetings were conducted at CAI research centers (Stanford, Illinois and the System Development Corporation) to give more exposure to the work of those projects. Four of the meetings were devoted to specific topics in CAI. A brief description of each conference follows:

1. Stanford University
2. University of Illinois
3. CAI Languages (Cambridge, Mass.)
4. CAI in Technical Education (Pennsylvania State University, April 1967)
5. Simulation in CAI (University of Texas, January 1968)
6. CAI in the Health Profession (Harvard University, February 1968)
7. Instructional Strategies Appropriate to CAI (Washington D. C., October 1968)

From 25 to 40 members of the CAI interest group attended each meeting. ENTELEK published the proceedings of each. In the final year of the contract the topical meetings were superceded by four regional meetings conducted by ENTELEK at no cost to the contract under the "phasing out" policy. The proceedings of these meetings were also published by ENTELEK. The second round of regional meetings was recently held and the proceedings are now in preparation.

Since 1968 sponsorship of national meetings on CAI has been assumed by various professional and user groups, e. g. , the National Security Industrial Association; ADIS, the IBM educational user's group; et al.

D. CAI Workshop at the Naval War College

From its vantage point in the Office of Naval Research, the Personnel and Training Branch felt that the summer of 1966 was the opportune time to demonstrate CAI to Navy educators and to give selected instructors the opportunity to learn to apply the new CAI technology to their teaching

objectives. To this end, ONR organized three CAI workshops for the summer of 1966.

1. At Project PLATO, University of Illinois, for Naval Academy faculty.
2. At the Naval Academy, Annapolis, for Naval Academy faculty.
3. At the Naval War College, Newport, for the faculties of Navy schools in the Newport area.

ENTELEK conducted the CAI workshop at the Naval War College, a three-week program extending from July 11 to 28. The objectives of the Newport workshop were to review the state of the computer-assisted instruction art in terms of its application to the U. S. Navy, with special emphasis on the activities at Newport, and to provide guided practice in writing CAI programs to a selected group of Naval officers on the Newport base.

Representatives were designated by the War College, Officer Candidate School, Destroyer School, Correspondence School, and Naval Supply Depot. The program gave equal time to (1) "hands-on" demonstration and practice with time-shared computer utilities and (2) presentations on man-computer interaction by guest lecturers.

Connections were established with remote computers at Bolt Beranek and Newman, General Electric, and IBM Yorktown. Interaction was also established with the concurrent workshop at the Naval Academy through the G. E. computer.

The staff and guest lecturers for the workshop included Professors Ward Edwards (University of Michigan), Philip Merrifield (Kent State), John Poppe (ICAF) and Harold Guezkow (Northwestern). Also Dr. John Summers (MITRE) and Mr. Wallace Feurzeig (Bolt Beranek and Newman).

Drs. Hickey and Gordon M. Becker conducted the workshop for ENTELEK.

III. DATA COLLECTION AND CLASSIFICATION

A. Site Visits

A primary objective of the Exchange has been to achieve a short lag in the distribution of CAI data. Consequently, ENTELEK adopted an active rather than a passive approach to data collection. From 1965 through 1969 ENTELEK personnel visited virtually every major CAI facility in the U. S. and attended the principal conferences at which reports of CAI research were given. Over 60 such visits were made in all. A list of sites visited is given in Appendix C.

B. Questionnaires

To capture data for the Exchange ENTELEK formulated a questionnaire for each kind of data:

- (1) CAI Research Abstract
- (2) CAI Program Specification
- (3) CMI Research Abstract
- (4) CAI Facility Descriptions

A copy of each appears in Appendix D.

C. CAI and CMI Thesauri

To classify the data on CAI, and later on CMI, it was necessary to build two thesauri, since the two subjects had not been covered in such detail before.

The same thesauri serve to organize the contents of CAI: A Survey of the Literature. They appear in Appendix E.

ENTELEK CAI CARD FILE ARRANGEMENT

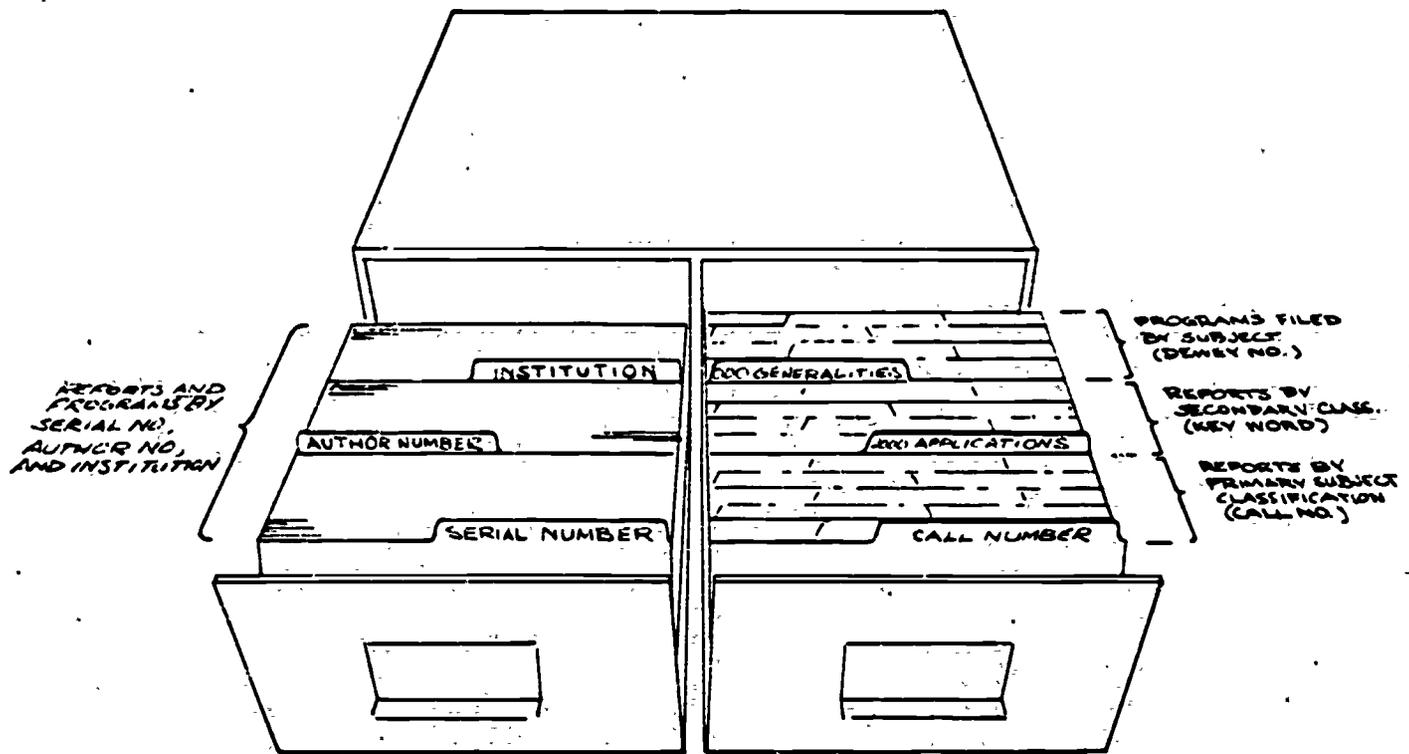


Figure 1.

APPENDIX A.

<u>Name</u>	<u>Institution or Organization</u>
Dr. J. Annett	Hull University, England
Prof. Richard C. Atkinson	Stanford University
Dr. Richard Balomenos	National Science Foundation
Richard Barry	Off. of Info. Sys. Planning and Development
Mr. Roger Berkshire	U. S. Naval School of Aviation Medicine
Dr. D. L. Bitzer	PLATO, Univ. of Illinois
Dr. A. deBrisson	Centre d'Etudes et de Recherches, France
Prof. C. Victor Bunderson	Univ. of Texas
Sqn Ldr. Ivor K. Davies	Royal Air Force
Dr. Barrett Denton	Behavioral Sc. Lab., Wright-Patterson AFB
Directorate of Individual Training	Off. of Asst. Secy. of Defense (Manpower)
Mr. James S. Duva	Naval Training Device Center
E. Elliott, Esq.	Ministry of Defense (Navy), England
Dr. Gerald Engel	U.S. Naval Weapons Lab.
Dr. Wallace Feurzeig	Bolt Beranek and Newman
Dr. Victor Fields	Office of Naval Research
Dr. John D. Ford	U. S. Naval Personnel Research Activity
Capt. J. E. Forrest	USN, Ind. College of the Armed Forces
Dr. Eugene E. Gloye	Office of Naval Research
Dr. Duncan Hansen	Florida State University
Mr. Larry G. Harding	Naval Air Station
Mr. Anthony M. Hodgson	Inst. for Comp. Study of Hist., Phil. & Sc., ENG.
M. O. Houziaux	Inst. de Mathematique, Belgium
Capt. Geoffrey Huggett	Greystoke, England
Mr. Max Jerman	Stanford University
Dr. Felix F. Kopstein	HumRRO, G. Washington Univ.
Mrs. Betta H. Kriner	Penn State Univ.
Dr. Herbert F. LaGrone	Texas Christian Univ.
F. H. Lakin	Defence Operation Anal. Establishment, ENG.
Dr. J. C. R. Licklider	M. I. T.
Dr. Sylvia R. Mayer	HQ ESD (ESVPT), Hanscom Field
Major John R. Parker	U. S. Military Academy
Mr. Adrian Parmeter	Office of Education
Gordon Pask, Esq.	System Research Ltd., England
Capt. Edward M. Porter, Jr.	Naval War College
Dr. Paul Quinn	U. S. Naval Academy
Mr. William W. Ramage	Univ. of Pittsburgh LRDC
Dr. Joseph W. Rigney	Univ. of Southern California, L. A.
Dr. Ray Roberts	Naval Pers. Prog. Support Activity
Dr. Harry Silberman	System Development Corp.
Dr. H. Wallace Sinaiko	Office of Naval Research Branch Office
Dr. Lawrence M. Stolurow	Harvard Computing Center
Mr. Harley Tillitt	U. S. Naval Ordnance Weapons Center
Mr. Earl K. Wallace	USAFHQ (AFP-TRD)
Dr. Richard L. Wing	BOCES
Dr. Karl L. Zinn	Univ. of Michigan - CRLT

<u>Name</u>	<u>Institution or Organization</u>
Department of Education	Michigan State University
D'Anne Boedeker	McREL (Mid-continent Regional Educ. Lab.)
Dr. Louis A. Formica	Mineola Public Schools
Mr. John R. Crocker	Minnesota School Districts
Special Education Dept.	University of Minnesota
Department of Sociology	The University of Minnesota
Mr. William L. Stucker	Univ. of Missouri Regional Medical Program
--	The Mitre Corporation
--	Montgomery County Public Schools
Product Specifications Dept.	The National Cash Register Co.
Chief, Training Unit	Natl. Communicable Disease Center
John Duke	Natl. Council for Educational Tech., England
Training Supervisor	NATTC, Naval Air Station
Technical Reference Library	Naval Medical Research Institute
Washington Navy Yard	(Navy) Personnel Research Laboratory
David H. Brand	N. E. Medical Center Hospitals
Speech Dept.	New Mexico State University
Mr. Hugh McDougall	Board of Education - City of New York
Prof. A. Dorman	New York City Community College
Dr. Cyril H. Price	New York City Community College
Dr. F. Brooks Sanders	State University of New York
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Order Librarian	State University College (Potsdam, N. Y.)
Computing Center	N. Y. State Univ. Downstate Medical Center
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NameInstitution or Organization

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(" ") Lt. Col. D. Ford	Wright-Patterson AFB (AFIT-SLF)
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Rec'g. Dept. Parnassus at Arguello	University of California-S. F. Medical Ctr.
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Dr. Ian C. Bennett	Univ. of Kentucky Medical Center
Dr. John G. Navarra	Learning Resources Laboratories
John K. Taylor	LIBERTY Council of Schools
Mr. Thomas Hartsig	County of Macomb, Intermediate Sch. Dist.
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Dr. Thomas E. Rogers	Medical College of South Carolina
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Mr. Harry Denzel	Southern Illinois Univ., Self-Instruction Ctr.
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Ross Snyder	Taylor University, Educ. Media Dept.
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Library	Xerox Education Division

APPENDIX B.

Sample of Data Cards

S000
S927

68-1030/31

Strum, Irene

Use of CAI in New York State Public Schools

New York
State
3300

Summary report, Board of Cooperative Educational Services #1
(BOCES), Yorktown Heights, N. Y. ; October 1968.

El-hi
2735

The purpose of this investigation was to study in depth the use of computer-assisted instruction (CAI) in New York State public school districts. As a follow-up to a study by the State Education Department, questionnaires were sent to eighty chief school administrators who had indicated that they were engaged in CAI. On the basis of 39 returns, it was found that eight schools were actually engaged in CAI.

Craig School, Schenectady - teaches math, language arts, and social studies for grades 1 to 5; programs written by teachers in Basic and Fortran. GE computer used belonging to GE Research and Development Lab; one GE terminal. Computer operations financed through GE Lab.
Half Hollow Hills High School, Huntington - teaches science for 10-12 grade; programs written by professors at Brooklyn Polytechnic Institute
(over)

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1300
S582

M68-0201/30

Silberman, Harry F. (System Development Corp.)

Design Objectives of the Instructional Management System

Paper presented at AERA annual meeting, February 8, 1968.

To help the teacher make more accurate decisions about the daily presentation of lessons, an Instructional Management System, called IMS, is being developed by the System Development Corporation and the Southwest Regional Laboratory. IMS is currently operating in two elementary schools in the Los Angeles City School District. Its purpose is to provide diagnostic and prescriptive information to the teacher to assist her in making such instructional decisions as how fast to pace instructional units, when to re-group students, and how to modify the sequence of instruction. The testing and information system of the Instructional Management System is described briefly.

Three design objectives guided the development of IMS:

- 1) An evolutionary approach to implementation

(over)

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1. MAC03
- 1a. Elementary Keynesian macroeconomic models (4)
2. Richardson, David A.
3. College students in introductory economics course
4. No prerequisites
5. User time varies with level of sophistication from 1/2 to 1 hour.
6. Socratic and tutorial
7. FORTRAN IV
8. IBM 1802 (16K core storage and 16 bit words; core requirement is 3500 words)
9. Teletypewriters
10. Handout stating basic model equations and definitions
11. Reports available from Director of Beloit College Computing Center
12. Beloit College Computing Center, Beloit, Wisconsin
13. Available upon request
14. See also MIC01 (P69-0205), MAC05(P69-0207) and Facility Description F69-0203
15. Specifications submitted in February 1969
16. National Science Foundation (COSIP grant) and Beloit College

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1. Air Force Institute of Technology, School of Systems and Logistics, Computer Support Department
2. Wright-Patterson Air Force Base, Ohio 45433
3. Director: Captain D. Veasey
4. Key personnel: ILT David B. Loveman
5. Facility is operational
6. Computer is general purpose
7. Central Processor: IBM 1620 II
8. CPU is at facility
9. Processor Controllers: --
10. Storage: 2 disks (2 million digits each)
11. On-line I/O:
 - a. Terminals: Teletypes (Model 35)
 - b. Auxiliary visual displays: --
 - c. Audio I/O: --
 - d. Other: --
12. Data-processing I/O:
 - a. Card-reader punch: IBM 1622
 - b. Paper tape: --
 - c. Magnetic tape: --

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APPENDIX C

SITE VISITS AND CONFERENCES ATTENDED

<u>CAI Site</u>	<u>Man Days</u>
System Development Corporation	5
Stanford University	2
Dartmouth College	1
Providence College	2
Brown University	1
Philco-Philadelphia	1
USNA	1
U/Pitt LRDC	1
Bolt, Beranek and Newman	3
Harvard University	3
Pennsylvania State University	5
Dartmouth College	2
Harvard University	10
U. S. Navy Training Device Center	1
U. S. Naval Academy	1
University of Pittsburgh	2
American Educational Research Assoc. (Annual Meeting)	4
Association for Educational Data Systems (Workshop)	1
School District of Philadelphia	2
U. S. Navy Medical School	1
Office of Under Secretary of Defense (Man)	1
IBM Instructional Systems Mktg. Dept.	1
American Management Association Conference on Educational Technology	6
Project ARISTOTLE Symposium	2
ONR Conference, Washington, D. C.	6
Dartmouth College	1
Assoc. for Programmed Learning (UK)	4
Nat'l. Council Teachers of Mathematics	8
Am. Soc. for Training and Develop.	4
Am. Assoc. of School Admin.	2
Am. Educ. Research Assoc. Annual Meeting	
U/Pitt LRDC	
U/Mass. Educ. Adm. Conference	
Lehigh University, Psychology Department	
Nat'l. Council Teachers of Mathematics	
Assoc. for Educ. Data Systems Annual Conf.	
Spring Joint Computer Conference	
Am. Management Assoc. 5th Education and Training Equipment Exposition	

ENTELEK CAI/CMI Regional Conferences

Chicago, February 4, 1969

Los Angeles, February 1969

Chicago, October 1969

New York, October 1969

Washington, D. C., November 1969

APPENDIX D.

Data Collection Questionnaires

ENTELEK CAI PROGRAM SPECIFICATIONS

Dewey Decimal
classification no.

Entelek Serial no.

Cutter Sanborn
classification no.

1. Program name _____
- 1a. Subject matter _____
2. Author(s) _____
3. Target population _____
4. Curriculum relationships (e.g. prerequisites) _____
5. Length of program _____
6. Instructional logic (e.g. tutorial, sooratic) _____
7. Instructional language (e.g. COURSEWRITER) and/or compiler _____
8. Computer(s) (incl. storage requirements) _____
9. I/O Devices (e.g. terminals) _____
10. Auxiliary equipment or materials (e.g., notebooks, projectors) _____
11. Performance results (e.g. published reports) _____
12. Installations _____
13. Availability _____
14. See also ENTELEK Program Abstracts _____
15. Source documents _____
16. Sponsoring Agency _____

ENTELEK CAI FACILITY DESCRIPTION

1. Official name of the CAI facility: _____
2. Address: (Street) _____
(City) _____ (State) _____ (Zip) _____
3. Director: _____
4. Names and titles of additional key personnel: _____
5. Facility is operational _____ or in development _____
6. Indicate whether general purpose _____ or special purpose _____ computer
7. *Central Processor: _____
8. CPU is at facility _____ or is remote _____
9. *Processor Controllers (incl. number): _____
10. *Storage (disk, tape, etc.; incl. capac): _____
11. *On-line I/O:
 - a. Terminals (including number of each kind) _____
 - b. Auxiliary visual displays _____
 - c. Audio I/O _____
 - d. Other _____
12. *Data-processing I/O:
 - a. Card-reader punch _____
 - b. Paper tape _____
 - c. Magnetic tape _____
 - d. Line printer _____
 - e. Plotter _____
 - f. Other _____
13. Programming Systems and Languages:
 - a. Assembler _____
 - b. Compiler _____

(Over)

APPENDIX E.

CAI and CMI Thesauri

ENTELEK CAI/CMI INFORMATION EXCHANGE

CAI THESAURUS

1000-1999	GENERAL INFORMATION	2302	Metal surfaces, discriminating smoothness
1000	General	2303	Non-verbal sounds
1010	Literature review or surveys	2304	Nursing; clinical methods
1020	Bibliographies	2305	Task logic
1030	Source documents for CAI instructional programs	2306	Typing
		2307	Library maintenance
		2308	Electronic operation and maintenance
2000-2999	APPLICATIONS OF CAI	2320	Other specific applications of CAI
2000	Instructional programs by subject matter - General	2330	Creativity
2100	Mathematics and Statistics - General	2400	Counseling
2101	Algebra	2500	Library retrieval
2102	Arithmetic, binary	2700	Level of Application of CAI - General
2103	Algebraic proof	2710	Retarded children
2104	Number squaring, cubing, etc.	2720	Special education
2105	Statistics, descriptive	2730	Elementary school
2106	Statistics, inferential	2740	Secondary school
2107	Arithmetic, elementary school	2750	Vocational
2120	History - General	2760	College
2121	American history	2770	Continuing
		2771	Inservice Teacher Education
2140	Languages - General	2780	Industrial
2141	English	2790	Military
2142	Logic: Syllogisms		
2143	Spanish	3000-3999	CAI SYSTEMS
2144	German	3000	Systems - General
2145	Chinese	3100	Systems analysis
2160	Science - General	3200	Common system characteristics
2161	Medicine	3210	Time-sharing
2162	Physics	3220	Response processing
2163	Science, elementary	3400	I/O Equipment - General
2164	Genetics	3401	Display techniques
		3410	Response techniques
2180	Economics - General & Social Sciences	3500	Central Processing Units
2181	Economics games	3501	GE-235 and D-30
2220	Engineering - General	3502	GE 245
2221	Structures	3510	IBM 1400 series
2222	Dynamic systems	3511	IBM 7094
2223	Electrical	3512	IBM 1620
2240	Computer technology - General	3513	IBM 650
2241	Computer approaches to engineering problems	3514	IBM 7090
2242	Computer programming	3515	IBM 360 series
2243	Computer use	3516	IBM 1800, 1130
2260	Games - General	3520	DEC PDP series
2261	Bridge	3525	CDC 1604
2262	Roulette	3530	ILLIAC
2263	Tic-Tac-Toe	3535	Bendix G-20
2270	Decision-making	3536	UMShN
2280	Intellectual skills	3537	Utal-1
2281	Reading	3538	Solomon
2282	Concept acquisition	3539	SDS 940
2283	Problem-solving	3600	Student Variables - General
2300	Task skills	3610	Individual differences
2301	Keyboard operation	3620	Motivation
		3700	Storage
		3800	Systems
		3801	IBM/System 1500

ENTELEK CAI/CMI INFORMATION EXCHANGE

CAI THESAURUS

3860	RCA/Instructional 70	5165	Response Mode
3861	RCA/Instructional 71	5170	Response Measurement
3870	Technomics 6700	5171	Response Latency
3900	Training Subsystems	5200	Instructional logics
3901	System 473L	5201	Tutorial
4000-4999	PROGRAMMING LANGUAGES	5202	Intrinsic
4000	Languages - General	5203	Adaptive
4001	Natural language	5204	Socratic
4010	Problem and calc. languages	5205	Drill & Practice
4011	BASIC	5206	Learner Controlled
4012	TEACH	5300	Simulation
4013	SIMIN	5400	Game
4014	APL	5500	Testing
4015	TALCOMP	6000-6999	PROGRAMMED INSTRUCTION
4016	ESI	6000	General
4017	CAL	6100	Sequence variables
4018	FOCAL	6101	Subject-matter structure
4100	Teacher languages (incl. text processing languages)	6200	Adaptivity (Individualizing) Decision Structure - General
4101	COURSEWRITER	6210	Instructional Alternatives
4102	MENTOR	6220	Decision logic
4103	CATO	6300	Frame construction
4104	COMPUTEST	6400	Program Generation
4105	PLANIT	6500	Motivation
4106	ELIZA	7000-7999	GENERATION & EVALUATION
4107	ISL-1	7100	Methodology
4200	Problem-oriented student languages	7200	Results
4201	STRESS	8000-8999	ADMINISTRATION
4202	COGO	8000	General
4203	SFPOL	8100	Conferences and workshops
4300	Compilers	8200	Cost Analyses
4301	ALGOL	8300	Regulations
4302	DIP	8301	Copyright
4303	EDIT	8302	Communication tariffs
4304	FORTRAN		
4400	Interpreters		
4500	Assemblers		
4501	PDP-8		
4600	Utility programs		
4601	PDP-8		
5000-5999	INSTRUCTIONAL THEORY		
5000	General		
5100	Studies of learning		
5101	Paired-associates learning		
5110	Learning set		
5120	Inspection behavior		
5130	Problem-solving		
5135	Concept formation		
5140	Computer simulation of human learning and problem-solving		
5145	Artif. Intelligence		
5150	Pattern Recognition		
5160	Learning Models		

ENTELEK CAI/CMI INFORMATION EXCHANGE

CMI THESAURUS

- 1000 General
 - 1100 Educational Goals
 - 1200 Bibliographies
 - 1300 Literature Reviews or Surveys
 - 1400 General Periodicals
- 2000 CMI System Design
 - 2100 General System Design and/or Theory
 - 2200 CMI Environment
 - 2210 Physical Plant
 - 2220 Management Information System
 - 2230 Staff
 - 2231 Requirements
 - 2232 Organization
 - 2233 Training and Development
 - 2300 Hardware
 - 2310 CPU
 - 2320 Terminals
 - 2330 Storage
 - 2400 Software
 - 2410 Compilers
 - 2411 COBOL
 - 2500 System Evaluation and Optimization
 - 2600 Prescription Generation
 - 2700 Results
- 3000 Subject Matter
(Use Dewey headings)
- 4000 Educational Objectives
 - 4100 Behavioral Objectives
- 5000 Instructional Alternatives
 - 5100 Content
 - 5200 Sequence
 - 5300 Media and Learning Materials
 - 5400 Grouping
- 6000 Testing
 - 6100 Entry and Prior
 - 6110 Aptitude
 - 6120 Achievement
 - 6130 I. Q.
 - 6200 Internal Testing
 - 6210 Pre-tests
 - 6220 Post-tests
 - 6230 Curriculum-embedded Tests
- 7000 Decision-Making
 - 7100 Among Instructional Alternatives
 - 7200 Among Career Alternatives
 - 7210 Guidance, counseling

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