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ABSTRACT

The nine-year history of the Computer Assisted Instruction Laboratory, College of Education, Pennsylvania State University, is traced. Some 30 projects in curriculum development in teacher education, public school classes, and adult vocational education are described, along with several advances in computer-assisted instruction (CAI). Interinstitution, intra-college, and intra-university cooperative efforts are defined. The laboratory's resources are detailed in terms of financial support, space, and staff. Some of the major issues facing the laboratory are briefly discussed, including the use of CAI in college instruction, sources of financial support, basic vs. applied research, and hardware systems development. Appendixes contain a chart which summarizes the Laboratory's CAI programs; a list of refereed publications by staff members; bibliographies of laboratory publications, applied research studies, and dissertations; a list of faculty participants; and the vitae of the principal investigators. (SK/JY)

Report No. R–60
September, 1973

REVIEW OF THE PROGRAM

The Computer Assisted Instruction Laboratory
College of Education
The Pennsylvania State University

TABLE OF CONTENTS

	Page
Overview	1
Research and Development	1
Goals	1
Accomplishments	2
Curriculum Development	3
Applied Research	4
Systems Development	5
Dissemination	6
Proposed Projects	12
Resident Instruction	14
The Program	14
Continuing Education	15
Inter-Institution Cooperative Efforts	17
Intra-College Cooperative Efforts	17
Intra-University Cooperative Efforts	18
Resources	18
Financial Support	18
Space	20
Staff	20
Issues	20
Making CAI a Viable Alternative in College Instruction	20
Resources for Resident Instruction	22
Sources of Support	22
Basic vs. Applied Research and Development	23
Teacher Education Curriculum vs. Other	24
Hardware System Development	24
Cooperative Efforts Within the College	25
Appendices	26
Summary of Penn State Programs in CAI	26
Refereed Publications	37
CAI Bibliography	43
Applied Research Studies	57
Dissertations Written in Conjunction With Research Done in the CAI Laboratory	63
Faculty Participants on Research and Development Projects	66
Vitae	69

LIST OF TABLES

Table		Page
1	Time-Line of Improvement of Instructional Systems.	7
2	Locations Served by the Mobile Laboratories.	11
3	Summary of Resident Instruction Courses Offered at University Park to Date.	15
4	A Summary of the Computer Assisted Instruction Staff.	23

LIST OF FIGURES

Figure		Page
1	Percent of Total College of Education Research in CAI.	3
2	Interior View of Mobile CAI Laboratory	9
3	Exterior View of Mobile CAI Laboratory	10
4	A Comparison of Submitted Research Proposals for the CAI Lab and the College of Education	13
5	The CAI Resident Instruction Program Student Enrollment and Credits Generated	14
6	Half-time Equivalent Graduate Assistants Appointed in the CAI Laboratory Supported by Miscellaneous Funds.	16
7	Comparison of Financial Support for CAI Laboratory From Miscellaneous Funds and the University.	19
8	Percentages of Operating Budget Provided by Miscellaneous Funds and the University.	19

THE PENNSYLVANIA STATE UNIVERSITY
THE COLLEGE OF EDUCATION
PROGRAM REVIEW

THE COMPUTER ASSISTED INSTRUCTION LABORATORY

Overview

Since the inception of the Computer Assisted Instruction (CAI) Laboratory nine years ago the staff has successfully engaged in research and development sponsored by both the University and by agencies outside the University. The Laboratory has, as of this date, completed some 30 projects which have resulted in a considerable amount of curriculum aimed at teacher education, public school classes and adult vocational education audiences. In this same period, the staff of the Laboratory has made several advances of importance in computer systems development.

The following is intended to be not only a short history of the efforts of the CAI Laboratory, but also a statement of what we feel to be the direction of effort both in the past and in the future.

Research and Development

Goals

The primary goal of the staff in the CAI Laboratory has been the improvement of instruction in education through the application and exploitation of one of the most powerful technologies of the decade: computer-assisted instruction. When the Laboratory was first established, there were very few curriculum materials available which could be used with a computer. Therefore, one of the first objectives of the staff was to develop curriculum materials and to learn the skills of implementing educational content for use with students on a computer. The second objective of the Laboratory staff grew from the first objective of curriculum development. As we gained experience in developing curriculum it became obvious to us that there were many questions

related to how students learn and how they learn from materials mediated by computers. The second objective of the staff then became that of systematic investigation of optimizing the learning effect of CAI curriculum materials. As this work progressed, we soon learned that there were many limitations in the existing hardware components which had been designed originally for business and banking applications and had been modified for applications in education. The early system which we used provided a typewriter-like device where all material was presented to the student at a very fast typing speed but at a very low reading speed for adult learners. To maintain a balanced program in the Laboratory it became necessary to acquire staff competencies to implement the third objective of the Laboratory, i.e., computer systems development and research. The three objectives of the Laboratory (curriculum development and research, learning research, and computer systems development and research) operate in a circular fashion. As we gain skills and expertise and make advances in one of the objectives, those accomplishments produce an imbalance with the other two objectives. For example, some of the earlier work in measurement and evaluation indicated to us that it was desirable not to administer a battery of test items to students but to administer a non-sequential power test in which the next item presented to the student was determined by the performance of the student on the preceeding item. This technique allowed us to establish a point of learner performance with 10 to 20 test items, as compared to requiring 250 test items following normal evaluation techniques. However, at the point of history at which this technique was established and validated, the hardware configuration of the computer system was of insufficient power and speed to allow us to implement the technique as a regular practice, thus pointing to a need and requirement for computer systems development and research. This need has now been met by adding larger and faster disk drive units to the system and the power testing concept can now be further developed and implemented.

Accomplishments

The following is intended to be a short review of the research and development contributions made by the CAI Laboratory. A summary of all Penn State's CAI projects is included as Appendix A; Appendix B contains a listing of refereed publications by Laboratory staff members, while Appendix C is the

CAI Laboratory Bibliography. Extensive effort has been made in the areas of curriculum development and applied research. Our work in systems development and improvement and our dissemination projects will also be considered. Figure 1 illustrates the proportion of the total College of Education research done in computer assisted instruction.

Curriculum Development. Curriculum development has been a major goal of the CAI Laboratory. Several research projects had as their mission to specifically develop pieces of curriculum for use by designated audiences. Other projects saw curriculum as a by-product necessary to perform required research studies. Several pieces of curriculum have been revised, expanded, and/or improved through successive funding opportunities and are currently incorporated in the resident instruction program of the College. Four such courses provide 13 credits in special education and mathematics education. These courses are further described in the Resident Instruction section of this report on page 14.

In Appendix A, each major project that produced CAI course material is outlined and categorized. Note that materials exist for nearly every category of student, from elementary school through adult vocational education, and cover seven areas of study.

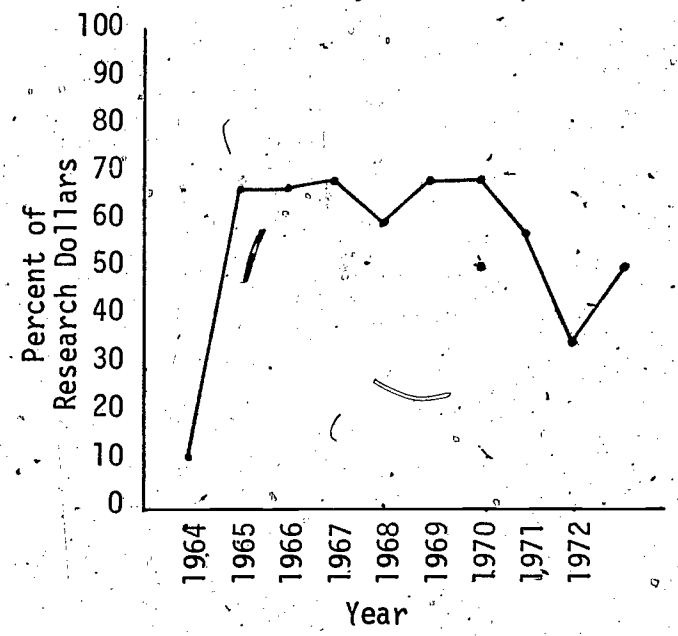

Fig. 1. Percent of total College of Education Research in CAI (Source of data: H.E. Mitzel, Sponsored Research Reports, # 1 - 38).

Applied Research. Applied research problems have received attention from the CAI Laboratory. For the most part, efforts were applied to evaluation techniques and measurement tools.

Formative, summative and consequential evaluations have been carried out. The formative evaluation model is composed of many steps including review of authored materials by senior staff members and the execution of the curriculum materials by a small group of students as staff members sit with the students and record their comments about portions of the material. After the material is revised to clarify confusing material, etc, a larger group of students (10-20) goes through the course. A summary of each student's response to each question is then analyzed by the laboratory staff and revisions are again made if necessary. This process continues throughout the development period.

A summative evaluation is then performed which compares the computer-assisted instruction course with other modes of instruction. Generally the results of summative evaluations have found the CAI students complete course material in less time and score higher marks on final exams. For example, the summative evaluation of the CARE 1 (EEC 400) program indicated that students completed the course in 33 1/3% less time and scored 24% higher on the final exam.

A consequential evaluation of the EEC 400 curriculum showed that . . . of 31 pre-school and elementary teachers who took EEC 400 in September and October 1971, 100 percent indicated: that they were more aware of individual differences in children and that as a result of the course they felt they were better able to identify behaviors which may be signs of potential learning problems. One hundred percent of the respondents also felt that they would take another course by CAI and that CAI was a more convenient way of taking the course than attending classes at a local college or university.

Other research projects have dealt with the effect that CAI has had on the learning process. A continuing effort is being made to identify variables which could best be managed by the computer in adapting instruction to individual differences. Stimulus and response variables as well as response latency and reward preference variables were manipulated. A brief description of the applied research projects is given in Appendix D.

Systems Development. The Laboratory staff has established two goals in the area of systems development: maximum service to the users of the system and maximum use of the existing system. Application programs were developed in order to achieve the goals: TACL, DOCUMENT, STRAP, and BUDGE.

At one time, an estimated 100 hours of preparation time was required to produce 1 hour of CAI instruction using the author language provided by the manufacturer, after each author underwent about 40 hours of training. To alleviate this time-consuming process, an authoring language called TACL was developed to provide an English-oriented language. After as little as 2 hours of training, an author can begin coding a lesson since the TACL operation codes are very similar to the statements an author would use when outlining a lesson. It is estimated that the ratio of preparation time to on-line student time has thus been decreased from 100 to 1 to 60 to 1. In addition TACL also provides course documentation in a form which can be understood by a person unfamiliar with computer languages. TACL also has the potential of creating courses for the 1500 system as well as other systems.

An application called DOCUMENT produces printed documentation of courses written in Coursewriter II in a format which can be understood by a person not familiar with Coursewriter II. Document output has proved very useful to authors who have written course material and then passed the material on to a programmer. The authors have been able to study their course at their leisure, away from a terminal, and make modifications.

The IBM 1500 Instruction System provides the capability to record each student's response to every question. The Student Records Analysis Program (STRAP), enables a staff member to select those records which are of interest to him, for course improvement. STRAP also allows the author to merge various data points into a vector which contains a person's CAI history. The vector is very useful for awarding grades based on past experiences.

A budget system (BUDGE), developed for the 1500 system, provides for on-line input of transactions and on-line display of transaction summaries and budget summaries. Daily budget summaries are available for either on-line display or hard copy.

The IBM 1500 Instructional System was designed to provide enough storage to accommodate about 4 credit hours of course material. The CAI Laboratory is currently offering 6 credit hours of course material and supporting its own

curriculum development efforts as well. The increased capacity of the system has been made possible by implementation of an Intercomp 114/115 disk system. An extensive rewriting of the operating system was necessary to support the Intercomp disk system. With the addition of the larger disk, the 1500 system is now capable of having 99 student credit hours of course material available at one time. The efficiency of the 1500 system has also increased to the point that it is now possible to accommodate 30 students at one time while only experiencing an average delay of 1.5 seconds. Average system delays of 10 seconds were common before the implementation of the Intercomp system.

The 1500 Instructional System has also been expanded in other ways to provide maximum service to faculty staff and students. Table 1, page 7, shows the additions that have been made to the system during the last ten years and the additional capability the Laboratory has derived from the improvements.

Dissemination. With the abundance of curriculum available which had been developed in conjunction with and for research projects, it became evident that the curriculum and the method of instruction should be shared with other CAI institutions and non-CAI groups. An effort has been put forth to make available to as many people as possible the CAI curriculum and CAI instruction in general.

This effort has been successfully attacked by way of several methods; two mobile CAI laboratories, demonstrations for agencies, a summer institute, publications, and CAI instruction within school districts.

Inservice Education in Appalachia. The staff at the Penn State Laboratory has devoted much time and effort in developing inservice teacher education programs. In February 1969, Penn State mounted an inservice education program in three locations in rural Appalachia. A complete computer system with 16 student stations was moved into three different rural communities. The system was installed and made operational with a program in modern mathematics for elementary teachers. In three settings, the program served 387 educators. This effort proved the viability of mobile CAI and was the forerunner of the Mobile CAI Laboratories.

Table 1

THE COMPUTER ASSISTED INSTRUCTION LABORATORY

Time-Line of Improvement of Instructional Systems

Acquisition Date	1964	1965	1967	1970	1972	1973
COMPUTER ROOM IMPROVEMENT	Teleprocessing to computer at IBM in Yorktown Heights, NY	Connection to PSU computation center	Install IBM 1500 Instructional System.	Purchase IBM 1500 System		Implementation of Intercomp 114/115 Disc System
TERMINAL CAPABILITY IMPROVEMENT	Two terminals with connected A-V equipment	Stations located in Chambers Bldg. (4); State College schools (4); Altoona schools (2) and Bethesda Naval Hospital (1)	Eight Cathode Ray tube terminals	Purchase eight complete terminals with audio & video equipment	Purchase 24 additional complete terminals	
				Acquired first mobile CAI System with 15 student stations		Acquired second mobile CAI system with 16 student stations
SYSTEM CAPABILITY IMPROVEMENT	Allowed research on terminals with the terminal typewriter and program controlled slide projector	Teleprocessed courses possible between University Park and locations of terminals (limited access)	First capability for presentation of graphics, annimation and instant block of text to a student at terminal (unlimited access)		Purchase additional stations allows (1) continuation of research commitments (2) beginning Resident Instruction	Reduced system response latency by 50%. Increased disc storage capacity by five times.

Mobile Laboratories. In order to make courses available to as many inservice teachers as possible, we have outfitted two custom-designed, expandable, mobile vans which house complete IBM 1500 instructional systems (see Figures 2 and 3). The vans each contain 560 square feet when expanded, and contain 16 student stations at which inservice teachers and supervisors take the offered courses. The vans, with the CAI systems, can be pulled by diesel tractor to locations and set up for instruction in a short period of time. The mobile CAI systems are usually located in an area for a six- to eight-week period adjacent to a centrally-located school building. Teachers then take courses at their convenience during the afternoons, evenings and weekends. Each mobile facility can service up to 200 teachers during the six- to eight-week stop. Table 2 shows locations served by the mobile laboratories.

Mobile CAI is a new and innovative concept in inservice teacher education. The impact of the course is maximized by the fact that mobile CAI permits the course to be disseminated to large numbers of teachers who reside in different parts of the United States. To date the laboratories have provided instruction at 19 locations throughout the U.S. A total of 2,384 students have completed courses generating 5,049 Penn State University credits.

Demonstrations. The University Park CAI Laboratory is available for prearranged tours and demonstrations for not only University-wide groups but also outside persons. During 1972 alone, 648 people visited the Laboratory. Of these three were foreign visitors; 323 were students visiting with classes from the College of Education; 169 were with Continuing Education sponsored groups, and 153 represented other interests.

The staff of the Laboratory has been invited to make the Mobile Laboratory and several pieces of curriculum available to agencies both governmental and professionally affiliated. In December 1971, a Mobile Laboratory was located for 14 days at the U.S. Office of Education in the HEW complex in Washington, D. C. to offer the CARE 1 CAI course to selected area teachers and members of the staff of OE. While there, staff members were available to provide expanded insight into the curriculum and CAI in general to visitors, most of whom were government officials. A total of 17 government employees and Washington-area teachers completed the 3-credit CARE 1 course.

Interior View of Mobile CAI Laboratory

Figure 2

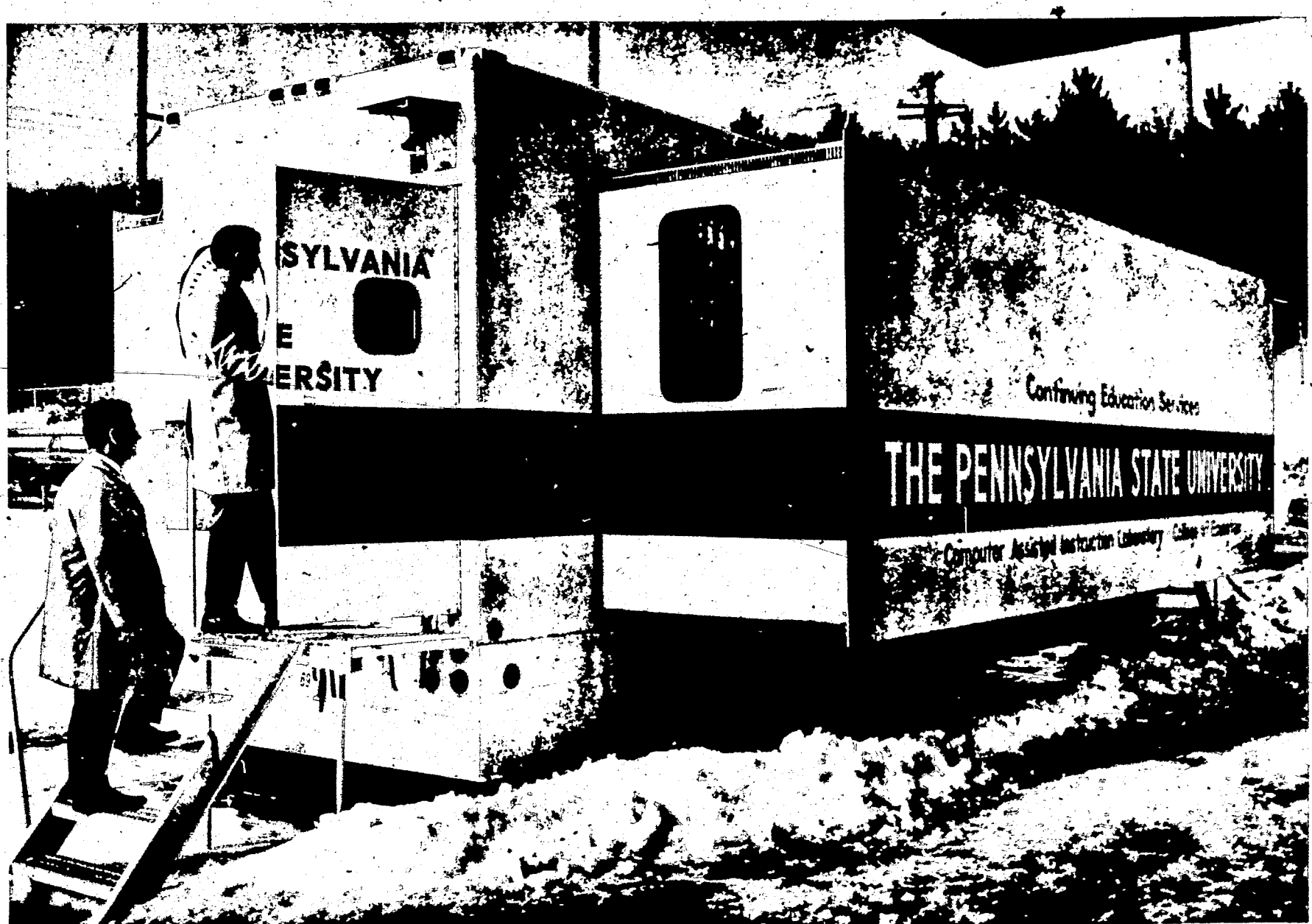

Figure 3

Exterior View of Mobile CAI Laboratory

Table 2

Locations Served by the Mobile Laboratories

[Courses offered included CARE 1 (EEC 400) and CARE 4 (EEC 460)].

Location	Registrants	Credit Hours (Penn State)
Clearfield, Pa.	107	321
Ridgeway, Pa.	132	396
Smethport, Pa.	127	381
Athens, Pa.	139	417
Williamsport, Pa.	163	489
Holidaysburg, Pa.	141	423
Bedford, Pa.	85	255
Washington, D. C.	17	24
Somerset, Pa.	124	372
Johnstown, Pa.	192	576
Ebensburg, Pa.	110	330
Langhorne, Pa.	147	441
Ford City, Pa.	115	345
Houston, Texas	210	12*
Bloomington, Ind.	99	*
Atlanta, Ga.	81	*
Edwardsville, Ill	126	*
Dekalb, Ill.	180	*
Elwyn, Pa.	89	267
Total	2384	5049

*Credits were awarded by local institutions of higher learning: University of Houston, Indiana University, Georgia State University, Southern Illinois University and Northern Illinois University.

From May 24, 1972 to June 4, 1972 a Penn State Mobile CAI Laboratory was in the U. S. Office of Education exhibit area at TRANSPO '72, the Department of Transportation's International Transportation Exposition. While there, a total of 11,455 persons toured the CAI laboratory, an average of 1,145/day.

The Mobile Laboratory was also utilized for dissemination of PSU's CAI capability at The Pennsylvania Education Congress (Harrisburg, Pa. 1971), the Annual Meeting of the Council for Exceptional Children (Miami, Fla. 1972) and the Meeting of the American Association of Mental Deficiency (Atlanta, Ga. 1973).

Institute. A Media Specialist Institute was conducted at Penn State by the staff of the CAI Laboratory. Participants in the Institute spent three weeks in training to develop an awareness of CAI, its potential and basic methods for managing a CAI classroom. Participants were chosen from schools in Philadelphia and Pittsburgh that were to participate in a Commonwealth CAI Consortium with Penn State and the Pennsylvania Department of Education.

Publications. In addition to the extensive bibliography of technical reports produced in conjunction with research and curriculum development at Penn State's CAI Laboratory, (see Appendix C) a summary effort was undertaken in 1970 for the Pennsylvania Department of Education, to survey CAI in the State and report on its status.

Proposed Projects. Ongoing efforts are being made for continued non-University funding. At the present time, proposals, which are pending approval, have been submitted to the U. S. Office of Education for the "Development of a Computer Assisted Instruction Course in the Education of Hearing Impaired Children" and "Computer Assisted Instructional Experiences Designed for Teachers of the Severely and Profoundly Retarded." These proposed projects will provide a continuation of the series of wholly, self-contained CAI courses designed to promote clinical sensitivity on the part of regular classroom teachers and to develop in them an awareness and understanding of the strengths and weaknesses of handicapped and normal children.

A proposed project, "Inquiry Methods for Elementary Science Teachers via CAI", submitted to The National Science Foundation will develop, test, and make available materials for training elementary teachers in the area of science.

A proposal has been submitted to the National Institutes of Health that, if approved, will provide opportunity to prepare a computer based extended degree program of instruction for nurses in remote areas. The project will develop evaluative and diagnostic credit examinations as well as credit courses for delivery to nurses via the Mobile CAI Laboratories.

Providing recently appointed faculty members an opportunity for a work/study Computer Assisted Instruction Residency focused on the development of an individually adaptive program of instruction, is the focus of an effort that has been proposed to The Exxon Education Foundation. The perspectus is awaiting approval at this time.

The staff of the CAI Laboratory provided considerable assistance in the preparation and submission of the proposal for The National Center on Educational Media and Materials for the Handicapped, (NCEMMH), submitted to the Bureau of Education for the Handicapped, U. S. Office of Education, in response to RFP 72-17. The award for the Center was given to Ohio State University. Other efforts include a proposal to U.S.O.E. to develop and implement, at Allentown, Pa., a computer-based diagnostic-prescriptive instruction model in a branch campus. Ten courses will be developed for evaluation.

The CAI Laboratory's efforts in presenting proposed research to funding agencies is illustrated in Figure 4.

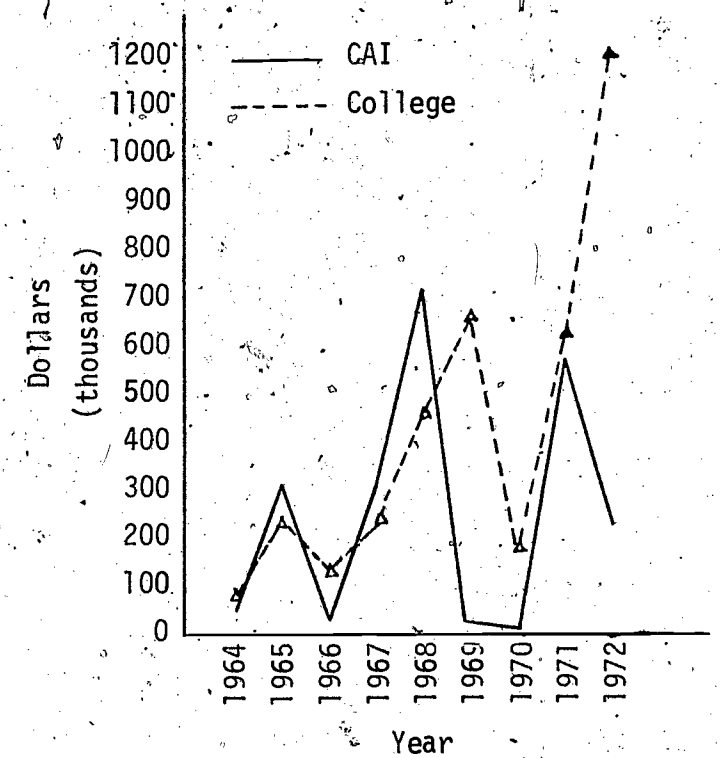

Fig. 4. A comparison of submitted research proposals for the CAI Lab and the College of Education. (Source of Data: Sponsored Activities Report, #1-#38, H. E. Mitzel)

Resident Instruction

The program. Beginning with the Fall Term, 1972, the College of Education began to offer courses via CAI for on-campus resident instruction. A room in Chambers Building was readied and equipped with 30 student terminals available for both undergraduate and graduate students to schedule at their convenience. Since that time 2,902 students have completed CAI courses, generating a total of 4,661 credits (Fig. 5). Table 3 outlines the courses offered to date. Beginning Winter Term, 1973, a three-credit course, EEC 401, Diagnostic Teaching of Preschool and Primary Children will be offered also.

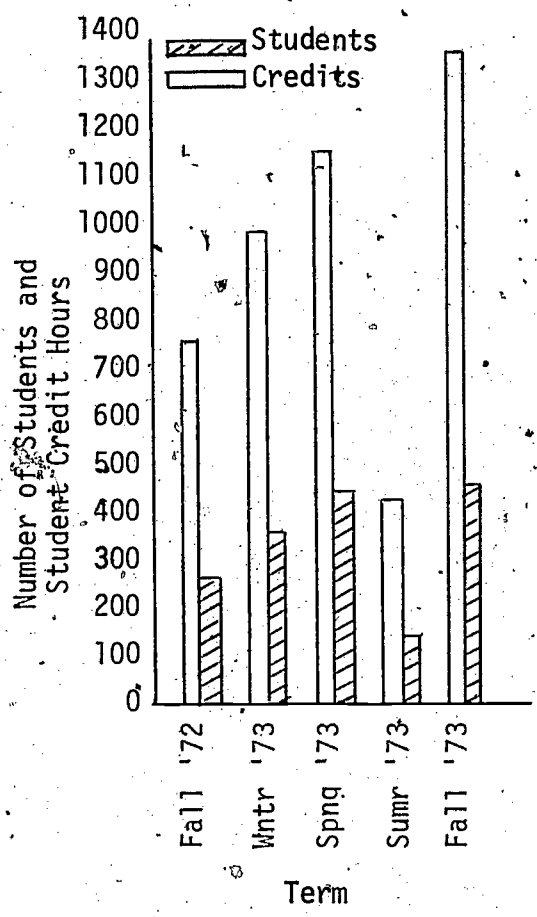

Fig. 5. The CAI Resident Instruction Program Student Enrollment and Credits Generated.

Since 1964, there have been a total of 184 terms of Graduate Assistant (half-time equivalent) support generated for 52 individuals (Fig. 6). During the same period 18 students were provided the opportunity to conduct research in the Laboratory for graduate degrees. Appendix E lists these students and the research projects they conducted.

Table 3

Summary of Resident Instruction Courses Offered at University Park to date.

Designator	Credits	Title	Number of Students Served To Date
EEC 400	3	Introduction to The Early Identification of Handicapped Children (CARE 1)	1209
EEC 460	1	Education of the Visually Handicapped (CARE 4)	21
C&S 588	1-6	Problems, Projects, and Area Studies in Curriculum and Supervision	138
EL ED 326	2	Teaching Mathematics in the Elementary Schools	84
M ED 420	2	Teaching Mathematics in the Elementary Schools (Revision of EL ED 326)	372

Continuing Education

The CAI Laboratory has worked closely with the University's Division of Continuing Education to provide courses of instruction to as many persons as possible. The Mobile CAI Laboratory, the Appalachian Project (see pages 6 - 8), the demonstration visits and a proposed on-campus program have provided college-level instruction to persons otherwise unable to attend formal classes. A total of 2,402 persons have received 6,851 credits from Penn State through

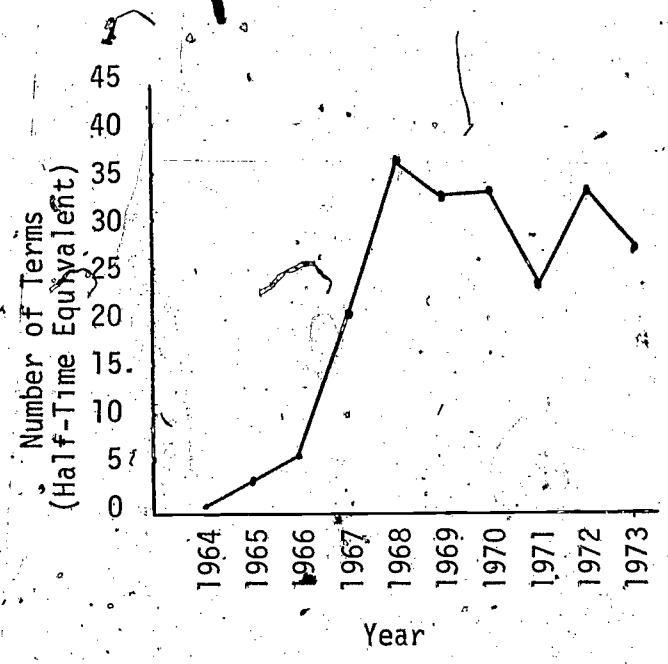

Fig. 6. Half-time Equivalent Graduate Assistants Appointed in the CAI Laboratory Supported by Miscellaneous Funds

Continuing Education for their work on CAI mediated courses. Credit has been given for students completing EEC 400, Introduction to the Early Identification of Handicapped Children (3 cr), EEC 460, Education of Visually Handicapped Children (1 cr), and Elementary Education 328 (2 cr). Beginning with Winter Term, 1973, two additional courses, EEC 401 Diagnostic Teaching of Preschool and Primary Children (3 cr) and C&S 588, Problems, Projects and Area Studies in Curriculum and Supervision (1-6 cr) will be offered.

In addition, the Laboratory has made available to physicians within the Central Pennsylvania area a course in cardiology. The course, requiring eight hours for completion, was developed by The University of Alberta and is offered in cooperation with The Pennsylvania Medical Society

Inter-institution Cooperative Efforts

Penn State curricula are currently in use at seven other IBM 1500 computer system installations. The Montgomery County, Maryland, public schools, the Altoona Vocational School and the Philadelphia Public Schools have used the 9th grade algebra and general math curricula developed at the Penn State CAI Laboratory. The special education courses (CARE 1, CARE 4) are currently in use at: Montgomery County, Maryland, public school, The University of Texas at Austin; The National Technical Institute for the Deaf at the Rochester Institute of Technology; The State University of New York at Stony Brook; and the University of Alberta in Edmonton, Alberta, Canada.

At the systems programing level a number of applications developed at Penn State have been adopted by all 1500 System installations in the country. A program to transfer material written on a disk to a magnetic tape, which was significantly modified at Penn State, has become the standard method of transferring course material from one location to another. As another example, a program to rearrange the contents of disks which was extensively modified at Penn State is now being used at every 1500 System installation. Similarly, applications developed at other installations are also being used at Penn State. (Primarily functions which are used to increase the flexibility of the Coursewriter II).

Although TACL is still in the developmental stages, The National Technical Institute for the Deaf at the Rochester Institute of Technology has been using the TACL language since June 1, 1973. All of their courses since that time have been written in TACL.

Intra-College Cooperative Efforts

Although the regular staff of the CAI Laboratory consists of three faculty members, one administrative assistant, one resident instruction manager, and one secretary, we have been fortunate in securing cooperation from the faculty within the College of Education. A total of 37 faculty members representing eight departments have either worked directly with the Laboratory in developing curriculum or have acted in an advisory capacity. In addition to the Penn State faculty there have been some 39 professional persons from 10 institutions who have contributed to CAI curriculum development. Material is now available

in the areas of special education, mathematics education, science education, audiology, educational psychology, music education, vocational education, and language arts.

A list of faculty members who acted as project coordinators or senior researchers for the Penn State CAI projects is included as Appendix F.

Intra-University Cooperative Efforts

Of course computer-assisted instruction is not limited to the College of Education. Faculty from other Colleges and Departments within the University are considering CAI for offering instruction related to their discipline.

Working with the Department of Nursing, College of Human Development, the CAI Laboratory has submitted a proposal to The National Institute of Health which, if funded, will develop evaluative and diagnostic credit examinations as well as baccalaureate degree credit courses for delivery to nurses via the Mobile CAI Laboratory.

The staff of Pattee Library and the CAI Laboratory have cooperated in an attempt to secure funding for a project to develop and evaluate a series of computer-mediated instruction units to teach library skills and the use of resources to students with limited educational backgrounds.

Resources

Resources, in forms of financial support, staff assignment and space have been provided by way of a mixture of University support and outside monies.

Financial Support

Operating funds have been provided primarily in the form of contracts and grants. Support has come, for example, from the U. S. Office of Education, the National Science Foundation, the Pennsylvania Department of Public Instruction, the Pennsylvania Department of Education Services, the Pennsylvania Medical Society, the University of Pittsburgh, and the Penn State Foundation. In the nine year history of the CAI Laboratory, a total of $5,165,587 has been received from sources outside the University. This represents 93.8% of the total operating budget of the Laboratory since 1964 (see Figures 7 and 8).

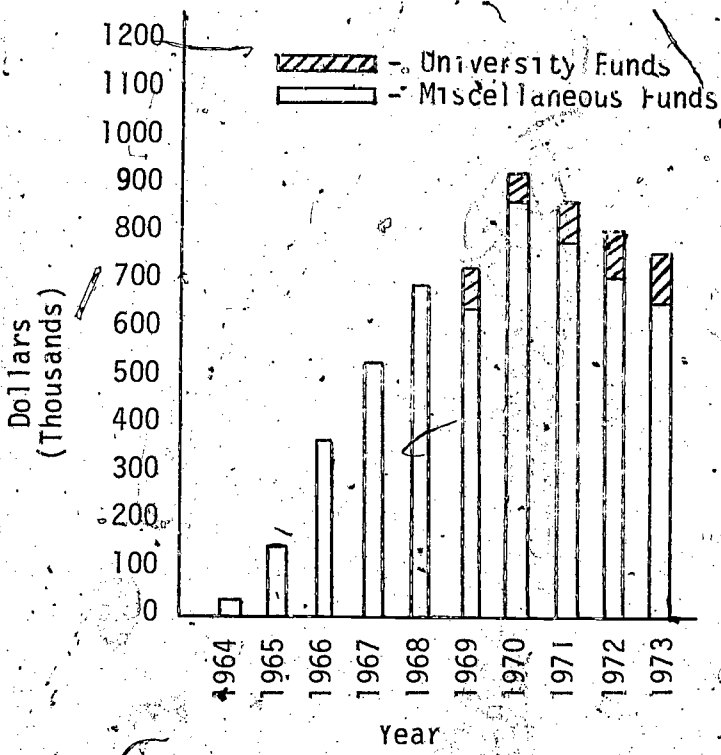

Fig 7 Comparison of financial support for CAI Laboratory from miscellaneous funds and the University

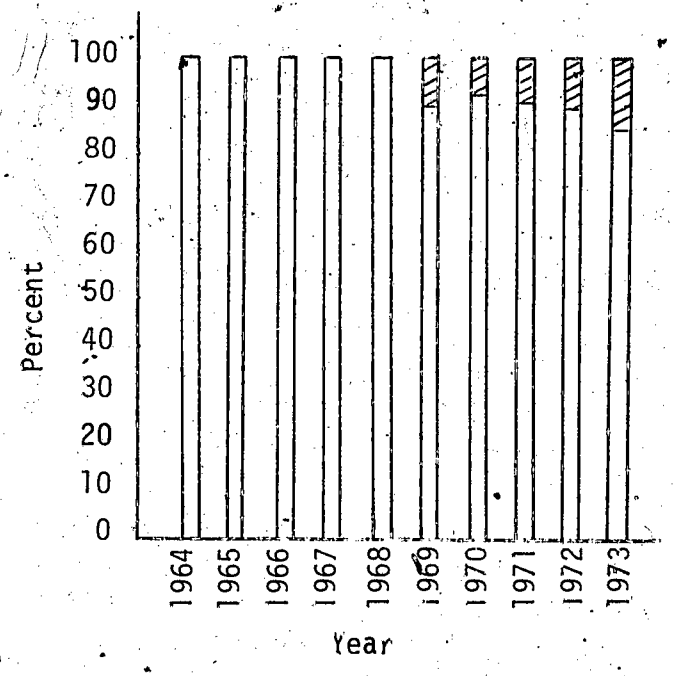

Fig 8 Percentages of operating budget provided by miscellaneous funds and the University

Equipment purchases made by the University have totalled $588,768 and have been made from non-continuing funds. No ongoing equipment support is allocated by the University, other than for maintenance to cover part of the Resident Instruction Program.

Space

The CAI Laboratory currently occupies 3,508 square feet of space, primarily in rooms 201-202 and 212 Chambers Building. Space has, in the past, been provided in CEDAR Building and other rooms in Chambers Building as needed.

Staff

Table 4 illustrates the variety and number of faculty and staff positions that have been supported by the CAI Laboratory. The figures represent the number of persons whose salary support, in some percentage, was provided by the CAI Laboratory. Of this number, three faculty, one staff and one clerical position have been supported directly by the University since 1969. Vitae are included in Appendix G.

Issues

The fact that the activities of the staff in the CAI Laboratory have been funded primarily by contracts and grants rather than through University allocations provides in one sense more latitude and opportunities for decisions afffecting the directions of the efforts and programs than many other units in the College of Education who have ongoing programs of instruction with continuing enrollments of students who need to be served. Some of the major issues related to decision making are amplified in the following text.

Making CAI a Viable Alternative in College Instruction

One of the strengths of the CAI Laboratory has been the capability of the staff to be responsive to training needs as they emerge. The CAI Laboratory has the flexibility and capability to extend its influence and products in diverse areas. Beginning in 1964, the CAI Laboratory began working toward the development of a viable alternative to traditional college instruction. A review of the CAI

curriculum projects completed reveals a considerable diversity among the content areas and the audiences to which the course segments are directed. One area of application in which the Penn State CAI Laboratory has had singular success is that of teacher education.

In the area of computer-assisted instruction in teacher education, Penn State is without peer in the nation. After several pioneering efforts in training courses in audiology and mathematics education, development of a far-ranging prototypic system for college instruction began in 1969 with the funding of the first of a series of CARE projects.

The CARE (Computer Assisted Remedial Education) projects have been supported by nearly $2,000,000 in grants from both state and federal sources. The result of the projects is an operational system which is a true alternative to traditional college instruction. Without doubt, the CARE projects in special education have shown that CAI has become competitive with typical college instruction, both in terms of quality of instruction and costs of instruction.

The key to the success of the CARE projects is the outstanding quality of the CARE courses, coupled with the sophisticated CAI system used. The CAI Laboratory was able to respond with quality curricula to a great need for trained persons to work with handicapped children. Whereas other areas of teacher education might be highly successful developers and users of modern technology, it has been the fortuitous combination of the CAI Laboratory with special education needs and financial resources to turn a good idea into an operational program. For the last three years the large majority of new funding attracted by the CAI Laboratory has been focussed on the development of the CARE courses and the mobile facilities to implement the CARE courses.

We recognize the substantial impact that the CARE special education project has had on the CAI Laboratory Research and Development program, and especially on the Resident Instruction program (e.g., 80 percent of the course credits given by CAI in the Fall Term, 1973, were special education). However, the overall potential of the CAI Laboratory operation should not be construed as being limited to special education. The successes with the CARE programs should demonstrate that a viable alternative to traditional college instruction has been reached. The CAI Laboratory is ready to extend the concept to other areas of college instruction, especially teacher education.

Resources for Resident Instruction

In 1970 and 1972 the University expended an excess of $580,000 from non-continuing funds to purchase the existing CAI system and 32 student stations in the CAI Laboratory for the purpose of providing resident instruction. The intent of those purchases was to take advantage of the federally funded curriculum development efforts in the Laboratory for improving the resident instruction program in the College. By making maximum use of the purchased equipment and the available curriculum materials, 5,000 student credit hours can be produced annually at an approximate cost of $12 to $15 per student credit hour. This cost is considerably less then the cost per student credit hour produced by other means in the College (average cost of $32 per student credit hour in 1972-73). In order to produce these credits it is necessary to provide resources for staff, materials, and equipment maintenance. At the present time resources have been provided ($30,000) to produce approximately 2,900 student credit hours although the projected enrollment for the year is closer to 5,000 student credit hours which would require an additional allocation of approximately $40,000. If the College of Education is going to proceed with a policy of not closing classes to students, and if we are to continue offering these courses through CAI, then, additional resources must be allocated to support the effort.

Sources of Support

Until 1969 the activities of the Laboratory were supported solely from research contracts and grants. Since 1969 the University has provided annual allocations plus additional resources for the purchase of equipment. However, the University allocations have amounted to only 10 to 12 percent of the total resources of the CAI Laboratory during any one year. The continuing University resources support for the resident instruction program in the Laboratory and three full time faculty members, one administrative assistant, and one secretary, all of whose efforts are focused almost exclusively on securing additional research and development resources for the operation of the Laboratory. The remainder of the staff (there are presently 31 staff members) and activities

are supported from miscellaneous funds budgets. A larger University allocation would enable us to attract better qualified professionals whose appointments would not be determined by the availability of Federal funds.

Table 4

A Summary of the Computer Assisted Instruction Staff

YEAR	FACULTY	RESEARCH ASSISTANTS	GRADUATE ASSISTANTS	CLERICAL
1964	3	1	0	2
1965	4	3	1	7
1966	5	6	2	5
1967	3	10	5	9
1968	6	16	5	7
1969	14	19	8	7
1970	10	16	8	8
1971	8	11	3	8
1972	7	8	8	7
1973	8	9	8	6

Basic vs. Applied Research and Development

Much of the early work in the Laboratory required the development of curriculum materials for CAI inasmuch as there were none in existence. This was a natural course of events to follow at that time, but the question which now confronts the staff is to what extent should we continue the efforts in curriculum development or to what extent should we redirect our efforts and focus on more basic studies related to the characteristics of programs which enhance the performance of the learners. Of course the logical answer to this question is that both routes should be pursued. However, with the limited number of faculty

members available it does not seem wise to divide the effort at this time. If, however, we must continue to rely on funding agencies for support, the resolution of this issue is not always a free choice. Funding agencies are quite specific in the products they want to develop or in the research efforts they want to sponsor. Many of our decisions are made on the basis of available faculty members with an interest which matches the interest of available funding agencies.

Teacher Education Curriculum vs. Others

The majority of ccurriculum development work in the Laboratory has been in the area of teacher education and more specifically in training of teachers in the field of special education. The Laboratory staff has had experienc, though, in the development of curriculum materials for other audiences -- elementary school spelling, secondary school mathematics, U. S. Navy Medical corpsmen and adult illiterates. The question remains, -- which focus should the curriculum development efforts of the Laboratory take? Many other CAI laboratories throughout the country are developing curriculum materials for various audiences at different levels. The Penn State CAI Laboratory, however, is the only one which has undertaken extensive curriculum development efforts in the field of teacher education. It has seemed in the past that one strategy for promoting the use of CAI in general was to develop a large core of curriculum materials to facilitate the installation of systems for specific audiences, although a case could be built for a diversified approach.

Hardware System Development

The CAI Laboratory has primarily been staffed with individuals from the field of education. Our goal in the past has been to take existing CAI systems made available by computer manufacturing corporations and develop curriculum for those systems rather than the alternative approach of designing and developing the hardware component configurations required in a CAI system. Other CAI centers (notably the University of Illinois and the PLATO System) have focused on the development of computer software and hardware. Our approach seemed a viable approach to take at the time that Federal money was readily available for CAI development projects and computer manufactures saw a market they were willing

to supply with newly developed equipment and components. However, with the severe reduction of Federal money the computer manufacturers are less interested in developing new systems for education, and the issue is again open for consideration as to whether we should not become more involved in specifying and developing hardware for CAI.

Cooperative Efforts Within the College

It has always been the practice in the CAI Laboratory to have a faculty member (usually from the College of Education) responsible for any project conducted in the Laboratory. The 37 faculty members representing 8 departments and the 184 terms of graduate assistant support for 52 individuals in various programs in the College of Education are evidence of the cooperative nature of our work. Still we are needing to find more ways of being mutually supportive to programs in the College and to be mutually supported by other programs in the College in order to reap maximum benefits. The program of the CAI Laboratory would be greatly enhanced by more long-term commitment by regular faculty members in the College.

APPENDIX A

Summary of Penn State Programs in CAI

CAI Curriculum Development by Faculty & Staff
College of Education, CAI Laboratory
1964 - 1973

TEACHER EDUCATION - SPECIAL EDUCATION

Project Name	Staff	Description
Introduction to Audiology - One of Four College Courses Developed and Presented by Computer Teleprocessing	Harold E. Mitzel Kenneth H. Wodtke Bruce M. Siegenthaler Jeffery Katzer Keith A. Hall	Introduction to Audiology is a three-credit undergraduate course offered to Speech Pathology and Audiology (SPA) students. The course, which deals with a survey of the field, terminology, anatomy and principles of testing, was offered to SPA students as part of SPA 430, on the University Park Campus during the Winter Term, 1965. Because the course was written for the 1410 Computer system, it is, in its present state, unusable on the current 1500 system. 04/01/64 - 06/30/67
Development of a Computer Assisted Course in the Identification and Diagnosis of Handicapping Conditions in Children	G. Phillip Cartwright Harold E. Mitzel	CARE 1, Early Identification of Handicapped Children is the first in a series of CAI courses being developed which deal with handicapping conditions in children. The courses are designed for pre and inservice teachers as well as other educational practioners. CARE 1 prepares students to know the characteristics of, and be able to identify handicapped children. The course, a 3-credit presentation, is being used as EEC 400 both on Campus and in the Mobile CAI Laboratories. 06/01/69 - 05/31/71

Project Name	Staff	Description
Training Early Childhood Educators: Computer Assisted Instruction Courses in Diagnostic Teaching - Teaching of Preschool Children	G. Phillip Cartwright Carol A. Cartwright Marjorie E. Ward	CARE 2, The Diagnostic Teaching of Preschool Children is prepared for pre and inservice teachers and other interested personnel. The course is designed to teach these people how to work effectively with children who have learning problems because of learning disabilities, mental retardation, cultural disadvantage and/or emotional disturbance. The course, worth 3 credits, will be utilized as EEC 401 both at University Park and in the Mobile CAI Laboratories beginning with the Winter term 1973. 01/10/72 - 01/09/74
Training Early Childhood Educators: Computer Assisted Instruction Courses in Diagnostic Teaching - Diagnostic Teaching of Primary Children	G. Phillip Cartwright Carol A. Cartwright Marjorie E. Ward	CARE 3, The Diagnostic Teaching of Primary Children is used in conjunction with the CARE 2 course as an option for the student to study the level of children closest in age to those with whom he or she is working. CARE 3 is, in a sense, a part of the CARE 2, 3-credit course. After certain basic information is presented to the student, the course then branches into the area of child study in which the student is most interested. 01/10/72 - 01/09/74
A Computer Assisted Course in the Education of the Visually Handicapped Children for Rural Regular Classroom Teachers	Ralph E. Peabody Marjorie E. Ward	CARE 4, Education of Visually Handicapped Children, is another in the series of CARE courses for Special Education. CARE 4, a one-credit EEC course, is designed to equip regular classroom teachers with the knowledge and skills necessary to manage the instruction of visually handicapped children. CARE 4 is also being used at University Park and the Mobile CAI Laboratories as EEC 460, a graduate level, resident instruction course. 06/01/71 - 08/31/72

TEACHER EDUCATION - MATHEMATICS

Project Name	Staff	Description
Modern Mathematics - One of Four College Courses Developed and Presented by Computer Teleprocessing	Harold E. Mitzel Kenneth H. Wodtke C. Alan Riedesel Marilyn N. Suydam Keith A. Hall	The Modern Mathematics program (MODMATH) attempts to make use of a teaching pattern similar to the inductive technique. MODMATH provides the background for understanding mathematical content and concepts of the system of real numbers. MODMATH was transmitted to schools in Altoona and Williamsport and offered to students there. Since that time the course has been revised extensively and expanded. 04/01/64 - 06/30/67
Inservice Mathematics Education Via Computer-Assisted Instruction for Elementary School Teachers in Appalachia	Keith A. Hall.	Between March 1 and August 20, 1969 a total of 387 students in three sites in Virginia and Pennsylvania received instruction via a CAI system that was moved from school to school. A forerunner of the CAI Laboratory's Mobile CAI Van, this project offered to inservice elementary teachers in the three locations, a course ELMAT which provides mathematical content and methods of teaching that content in an elementary school. 08/01/66 - 06/30/67
The Translation into Spanish of a Computer Assisted Instruction Course in Mathematics	Marilyn N. Suydam Cecil Trueblood	ELMAT, a CAI course which provides mathematical content and methods of teaching that content in an elementary school, was translated, in its entirety into Spanish for study as future material for teachers in Latin American schools. 02/02/70 - 09/30/70

TEACHER EDUCATION - LANGUAGE ARTS

Project Name	Staff	Description
Initial Teaching Alphabet	Patricia Mull Lester S. Golub	The Initial Teaching Alphabet is the subject of this three-hour course segment that presents to teachers an introduction of the alphabet and provides them with some ability to transliterate to and from ITA. The course is not available for credit from PSU but can be used in conjunction with several Language Education courses. 01/01/72-08/30/72
Computer-Assisted Phonics Analysis	Ruby L. Thompson Lester S. Golub	Phonics is a non-credit, eight-hour course which deals with phonics analysis, phonics content, and teaching methods for preservice teachers. The segment can be used in Language Education courses. 01/01/72 - 12/31/72

PUBLIC SCHOOL CURRICULUM

The Development and Evaluation of a Pilot Computer Assisted Occupational Guidance Program	Joseph T. Impellitteri	The need of youth to explore the world of occupational opportunities was the focus for this computer assisted effort conducted with junior high students in Altoona, Pa. The course provided students, who sat at a terminal connected via telephone to the computer at University Park, with a series of occupations. By selecting one or several and requesting such, the student was provided with enough additional information to perhaps make some decision regarding his vocational future. Information relating to the student's abilities and preferences were stored in the computer and affected the type of information given to him. 01/01/66 - 06/30/68

Project Name	Staff	Description
Use of Computer Assisted Instruction to Teach Spelling to Sixth Graders	George N. Demshock C. Alan Riedesel	This three hour spelling course was developed to teach spelling to sixth graders. The program, which contained basic word lists, was presented to three State College area sixth grade classes. Later efforts studied the effects of and the efficiency of CAI spelling with conventional methods of teaching. 07/01/67 - 06/30/68
The Development, Implementation and Evaluation of a Pilot Program of Computer Assisted Instruction for Urban High Schools	Keith A. Hall Harold E. Mitzel Marilyn N. Suydam Lars C. Jansson Robert V. Igo	The purpose of the project was to develop and evaluate two individually adaptive mathematics courses for urban high school youth. Ninth grade general mathematics and algebra I courses were developed and presented to two high schools; one in Philadelphia and one in Pittsburgh. The courses provided one half of the class time for a typical ninth grade mathematics class. Utilizing the 1500 system, the courses, ALGEB and GENMA, are available as the beginning courses of a complete four-year high school mathematics curriculum. 03/16/68 - 07/30/71
The Slide Rule	Pearl Laird	SLIDE provides instruction in the use of a slide rule. The course, a non-credit segment adaptable for mathematics classes, shows the student how to multiply and divide with the appropriate scales. Designed for anyone over ten years of age, SLIDE takes about 2 hours to complete. 06/30/69 - 12/31/69

Project Name	Staff	Description
Development and Evaluation of Computer Assisted Instruction in Instrumental Music	Ned C. Deihl	An outgrowth of a project to study the feasibility of developing a course via CAI in areas of aural-visual discrimination and performance skills. CLARINET is a twelve hour program that concentrates on articulation, phrasing and rhythm. It presents models and allows time for off-line practice during which students implement the aural concepts presented via CAI. The program is available for junior high or high school use. 06/28/67 - 09/30/69
Development of a Test for the Nonperformance Aspects of Music Education	Rudolf E. Radocy	The study was performed to develop a prototype computerized test for measuring competencies in certain non-performance musical behaviors present in undergraduate students entering their course of study in music education. The test is available for administering to students. 03/02/70 - 11/01/70
Evaluation of Computer Assisted Instruction in Instrumental Musicianship	Ned C. Deihl	This project extended the efforts and the curriculum developed in an earlier CAI course in instrumental music. At this time, diversification of aural models and off-line performance to other treble clef woodwind and brass instruments was accomplished. The expanded course is available and adaptable to junior high and high school music students. 11/15/71 - 08/15/72

ADULT VOCATIONAL EDUCATION - GUIDANCE

Project Name	Staff	Description
Computer Assisted Literacy Development Program for Career Oriented Youth and Adults (LITE)	Lester S. Golub	LITE is designed to increase the literacy levels of illiterates and semi-literates to at least the eighth grade level. The 20-35-hour course provides career information which assists the student in not only increasing his reading ability, but also aiding him in his career choice. The program, through reading content, supplies job, task and technical descriptions of a variety of occupational categories. 01/01/72 - 06/30/73
The Development and Evaluation of a Teleprocessed Computer Assisted Instruction Course in the Recognition of Malarial Parasites	Harold E. Mitzel Robert V. Igo	Penn State received from the U. S Navy, permission to plan, develop, and evaluate CAI as an improved instruction technique for medical and para-medical subjects. A CAI course in the recognition of malarial parasites in blood smears was developed and presented via teleprocessing to the National Naval Medical Center in Bethesda, Maryland. The course was four to 13 hours in length. 05/01/67 - 06/30/68

SUMMARY OF PENN STATE PROGRAMS IN CAI

Miscellaneous Funds	Duration	Support	Amount
CAI Feasibility Study for Four College Courses	4/01/64 - 6/30/67	U.S.O.E., Title VIII Bureau of Research	$ 97,014
Experimentation with CAI in Technical Education	6/01/65 - 6/30/69	U.S.O.E. Vocational Ed. Act 1963 Bureau of Research	958,887
Development of Pilot Computer-Based Vocational Information	1/01/66 - 6/30/68	Pennsylvania Department of Public Instruction	191,530
Random vs. Ordered Sequencing in Computer Assisted Instruction	6/10/66 - 3/31/67	U.S.O.E., Title VII NDEA	8,400
Inservice Training in Modern Math for Elementary Teachers	8/01/66 - 6/30/67	Williamsport (Pennsylvania) Public School (Title III ESEA)	34,311
Development and Evaluation of CAI in Instrumental Music (Clarinet)	6/28/67 - 9/30/69	U.S.O.E., Bureau of Research	48,460
Development and Evaluation of CAI Course in Recognition of Malaria Parasites	5/01/67 - 6/30/68	U.S. Naval Medical School	62,004
Development and Programing of Simulated Pure Tone Audiometer	7/01/67 - 12/31/68	U.S.O.E. Development of Handicapped Children and Youth	78,025
Use of CAI to Teach Spelling to Sixth Graders	7/01/67 - 6/30/68	College Area Schools Title III ESEA	32,926
Commonwealth Consortium to Develop, Implement, and Evaluate a Pilot Program of Computer Assisted Instruction in Urban High Schools	3/16/68 - 7/30/71	U.S.O.E. Pittsburgh School District Title III	1,347,582

Miscellaneous Funds	Duration	Support	Amount
Development Operations and Evaluation of a Modern Mathematics Course for Inservice Education of Elementary School Teachers	2/01/69 - 9/22/69	U.S.O.E., Appalachia Educational Laboratory, Inc., Title III	98,297
Development of a Computer-Assisted Course in the Identification and Diagnosis of Handicapping Conditions in Children	6/01/69 - 5/31/71	U.S.O.E., Bureau of Education for the Handicapped	201,116
A Study of Paradigms for the Development and Evaluation of CAI Programs	6/01/69 - 10/15/71	National Science Foundation	156,305
Summer Institute for Teachers of Computer-Assisted Instruction Courses in Pittsburgh	6/12/69 - 8/29/69	U.S.O.E., Bureau of Educational Personnel Development	20,036
Spanish Translation of a CAI Course	2/02/70 - 9/30/70	U.S.O.E., Bureau of Research	9,986
Development of a Test for the Nonperforming Aspects of Music Education	3/02/70 - 11/01/70	U.S.O.E., Bureau of Research	10,000
Mobile Inservice Special Education Instruction for Education in Sparsely Populated Areas	3/16/70 - 4/15/73	U.S.O.E., Bureau of Educational Personnel Development	1,251,622
Development of a Model for the Teaching of Beginning Shorthand Through the Use of Computer Assisted Instruction	4/01/70 - 10/15/71	U.S.O.E., Bureau of Research	10,000
Review of CAI in Pennsylvania	5/01/70 - 6/30/70	Pennsylvania Department of Education Service	700
The Interaction Between Reward Preference and Task-Difficulty in a Computer Assisted Setting	6/01/71 - 11/30/71	U.S.O.E., Bureau of Research	9,780
Evaluation of Computer Assisted Instruction in Instrumental Musicianship	11/15/71 - 8/15/72	U.S.O.E., Bureau of Research Region III	10,000
A Computer-Assisted Literacy Development Program for Career Oriented Youth and Adults	1/01/72 - 6/30/73	U.S.O.E., National Educational Research and Development Program	119,479

Miscellaneous Funds	Duration	Support	Amount
Training Early Childhood Educators: Computer Assisted Instruction Courses in Diagnostic Teaching	1/10/72 - 1/09/74	U.S.O.E., Bureau of Education for the Handicapped	379,359
Pilot Study of CAI Cardiology Program	1/01/72 - 9/30/72	Pennsylvania Medical Society	500
A Computer-Assisted Course in the Education of Visually Handicapped Children for Rural Regular Classroom Teachers	6/01/71 - 8/31/72	University of Pittsburgh and U.S.O.E.	29,268
		Total	$5,165,587

APPENDIX B

Refereed Publications in CAI

Borman, Cartwright, Hall,
Mitzel, Ward, Deihl,
Heimer, Trueblood,
and Golub

Refereed Publications by
the Staff of the CAI Laboratory

Karl G. Borman

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APPENDIX C

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THE PENNSYLVANIA STATE UNIVERSITY
COLLEGE OF EDUCATION
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UNIVERSITY PARK, PENNSYLVANIA 16802

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Area Code 814
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APPENDIX D

Applied Research Studies

SUMMARY OF APPLIED RESEARCH STUDIES

Project Name	Staff	Description
A Study of Paradigms for the Development and Evaluation of CAI Programs	Ralph T. Heimer Harold E. Mitzel	The major concern of the PARADIGMS project centered around questions about how to develop, evaluate, and improve CAI curriculum materials, and to make reasoned and defensible judgments about their worth. Mathematics curriculum segments were developed to conform to the requirements imposed by the selected philosophical construction. As part of the project, eight individual studies were performed. These are listed. 06/01/69 - 10/15/71
"Toward a Theory of Sequencing: Study 1-1: An Exploration of Selected Relationships Among the Enactive, Iconic, and Symbolic Modes of Representation"	Paul A. Klein	
"Toward a Theory of Sequencing: Study 1-2: An Exploration of Selected Relationships Among the Enactive, Iconic, and Symbolic Modes of Representation"	Dan C. Farris	
"Toward a Theory of Sequencing: Study 1-3: An In-Depth Exploration of the Role of Iconic Representations in the Study of Congruence of Triangles:	Gerard Paquette	
"Toward a Theory of Sequencing: Study 1-4: An Exploration of the Effect of Congruent Triangle Pair Configuration Variation on Achievement of Selected Classes of Instructional Objectives"	Robert G. Bowers	
"Toward a Theory of Sequencing: Study 1-5: An Exploration of Selected Transitivity and Conjunctive Relationships Among the Enactive, Iconic, and Symbolic Modes of Representation"	John J. Hirschbuhl	

Project Name	Staff	Description
"Toward a Theory of Sequencing: Study 2-1: An Exploration of the Effect of Selected Sequence Variables Upon Student Choice in the Use of Algorithms"	Robert Hostetler	
"Toward a Theory of Sequencing: Study 3-1: Curriculum Heirarchies and the Structure of Intelligence: A Strategy of Organizing Instructional Objectives into Mathematical Systems Employing Basic Piagetian Constructs"	Daiyo Sawada	
"Toward a Theory of Sequencing: Study 3-2: An Exploration of Transitivities Formulated From a Set of Piagetian-Derived Operations and Their Implications in Traversing Learning Hierarchies"	Layne V. Hopkins	
Scrambled Versus Ordered Sequencing in Computer Assisted Instruction	Kenneth H. Wodtke	This project examined the question of random versus ordered sequencing of learning materials in programed instruction. Effort was spent trying to determine if ordered sequencing was important, and to what degree, in determining the effects of programed instruction. 06/01/65 - 06/30/69
The Interaction Between Reward Preference and Task Difficulty in a Computer Assisted Instruction Setting	David P. Yens	This study investigated two aspects of motivation: the use of individual incentives to enhance learning of children and the effect of different levels of task difficulty on the effectiveness of these incentives. The study involved fourth and fifth grade students working on arithmetic problems. 06/01/71 - 11/30/71

Project Name	Staff	Description
Development of a Model for the Teaching of Beginning Shorthand Through the Use of Computer Assisted Instruction	Karl G. Borman	A model, based on the proposition that the prevention of errors would increase the efficiency of the learning process was developed to teach beginning shorthand. Subjects were taught shorthand via the interception method that allowed the student to be interrupted when a predicted incorrect response was evident. This interception method was contrasted with prompting and confirmation methods of instruction. 04/01/70 - 10/15/71
Student Opinion Survey	Bobby R. Brown Karl G. Borman	Student Opinion Survey (SOS) is a 42-item questionnaire developed at the CAI Laboratory that is given via computer following a CAI course's final examination. It measures the students' attitudes toward CAI, the equipment, and their feelings in general about the instruction. It has been used successfully in determining the success of CAI instruction and the areas of courses which need revisions.
Experimentation with Computer Assisted Instruction in Vocational-Technical Education	Harold E. Mitzel George L. Brandon William Rabinowitz Paul Rowe Keith A. Hall Helen A. K. Farr	In addition to the curriculum developed during this project, 19 individual studies were accomplished dealing with various aspects of learning variables inherent in CAI. Several studies dealt with rote learning, feedback types, relationship among attitude, and achievement aptitude. 06/01/65 - 06/30/69

1. Relationship Among Attitude, Achievement and Aptitude Measures and Performance
2. Scrambling versus Ordered Sequencing
3. Rote Rule-learning on Transfer of Training
4. Educational Variables
5. Typewriter Interface

Project Name

Experimentation With Computer Assisted Instruction in Vocational-Technical Education (Continued)

6. Gradient- and Full-Response Feedback in Computer Assisted Instruction
7. A Comparison of the Effectiveness of Five Feedback Modes in a Computer-Assisted Adjunct Auto-Instruction Program
8. Effect of CAI on Natural Spelling Behaviors
9. Comparability of Computer-Assisted and Conventional Test Administration
10. Numerical and Verbal Aptitude Tests Administered at the Student Station
11. Remedial and Review Branching in Computer Assisted Instruction
12. Relative Affectiveness of Various Modes of Stimulus Presentation Through Computer Assisted Instruction
13. An Experimental Procedure for Course Revision Based on Students' Past Performance
14. Expressed Student Attitudes Under Several Conditions of Automated Programed Instruction
15. Effects of Reducing Verbal Content in Computer Assisted Instruction Programs

Project Name

Experimentation With Computer Assisted Instruction in Vocational-Technical Education (Continued)

16. Prior Knowledge and Individualized Instruction
17. Response Latency: It's Relationship with Errors and Response Stability in Two Tasks Involving Response
18. Prompting and Confirmation Modes of Feedback with Computer-Assisted Instruction
19. Reading Rate and Retention Under Two Modes of Presentation

APPENDIX E

Dissertations Written in Conjunction With Research Done in the CAI Laboratory

BORMAN, Karl G. Development of a Model for the Teaching of Beginning Shorthand Through the Use of Computer Assisted Instruction. 1971

BOWERS, Robert G. Toward a Theory of Sequencing: Study 1-4: An Exploration of the Effect of Congruent Triangle Pair Configuration Variation on Achievement of Selected Classes of Instructional Objectives. 1971

COUNTERMINE, Terry A. The Development and Evaluation of a Teaching and Coursewriting Computer Language (TACL). 1973

FARRIS, Dan C. Toward a Theory of Sequencing: Study 1-2: An Exploration of Selected Relationships Among the Enactive, Iconic, and Symbolic Modes of Representation. 1970

GILMAN, David A. A Comparison of the Effectiveness of Feedback Modes for Teaching Science Concepts by Means of a Computer Assisted Adjunct Auto-Instruction Program. 1967

HIRSCHBUHL, John J. Toward a Theory of Sequencing: Study 1-5: An Exploration of Selected Transitivity and Conjunctive Relationships among the Enactive, Iconic, and Symbolic Modes of Representation. 1971

HOPKINS, Layne V. Toward a Theory of Sequencing: Study 3-2: An Exploration of Transitivities Formulated from a Set of Piagetian-Derived Operations and their Implications in Traversing Learning Hierarchies. 1971

HOSTETLER, Robert. Toward a Theory of Sequencing: Study 2-1: An Exploration of the Effect of Selected Sequence Variables Upon Student Choice in the Use of Algorithms. 1970

KLEIN, Paul A. Toward a Theory of Sequencing: Study 1-1: An Exploration of Selected Relationships Among the Enactive, Iconic, and Symbolic Modes of Representation. 1970

MULL, Patricia A. A Comparison of Computer Assisted Instruction and a Programed Workbook to Teach the Initial Teaching Alphabet and Transliteration to Inservice Teachers. 1973

PAQUETTE, Gerard. Toward a Theory of Sequencing: Study 1-3: An In-depth Exploration of the Role of Iconic Representations in the Study of Congruence of Traingles. 1971

RADOCY, Rudolf E. Development of a Test for the Non-performance Aspects of Music Education. 1971

SAWADA, Daiyo. Toward a Theory of Sequencing: Study 3-1: Curriculum Hierarchies and the Structure of Intelligence: A Strategy of Organizing Instructional Objectives Into Mathematical Systems Employing Basic Piagetian Constructs. 1971

THOMPSON, Ruby L. Computer Assisted Phonic Analysis: A Validation Study. 1973

WARD, Marjorie E. Examination and Application of Formative Evaluation for Author Utilization During the Preparation of a CAI Course. The University of Pittsburgh. 1972

YENS, David P. The Interaction Between Reward Preference and Task Difficulty in a Computer Assisted Setting. 1972

APPENDIX F

Faculty Participants on Research and Development Projects

The Translation Into Spanish of a Computer Assisted Instruction Course in Mathematics - *Marilyn N. Suydam, Cecil Trueblood*

Four College Courses Developed and Presented by Computer Teleprocessing - *Harold E. Mitzel, Joe J. Cramer, Carl R. Moss, C. Alan Riedesel, Bruce M. Siegenthaler, David A. Gilman, Marilyn N. Suydam, Keith A. Hall, Donald W. Johnson, Kenneth H. Wodtke*

The Development and Evaluation of a Pilot Computer Assisted Occupational Guidance Program - *Joseph T. Impellitteri, Thomas Long, Jerome T. Kapes, Scott Kostenbauder*

Inservice Mathematics Education Via Computer-Assisted Instruction for Elementary School Teachers in Appalachia - *Keith A. Hall, C. Alan Riedesel, Cecil Trueblood, Harold E. Mitzel, Marilyn N. Suydam*

Introduction to Audiology - One of Four College Courses Developed and Presented by Computer Teleprocessing - *Bruce M. Siegenthaler*

Development of a Computer Assisted Course in the Identification and Diagnosis of Handicapping Conditions in Children - *Asa Berlin, Carol Cartwright, Phillip Cartwright, Mary Dupuis, Keith A. Hall, Larry Leslie, Harold E. Mitzel, Charles Orlando, Gerald Robine, David Sabatino*

Training Early Childhood Educators: Computer Assisted Instruction Courses in Diagnostic Teaching - Diagnostic Teaching of Preschool and Primary Children *G. Phillip Cartwright, John Salvia, Charles Orlando, Marjorie E. Ward, Carol A. Cartwright, Stanley Vitello, Charles Spinazola, Mary Dupuis*

A Computer Assisted Course in the Education of the Visually Handicapped Children for Rural Regular Classroom Teachers - *Marjorie Ward, Ralph E. Peabody, G. Phillip Cartwright*

Use of Computer Assisted Instruction to Teach Spelling to Sixth Graders - *George N. Demshock, Bobby R. Brown, C. Alan Riedesel, Marilyn N. Suydam*

The Development, Implementation and Evaluation of a Pilot Program of Computer Assisted Instruction for Urban High Schools - *Harold E. Mitzel, Keith A. Hall, Marilyn N. Suydam, Robert V. Igo, Thomas Kieren, Lars C. Jansson, C. Alan Riedesel*

Development and Evaluation of Computer Assisted Instruction in Instrumental Music - *Ned C. Deihl*

Computer Assisted Literacy Development Program for Career-Oriented Youth and Adults - *Lester S. Golub, Keith A. Hall*

The Development and Evaluation of a Teleprocessed Computer Assisted Instruction Course in the Recognition of Malarial Parasites - *Harold E. Mitzel, Robert V. Igo, Bobby R. Brown*

A Study of Paradigms for the Development and Evaluation of CAI Programs - *Ralph T. Heimer, Harold E. Mitzel, Paul A. Klein*

Development of a Model for the Teaching of Beginning Shorthand Through the Use of Computer Assisted Instruction - *Karl G. Borman*

Experimentation with Computer Assisted Instruction in Vocational Technical Education - *Harold E. Mitzel, Bobby R. Brown, Robert V. Igo, Donald W. Johnson, Kenneth H. Wodtke, Karl G. Borman, Helen L. K. Farr, Joseph T. Impellitteri, David Palmer, Keith A. Hall*

APPENDIX G

Borman
Cartwright, GP
Hall
Mitzel
Ward

VITA

Karl G. Bottman

EDUCATION

Liberty High School Bethlehem, Pennsylvania	1960	
York Junior College York, Pennsylvania	1963	A.A.
The Pennsylvania State University University Park, Pennsylvania Major: Educational Psychology	1965 1971	B.A. Ph.D.

PROFESSIONAL EXPERIENCE

The Pennsylvania State University

Division of Broadcasting	1965-1966	Graduate Assistant
Computer Assisted Instruction Laboratory	1966-1969	Graduate Assistant
College of Education	1969-1971	Research Assistant
College of Education	1971-Present	Assistant Professor of Education

HONORS AND MEMBERSHIPS

American Psychological Association (Member)
American Educational Research Association (Member)
Association for Educational Communication Technology (Member)
Association for the Development of Computer-Based Instructional Systems (Member)
Phi Delta Kappa (Member)

PUBLICATIONS AND CREATIVE WORKS

Ph.D. Thesis "The Development and Evaluation of a Model for the Teaching of Beginning Shorthand Through the Use of Computer Assisted Instruction." The Pennsylvania State University Library, 1971

Final Report "The Development of a Model for the Teaching of Beginning Shorthand Through the Use of Computer Assisted Instruction." Grant Number OEG-2-700019(509)

PUBLICATIONS AND CREATIVE WORKS -- Continued

Semi-Annual Reports: December 1968; June 1969. "Prompting and Confirmation as Modes of Feedback with Computer Assisted Instruction: Experiments I and II." With K.A. Hall.

Final Report: January 1970. "Expressed Student Opinion Toward Computer Assisted Instruction."

Semi-Annual Reports:

June 1967, "Relative Effectiveness of Various Modes of Stimulus Presentation through Computer Assisted Instruction." With D.W. Johnson.

June 1968, "Experimental Procedure for Course Revision Based on Students' Past Performance." With D.W. Johnson.

REFEREED PUBLICATIONS

"Using Student Attitude as an Index for Gauging Improvements Following a Formative Evaluation." *College Student Journal*, November-December 1972. With R.A. Sedlak and G.P. Cartwright.

"Prompting and Confirmation as Instructional Strategies with CAI: Experiment I." *Journal of Educational Research*, February 1973. With K.A. Hall.

VITA

G. Phillip Cartwright

PERSONAL DATA

Date of Birth: March 14, 1937
Place of Birth: New Castle, Indiana
Married: Carol A. Becker Cartwright
Home Address: 157 Le-Nor Drive, State College, Pennsylvania 16801
Office Address: 201 Chambers Building, University Park, Pennsylvania 16802

EDUCATION

University of Illinois	B.S., 1960	Psychology
University of Illinois	M.S., 1962	Education
University of Pittsburgh	Ph.D., 1966	Special Education
Graduate Fellow		Educational Research
U.S.O.E. 88-164 Fellowship		

PROFESSIONAL ASSOCIATIONS

Council for Exceptional Children
American Association on Mental Deficiency
American Educational Research Association
American Psychological Association
American Association for the Advancement of Science
Society of Sigma Xi

PRESENT RESPONSIBILITIES

Associate Professor of Special Education
Department of Special Education
The Pennsylvania State University
University Park, Pennsylvania 16802
Assistant Director
Computer Assisted Instruction Laboratory
Chairman, Graduate Programs in Education of Exceptional Children

TEACHING EXPERIENCE

College of Education	1970-Present	Associate Professor of
The Pennsylvania State University		Special Education
University Park, Pennsylvania		

TEACHING EXPERIENCE – Continued

College of Education The Pennsylvania State University University Park, Pennsylvania	1967-70	Assistant Professor of Special Education
Education Research and Development Center College of Education University of Hawaii Honolulu, Hawaii	1966-67	Assistant Professor of Educational Psychology
Evanston Township High School Evanston, Illinois	1962-63	Secondary Level Mentally Retarded Job Placement Coach
Edison Elementary School Westville, Illinois	1961-62	Primary Level Mentally Retarded (University of Illinois Research Project)

OTHER PROFESSIONAL EXPERIENCES

9/68-Present — Assistant Director, Computer Assisted Instruction Laboratory, The Pennsylvania State University.
Duties:
Actively involved in research and curriculum development in computer assisted instruction. Supervised faculty and graduate students on research in CAI and in extensive curriculum development projects. Gained experiences in developing and implementing operational CAI courses at the college level.

5/66-9/66 — Research Associate, Statistician, Research Department, Blue Cross of Western Pennsylvania, Pittsburgh, Pennsylvania.
Duties:
Consultation on research design and statistical analysis; supervision of four full time employees engaged in statistical analysis, evaluation and modification of medical review procedures.

5/65-9/65 — Research Assistant, Special Education and Rehabilitation, University of Pittsburgh, Pittsburgh, Pennsylvania.
Duties:
Statistical analysis; data processing.

1963-64 — Assistant Project Director, Science Research Associates, 259 East Erie Street, Chicago, Illinois 60611.
Duties:
1. Project Director, SRA Composition Laboratory Field Test. Approximately 1,000 junior high school students in five states participated for a period of four months.
2. Project Director, SRA Grammar Laboratory Field Test. Approximately 200 students in three schools participated for a period of three months.

OTHER PROFESSIONAL EXPERIENCES – Continued

3. Consultant: Construction of spelling tests and tests of linguistic principles.
4. Liaison: Research Department and Data Processing Center.

Duties included supervision of three part-time and full-time employees. All duties involved the evaluation of instructional materials.

1960-62 Research Assistant, Institute for Research on Exceptional Children, University of Illinois, Urbana, Illinois.
Duties:
Assisted in research with various groups of normal and exceptional children; responsible for data analysis and data processing for three projects.

1958-60 Research Assistant and Radar Controller, Coordinated Sciences Laboratory (formerly Control Systems Laboratory), University of Illinois, Urbana, Illinois.
Duties:
Computer operation, preparation of stimulus materials for computer simulation of man-machine systems, statistical analysis, preparation of technical reports on air defense networks (classified).

STUDENT ADVISING

Served as major advisor or committee member of the following graduates of doctoral programs at Penn State.

Ashbaugh, Larry
Berdine, William
Borman, Karl
Campbell, John
Countermine, Terry
Dangel, Harry
Dupuis, Mary
Haltom, Carl
Janssen, David
Kern, Robert
Reitz, Ronald
Sedlak, Robert
Walker, James
Yens, David

Presently serving as major advisor or committee member of 12 doctoral students.

CONTRIBUTIONS TO THE PROFESSION

Nineteen research reports have been presented at state (4 papers) or national (15 papers) meetings of the following organizations:

American Educational Research Association
American Psychological Association
National Council on Measurement in Education

CONTRIBUTIONS TO THE PROFESSION -- Continued

American Association on Mental Deficiency
Council for Exceptional Children
Association for the Development of Instructional Systems
Association for Special Educational Technology

Elected by the Association for the Development of Instructional Systems (ADIS) to be chairman of the Learning Research Section for a two-year period. ADIS is an international organization in which membership is restricted to persons actively engaged in the development of hardware and software for computer-assisted instruction.

Invited to present research papers and to organize research symposia during the academic year 1971-72 for four of the national organizations listed above.

MAJOR CONSULTANCIES

Field Reader and Site Visitor for Bureau of Education for the Handicapped, United States Office of Education.

CONFIDENTIAL WORK

Sinaiko, H. Wallace and Cartwright, Glen P. *Careful: A Study of the Effects of Heavy Target Load on Human and Automatic Tactical Decision Makers.* Report R-115, Coordinated Science Laboratory, University of Illinois, Urbana, Illinois, 1959.

Cartwright, G.P. Comparison of a test of linguistic principles and a dictated spelling test, Confidential Report: Materials Evaluation Section, Science Research Associates, Chicago, Illinois, 1963.

Cartwright, G.P. and Tartaro, S. The effectiveness of the SRA *Grammar Laboratory* in a public school setting, Confidential Report: Materials Evaluation Section, Science Research Associates, Chicago, Illinois, 1963.

Cartwright, G.P. Final Report: SRA *Composition Laboratory* field study, Confidential Report: Materials Evaluation Section, Science Research Associates, Chicago, Illinois, 1964.

Cartwright, G.P. Medical review: procedures and recommendations. Confidential Research Department, Blue Cross of Western Pennsylvania, Pittsburgh, Pennsylvania, 1966.

REFEREED PUBLICATIONS

Cartwright, G.P. Techniques of analysis of written language. *Abstracts of Papers,* Washington, D.C.: American Educational Research Association, 1966.

Cartwright, G.P. Use of the Peabody picture vocabulary tests with disadvantaged children. *Journal of Educational Research,* 1968, 61, 285.

Cartwright, G.P. Written language abilities of educable mentally retarded and normal children. *American Journal of Mental Deficiency,* 1968, 72, 499-505.

REFEREED PUBLICATIONS – Continued

Cartwright, G.P. Dimensions of written language of normal and retarded children. *American Journal of Mental Deficiency*, 1969, 73, 631-635.

Cartwright, G.P. Two sequences of programmed instruction for mentally retarded adolescents. *Selected Convention Papers*, Washington, D.C.: Council for Exceptional Children, 1969.

Cartwright, G.P. and Cartwright, C.A. Determining the motivational systems of individual children. *Teaching Exceptional Children*, 1970, 2, 143-149.

Cartwright, G.P. The relationship between sequences of instruction and mental abilities of retarded children. *American Educational Research Journal*, 1971, 8, 143-150.

Cartwright, G.P. and McIntosh, D.K. Three approaches to grouping procedures for the education of disadvantaged primary school children. *Journal of Educational Research*, 1972, 65, No. 9, 425-429.

Cartwright, G.P. and Cartwright, C.A. Determining the motivational systems of individual children. Reprinted in *Designing Instructional Strategies for Young Children*, B.C. Mills and R.A. Mills (Eds.). William C. Brown Company, Dubuque, Iowa, 1972, 221-226.

Cartwright, G.P. Written language of EMR and nonretarded children with the same mental ages. *American Journal of Mental Deficiency*, 1972, 77, No. 1, 95-99.

Cartwright, G.P., Cartwright, C.A. and Robine, G.G. CAI course in the early identification of handicapped children. *Exceptional Children*, February 1972, 38, 453-459.

Cartwright, G.P. and Cartwright, C.A. An undergraduate computer-assisted instruction course in the early identification of handicapped children. *Proceedings of the 1972 Conference on Computers in Undergraduate Curricula*, Southern Regional Education Board, Atlanta, Georgia, June 1972, 167-175.

Cartwright, G.P. and Cartwright, C.A. Gilding the Lilly: comments on the training based model for special education. *Exceptional Children*, November 1972.

Cartwright, G.P., Cartwright, C.A. and Ysseldyke, J.E. Two decision models: identification and diagnostic teaching of handicapped children. *Psychology in the Schools*, x, (1), January 1973.

Cartwright, G.P. and Cartwright, C.A. A computer-assisted instruction course in the early identification of handicapped children. Prepared for Council for Exceptional Children, National Conference on Instructional Technology, San Antonio, Texas. The Pennsylvania State University, CAI Laboratory P-37, December 1-5, 1970, 11 pp.

Cartwright, G.P. and Cartwright, C.A. Testimony of Carol A. Cartwright and Glen Phillip Cartwright on the extension of the education of the handicapped act (S. 896). Presented to the Sub-committee on the Handicapped. The Pennsylvania State University, CAI Laboratory P-44, March 21, 1973, 3 pp.

Cartwright, G.P. and Cartwright, C.A. A computer-assisted instruction course in the early identification of handicapped children. *Journal of Teacher Education*, 24, (2), Summer 1973, 128-134.

REFEREED PUBLICATIONS – Continued

Cartwright, G.P., Sedlak, R.A. and Borman, K.G. Using student attitude as an index for gauging improvements following a formative evaluation. *College Student Journal*, 6, (4), December 1972, 3-9.

Cartwright, G.P. and Sedlak, R.A. The written language ability of disadvantaged black and white fourteen year olds. *The Journal of Special Education*, in press.

OTHER PUBLICATIONS

Cartwright, G.P. Training elementary teachers to identify handicapped children in their classrooms. *Kaleidoscope, Emerging Patterns in Media*, Arlington, Virginia: Council for Exceptional Children San Antonio Conference, December 1970.

Cartwright, G.P. Issues in curriculum evaluation. Paper presented at Association for the Development of Instructional Systems, State University of New York at Stony Brook, February 1971.

Cartwright, G.P. and Mitzel, H.E. Computer assisted remedial education: early identification of handicapped children. Final Report, CAI Laboratory Report R-44, The Pennsylvania State University, June 1971, 157 pp.

Cartwright, G.P. and Mitzel, H.E. CARE 1 course documentation on computer tape. CAI Laboratory, The Pennsylvania State University. 22,000 hard copy pages, June 1971.

Cartwright, G.P., Villwock, M.A. and Cartwright, C.A. Computer assisted remedial education: early identification of handicapped children. Syllabus, CAI Laboratory Report R-43, The Pennsylvania State University, July 1971, 215 pp.

Cartwright, G.P., Palmer, D.P. and Shea, B.S. Computer assisted remedial education: early identification of handicapped children. Course Planning Manual, CAI Laboratory Report R-42, The Pennsylvania State University, July 1971, 71 pp.

Cartwright, G.P. and Cartwright, C.A. (Eds.). Overview of early identification of handicapped children. Educational information processing model. Interrelationship of handicaps. Mental retardation. In *Early Identification of Handicapped Children*, CAI Laboratory Report R-36, The Pennsylvania State University, 1972, 420 pp.

Cartwright, G.P. and Ward, M.E. Some contemporary models for curriculum evaluation. Paper presented at Association for the Development of Instructional Systems, Quebec City, August 1972.

Cartwright, G.P., Hall, K.A., Cartwright, C.A., Mitzel, H.E. and Wetcher, S.P. Sample computer assisted instruction student interactions. University Park, Pa.: The Pennsylvania State University, CAI Laboratory R-53, December 1972, 59 pp.

Cartwright, G.P. and Cartwright, C.A. Computer assisted remedial education: Diagnostic teaching of preschool children. Handbook for CARE 2, University Park, Pa.: The Pennsylvania State University, CAI Laboratory R-54, 1973, 135 pp.

CONTRACTS AND GRANTS RECEIVED

Development of a Computer Assisted Instruction Course in the Identification and Diagnosis of Handicapping Conditions in Children, Grant No. OEG-0-9-482129-4394 (032), G. Phillip Cartwright and Harold E. Mitzel. The final product of this project was a three-credit college-level computer-assisted instruction course (CARE 1). The self-contained CAI course was compared with the traditional lecture discussion method of live instruction. ($220,375)

Mobile Inservice Special Education Instruction for Educators in Sparsely Populated Areas, Grant No. OEG-0-70-1861 (725), with Harold E. Mitzel and Keith A. Hall. The purpose of this three-year project is to take the computer-assisted instruction course (developed by the project listed directly above) to rural areas by means of a mobile CAI Laboratory, thus making the course available to large numbers of educators. ($737,000)

Development of a Computer-Assisted Instruction Course in Teaching Visually Handicapped Children (CARE 4). Subcontracted from University of Pittsburgh. Prime Contract to Professor Ralph Peabody, University of Pittsburgh, from USOE/BEH/DTP. ($29,268).

Training Early Childhood Educators: Development of Two CAI Courses in Diagnostic Teaching of Preschool and Primary Handicapped Children. (Contract No. OEG-0-72-0653[607]). With Carol A. Cartwright. ($379,359)

Center for Educational Diagnosis and Remediation. An application for a grant for the construction of a University-Affiliated Facility for the Mentally Retarded, 250 pages. Submitted under the provisions of Title I, Part B, Public Law 88-164, to Social and Rehabilitation Services, HEW. The Pennyslvania General State Authority constructed the building according to the plan submitted. This was a product of a number of Penn State staff members. ($1,865,000).

VITA

Keith A. Hall
Associate Professor of Education
Director, Computer Assisted Instruction Laboratory
The Pennsylvania State University
University Park, Pennsylvania 16802

EDUCATION

Logansport High School Logansport, Indiana	Diploma, 1951-55
Indiana State University Terre Haute, Indiana	B.S., Art Education 1955-58
Indiana State University Terre Haute, Indiana	M.A., Instructional Technology 1958-59
Indiana University Bloomington, Indiana	Ed D., Instructional Technology Educational Technology 1960-63

PROFESSIONAL EXPERIENCE

The Pennsylvania State University University Park, Pa. 16802	1970-Present	Associate Professor of Education and Director, Computer Assisted Instruction Laboratory
Stanford University Stanford, California	July 1972-December 1972	Visiting Scholar
The Pennsylvania State University University Park, Pa. 16802	1967-1970	Assistant Professor of Education and Director, Computer Assisted Instruction Laboratory
The Pennsylvania State University University Park, Pa. 16802	1963-1967	Assistant Professor of Education
Indiana University Bloomington, Indiana	1962-63	Teaching Assistant
Indiana State University Terre Haute, Indiana	1958-1962	Instructor and Supervisor of Audio Visual Production

PROFESSIONAL ASSOCIATIONS

American Educational Research Association
National Society for the Study of Education
Phi Delta Kappa
American Educational Research Association Special Interest Group of CAI
American Psychological Association (past member)
Association for Educational Communication Technology (President Elect, Research and Theory Division, 1973-74)
Association for the Development of Instructional Systems (President, 1968-70)
Kappa Pi National Art Honorary Fraternity

PUBLICATIONS

"The Development, Implementation and Evaluation of a Pilot Program of Computer Assisted Instruction Courses in General Mathematics and Algebra for Urban High Schools." With Harold E. Mitzel, *Journal of Educational Technology Systems*, 1974, (In Press)

"Curricular and Computer Systems Compatability of CAI Programs for Multi-University Use." *Proceedings of the Fall 1973 Conference of the Interuniversity Communications Council* (EDUCOM)

"The Computer in Special Education." For *Review of Special Education*, Vol. II. With G.P. Cartwright, 1973 (In Press).

"CARE. *Proceedings of the Third International Congress for the Scientific Study of Mental Deficiency*, The Hague, The Netherlands, September 1973 (In Press).

"Inservice Mathematics Education for Elementary School Teachers via Computer Assisted Instruction." *Educational Technology* (In Press)

"Computer-Assisted Renewal Education." With G.P. Cartwright and H.E. Mitzel. *Phi Delta Kappan*, 1973 (In Press).

"Prompting and Confirmation as Modes of Feedback with Computer Assisted Instruction: Experiment II." With K.G. Borman. (*Journal of Educational Research*, Submitted.)

"Sample Computer Assisted Instruction Student Interactions." With G.P. Cartwright, C.A. Cartwright, H.E. Mitzel, and S.P. Wetcher. University Park, Pennsylvania, The Pennsylvania State University, CAI Laboratory, Report R 53, 1973.

"Prompting and Confirmation as Instructional Strategies with CAI: Experiment I." *Journal of Educational Research*, 66:6, February 1973, pp. 279-285. With Karl G. Borman.

"CARE Computer Assisted Renewal Education – An Opportunity in Pennsylvania." *Audiovisual Instruction*, 18:1, January 1973 pp. 35-39. With H.E. Mitzel.

"Continuing Education Through Mobile Computer-Assisted Instruction." *The New Campus*, 25, Spring 1972, pp. 36-38

PUBLICATIONS – Continued

Review of Atkinson, R.C., and Wilson, H.A. (eds.). "Computer Assisted Instruction: A Book of Readings." New York: Academic Press, 1969. 363 pp. In *Audio Visual Communications Review* 20:1, 1972, pp. 93-97.

Review of Margolin, J.B. and Misch, M.R. "Computers in the Classroom." New York: Spartan Press, 1970, 382 pp. In *Audio Visual Communications Review*, 20:1, 1972, pp. 93-97.

Review of Meredith, J.C. "The CAI Author/Instructor." Englewood Cliffs, Educational Technology Publications, 1971, 127 pp. In *Audio Visual Communications Review*, 20:1, 1972, pp. 93-97.

"Computer-Assisted Instruction: Problems and Performance." *Phi Delta Kappan*, June 1971, pp. 628-631.

"Research Papers 1971." *Audio Visual Instruction*, 16:6, June/July 1971, pp. 42-44.

"Computer Assisted Instruction: Status in Pennsylvania." July 1970. Monograph prepared for the Pennsylvania Department of Education

"Gradient- and Full Response Feedback in Computer-Assisted Instruction." *The Journal of Educational Research*, 61:5, January 1968, pp. 195-199

MANUSCRIPTS IN PROGRESS

"Review of Computer-Assisted Instruction Evaluative Studies." With H.E. Mitzel.

"Educational Technology Annual Review: Improving Instruction with Adaptive Interactive Systems." For ERIC at Stanford.

INVITED ADDRESSES

"Curricular and Computer System Comparability of CAI Programs for Multi-University Use."

Semi-Annual Meeting of the Interuniversity Communication Council (EDUCOM), Educational Testing Service, Princeton, New Jersey, Fall 1973.

"Inservice Teacher Education through Mobile CAI."

Third International Conference of the International Association for the Scientific Study of Mental Deficiency, The Hague, The Netherlands, September 1973

Conference on Educational Technology, Indiana University, Bloomington, Indiana, July 1973

National Association of State Directors of Special Education, Phoenix, Arizona, July 1973.

Leadership Training Institute sponsored by Bureau of Education for the Handicapped. U.S.O.E., Albuquerque, New Mexico, June 1973, and Chicago, Illinois, January 1973.

INVITED ADDRESSES -- Continued

Faculty of Education, University of Alberta, Edmonton, Alberta, Canada, March 1973.

Association for the Development of Instructional Systems, Summer Conference, Columbus, Ohio, August 1971.

American Association of School Administrators, Annual Convention, Atlantic City, New Jersey, February 1971.

"The Penn State Policy of the Distribution and Use of CAI Curriculum Materials."

Association for the Development of Instructional Systems, Winter Conference, San Francisco, California, January 1973.

"Summary of Penn State Programs and Activities in CAI."

Division of Educational Research Services, University of Alberta, Edmonton, Alberta, Canada, March 1973.

"Computer Uses in Special Education."

American Association of Mental Deficiency Annual Meeting, Atlanta, Georgia, May 1973.

"Summary of Research and Implementation of Computer-Assisted Instruction."

Association of Educational Communication of Technology Annual Convention, Philadelphia, Pennsylvania, March 1971. With H.E. Mitzel

"Computer Assisted Instruction: State of the Art."

American Association of School Administrators Annual Convention, Atlantic City, New Jersey, February 1970.

"Computer Assisted Instruction Applications in Industrial Arts."

Pennsylvania Industrial Arts Convention, Camp Hill, Pennsylvania, January 1970

"Realities of Computer-Assisted Instruction."

Symposium, Lock Haven State College, Lock Haven, Pennsylvania, March 1971

RESEARCH PROJECTS IN PROGRESS

March 16, 1970 – March 15, 1974: "Mobile Inservice Special Education Instruction for Educators in Sparsely Populated Areas." With H.E. Mitzel and G.P. Cartwright

January 1, 1972 – October 31, 1973: "A Computer-Assisted Literacy Development Program for Career Oriented Youths and Adults." With L. S. Golub

January 1, 1972 – January 1, 1974: "Training Early Childhood Educators: Computer-Assisted Instruction Course in Diagnostic Teaching With G.P. Cartwright, C.A. Cartwright and R.M. Smith

RESEARCH PROJECTS COMPLETED

"Commonwealth Computer-Assisted Instruction Consortium." Interim Reports, July 15, 1968, June 15, 1969, August 31, 1969, November 15, 1969, February 28, 1970, and April 15, 1970, Final Report: July 1971.

"Experimentation with Computer-Assisted Instruction in Technical Education." Edited contributions from staff members. Semi-Annual Progress Reports: December 31, 1967, June 30, 1968, December 31, 1968, and June 30, 1969.

"Prompting and Confirmation as Modes of Feedback with Computer-Assisted Instruction: Experiment I." With K.G. Borman. Semi-Annual Report: December 1968.

"Prompting and Confirmation as Modes of Feedback with Computer-Assisted Instruction: Experiment II." With K.G. Borman. Semi-Annual Report: June 1969.

"Inservice Mathematics Education for Elementary School Teachers via Computer-Assisted Instruction in Appalachia." Interim Reports: June 1969, August 1969, September 1969. Final Report: January 1970.

"The Development and Presentation of Four College Courses by Computer Teleprocessing." (O.E. 4-16-010) Major responsibility for compiling and writing final report. Final Report: June 1967.

"An Investigation of Programming Principles as Applied to the Production and Utilization of Filmstrips and Filmstrip-Type Materials in Natural Science. With D.W. Johnson and A.W. VanderMeer. Final Report: August 1964.

CAI DEMONSTRATIONS AND DISSEMINATION

(The Mobile CAI Laboratory and curriculum were demonstrated for members, invited guests and other interested persons.)

Indiana University
Bloomington, Indiana, April 4-5, 1973

CAI DEMONSTRATIONS AND DISSEMINATION – Continued

American Association for Mental Deficiency
Atlanta, Georgia, May 28 - June 1, 1973

International Transportation Exposition
Washington, D.C., May 21 - June 5, 1972

U.S. Office of Education
Washington, D.C., December 6-22, 1971

Education Congress
Harrisburg, Pennsylvania, September 21-24, 1971

Council for Exceptional Children International Conference
Miami, Florida, April 15-28, 1971

OTHER ACTIVITIES

Association for Educational Communications and Technology

Member of Research Commission, 1963-present
Chairman, National Program Committee for Research Paper Sessions, Annual Conventions, 1971, 1972, 1973
President Elect, Research and Theory Division 1973-74
National Program Chairman, Research and Theory Division, Annual Convention, 1974

Association for the Development of Instructional Systems

President 1968-1970
Wrote draft of constitution, developed agenda for five national meetings of the Association. Membership grew from 15 members from the United States to 175 members from the United States Italy, France, Germany, Great Britain, and the Netherlands.

College of Education Research Committee, 1971-72, 1973-74

GRADUATE STUDENT ADVISING

Anthony Lazarro, Ph.D. Candidate, Science Education
Thomas Rhoades, Ph.D. Candidate, Science Education
Terry Countermine, Ed.D., Computer Science, June 1973, "The Development and Evaluation of a Teaching and Coursewriting Computer Language (TACL)"
Ruby Thompson, Ph.D., Secondary Education, March 1973, "Computer Assisted Phonic Analysis: A Validation Study"

VITA

Harold E. Mitzel
Professor of Psychology and Educational Psychology
The Pennsylvania State University
University Park, Pennsylvania 16802

EDUCATION

University of Wichita Wichita, Kansas	B.A., 1943 Magna cum Laude
University of Minnesota Minneapolis, Minnesota	M.A., 1950
University of Minnesota Minneapolis, Minnesota Major: Educational Psychology Minor: Psychology	Ph.D., 1952

EXPERIENCE

City University of New York	1952-1955	Assistant Professor of Education
Office of Research and Evaluation	1955-1958	Acting Director
Division of Teacher Education	1958-1961	Associate Professor and Director
	1961-1962	Professor and Director
Cornell University School of Education	Summer, 1962	Lecturer in Measurement and Statistics
The Pennsylvania State University	1962-1971	Assistant Dean for Research
College of Education	1962	Professor of Psychology and Educational Psychology
	1971-Present	Associate Dean for Research
CENIDE–Ministry of Education and Science Madrid, Spain – UNESCO Mission	June 1973	Lecturer on Computer Assisted Instruction

HONORS AND MEMBERSHIPS

American Psychological Association (Fellow)
American Association for the Advancement of Science
American Educational Research Association
Member, Editorial Board, *Handbook of Research on Teaching*, 1960-1962;
Chairman, Committee on Conditions of Research Support, 1964-1966;
Secretary, Special Interest Group on Computer Aids to Instruction, 1968-1970;

HONORS AND MEMBERSHIPS – Continued

Member, Taskforce on Research Training, 1970-1972;
Co-Chairman, Division C Program Committee, 1973
Pennsylvania Educational Research Association
Member, Executive Committee, 1967-Present;
Vice President, 1970;
President, 1971-1972
Society for Applied Learning Technology – Charter Member, 1973
Phi Delta Kappa
National Council on Measurement in Education
National Society for the Study of Education
American Association for Higher Education
Society of Sigma Xi
Educational Research Association of New York State
Director, 1962-1964
Northeast Educational Research Association
Director, 1968-Present
Certified Psychologist, New York State, 1958-Present
Visiting Scientist APA-NSF Program, 1963
Eminent Lecturer Award in Educational Research, American Society for Engineering Education, 1969

SPECIAL PROJECTS AND PROFESSIONAL EXPERIENCES

Co-Director, Teacher Education Closed Circuit Television Project, Hunter College, 1959-1963
Editorial Board, *Journal of Educational Research*, 1960-Present
Consultant on Research Innovation, State University College at Fredonia, New York, 1961-1963, 1969-Present
Member of Committee of Eleven, research advisory group to New York State Education Department, 1961-1963
Associate Editor, *American Educational Research Journal*, 1963-1973
Co-Principal Investigator, U.S. Office of Education, Project No. OE-4-16-001, "A Study of the New Media and the Role of the Campus School in American Education," 1964-1965
Principal Investigator, U.S. Office of Education, Project No. OE-4-16-010, "The Development and Presentation of Four Different College Courses by Computer Teleprocessing," 1964-1966
Co-Principal Investigator, U.S. Office of Education, Project No. OE-5-85-074, "Experimentation with Computer Assisted Instruction in Technical Education," 1965-1969
Vice President, Board of Directors, Appalachia Educational Laboratory, 1965-1969; President, 1969-1970
Editorial Consultant, *Reading Research Quarterly*, 1966-Present; *Appalachian Review*, 1967-1968
Principal Investigator, ONR, Project No. N00014-67-A-0385-0003, "The Development and Evaluation of a Teleprocessed Computer-Assisted Instruction Course in the Recognition of Malaria Parasites," 1967-1968
ERIC Clearinghouse on Teacher Education
Member, Advisory and Policy Council, 1968-Present
Chairman, 1970-1971
Member of Board of Scientific Advisors, Harper and Row, Publishers, 1968-1970
Member, Commonwealth of Pennsylvania, CAI Consortium, 1968-1972
Editorial Board, *Journal of Educational Measurement*, 1969-Present

SPECIAL PROJECTS AND PROFESSIONAL EXPERIENCES – Continued

Co-Principal Investigator, U.S. Office of Education, Project No. OEG-0-9-482129-4394 (032), "Development of a Computer-Assisted Course in the Identification and Diagnosis of Handicapping Conditions in Children," 1969-1970

Co-Principal Investigator, NSF, Project No. GJ-102, "A Study of Paradigms for the Development and Evaluation of CAI Programs," 1969-1971

Chairman, Advisory Panel, Teacher Education Research Center, State University College at Fredonia, New York, 1970-1972

Principal Investigator, U.S. Office of Education, EPDA, Project No. 2062, OEG-0-70-1861 (725), "Mobile Inservice Special Education Instruction for Educators in Sparsely Populated Areas," 1970-Present

ERIC Clearinghouse on Tests and Measurements, Princeton, New Jersey
Member, Advisory Committee, 1971-1973

Far West Laboratory for Educational Research and Development, Berkeley, California
Member, Advisory Committee on Teacher Education Program Activities, 1971-1972

National Center for Educational Research and Development, U.S. Office of Education
Member Advisory Committee on Laboratories and Centers, 1971-1972

Consultant, Commissioner's Planning Unit, U.S. Office of Education, Washington, D.C., 1971-1972

Principal Investigator, U.S. Office of Education, Project No. 1-7059, "Planning Support for National Institute of Education," 1971-1973

Consulting Editor, *Journal of Applied Behavior Analysis,* 1972-Present

Consulting Editor, *Audio-Visual Communications Review,* 1972-Present

PUBLICATIONS AND CREATIVE WORKS

Ph.D. Thesis: *Interest Factors Predictive of Teachers' Rapport with Pupils,* University of Minnesota Library, 1952.

"Assessing Social-Emotional Climate in the Classroom by Withall's Technique," (With W. Rabinowitz). *Psychological Monographs General and Applied,* 67, 18 (Whole No. 368), 1953.

"A Methodological Study of Reciprocal Averages Technique Applied to an Attitude Scale," (With C. J. Hoyt). *Journal of Counseling Psychology,* 1, 1954, 256-259.

"Activities of an Office of Research in Teacher Education," (With J. S. Orleans and E. Wandt). *Journal of Teacher Education,* 5, 1954, 324-328.

"Minnesota Ph.D.'s Evaluate Their Training," (With R. J. Keller). Chapter in *A University Looks at Its Program,* R. Eckert (Ed.), Minneapolis, Minnesota: University of Minnesota Press, 1954.

"The Effects of Response Sets on the Validity of the Minnesota Teacher Attitude Inventory." *Educational and Psychological Measurement,* 16, Winter 1956, 501-515.

"Analysis of Variance Models and Their Use in a Three-Way Design Without Replication," (With D. M. Medley and A. N. Doi). *Journal of Experimental Education,* March 1956, 221-229.

"Pupil Growth in Reading–An Index of Effective Teaching," (With D. M. Medley). *Journal of Educational Psychology,* 48, April 1957, 227-239.

"Observing and Recording Group Behavior," (With M. Taylor). *Review of Educational Research,* 27, December 1957, 476-486.

"A Technique for Measuring Classroom Behavior," (With D. M. Medley). *Journal of Educational Psychology,* 49, 2, April 1958, 86-92.

"Application of Analysis of Variance to the Estimation of the Reliability of Observations of Teachers' Classroom Behavior," (With D. M. Medley). *Journal of Experimental Education,* 27, September 1958, 23-35.

"The Development of Pupil-Growth Criteria in Studies of Teacher Effectiveness," (With C. F. Gross). *Educational Research Bulletin,* October 1958, 186-187; November 1958, 205-215.

"Comments on the Cornell Experimental Program for the Preparation of Elementary Teachers." *Journal of Teacher Education,* 9, 4, December 1958, 383-386.

"Longitudinal Studies of a Group of Teacher Education Graduates," (With D. M. Medley and W. Rabinowitz). *Journal of Teacher Education,* 10, 1, March 1959, 117-119.

"Criteria of Teacher Effectiveness." *Encyclopedia of Educational Research,* Third Edition, C. W. Harris (Ed.), New York: Macmillan, 1960, 1481-1486.

"Obtaining Percentile Ranks to Interval Mid-points with the IBM Accounting Machine," (With L. Dubnick). *Educational and Psychological Measurement,* 20, 1960, 185-191.

"The Relative Scholastic Ability of Prospective Teachers," (With L. Dubnick). *Journal of Teacher Education,* 12, 1961, 73-80.

"Some Observations on the Selection of Students for Teacher Education Programs," (With W. Rabinowtiz). *Journal of Teacher Education,* 12, 1961, 157-164.

"A Tentative Framework for the Study of Effective Teacher Behavior," (With D. M. Medley). *Journal of Experimental Education,* 30, 4, June 1962, 317-320.

"Programming in Education and Teacher Preparation," (With W. Rabinowitz). *Teacher's College Record,* 64, November 1962, 128-138.

The Use of Television for Improving Teacher Training and for Improving Student Teaching Performance. Phase I, Improvement of Student Teaching, (With H. Schueler and M. J. Gold). Title VII, NDEA, Project No. 730035, Hunter College, November 1962.

Mathematics Individual Learning Experiment, (With G. Crosby and H. Fremont). Title VII, NDEA, Project No. 391, U.S. Office of Education, Queens College, New York, December 1962.

"Measuring Classroom Behavior by Systematic Observation," (With D. M. Medley). Chapter 6 in *Handbook of Research on Teaching,* Nathaniel Gage (Ed.), Chicago: Rand McNally, 1963, 247-328.

"The Place of Systematic Observation in Classroom Research." *Research Design and the Teaching of English.* Proceedings of San Francisco Conference, National Council of Teachers of English, November 1963, 93-100.

"Recent Research Holds Promise That We Can Measure Good Teaching Objectively." *NEA Journal,* January 1964, 35-36.

"Instructional Improvement Through Research." *Instructional Improvement Through Research,* 1963-1964. Proceedings of New York State Convocation on Educational Research, Albany, New York, 1965, 3-11.

"The Relative Importance of Teacher Misassignment as a Problem for Education," (With W. Dick). *Journal of Teacher Education,* March 1965, 54-60.

Campus School to a Research and Dissemination Center. P. W. Bixby and H. E. Mitzel, Eds., The Pennsylvania State University, June 1965.

"New Models for Implementing Technology in Education," (With W. A. Bost). *Planning for Effective Utilization of Technology in Education.* E. L. Morphet and D. L. Jesser (Eds.), Designing Education for the Future: An Eight-State Project. Denver, Colorado, August 1968, 182-192.

Conference Summary, *Computer-Assisted Instruction and the Teaching of Mathematics.* R. Heimer (Ed.), NCTM, Washington, D.C., 1969, 145-151.

"The Impending Instruction Revolution." *Engineering Education,* 60, 7, March 1970, 749-754. Reprinted in *Phi Delta Kappan,* April 1970, 434-439.

"The CAI on Wheels." *Educational Television,* December 1970, 6.

"The Computer and Adaptive Education." *American Education,* VI, 10, December 1970, 23-26.

"The Potential Contribution of Computers to Instruction Reform." *Alternative Futures in American Education.* Appendix 3 to Hearings on HR3606 (National Institute of Education) Committee on Education and Labor, House of Representatives, January 1972.

"CARE: Computer-Assisted Renewal Education--An Opportunity in Pennsylvania." *Audiovisual Instruction,* (With K. A. Hall), January 1973, 35-39.

PUBLICATIONS AND CREATIVE WORKS – Continued

"Mobile Computer Assisted Instruction for Inservice Teacher Education," in S. Winkler, (Ed.) *Applications of Learning Technology: Progress and Problems.* National Security Industrial Association, Washington, D.C., 1973.

BOOK REVIEWS

"A Reaction to Holmes' Basic Assumptions Underlying the Substrata-Factor Theory," (With J. N. Sparks). *Reading Research Quarterly,* 1, 3, Spring 1966, 137-145.

"Review of Lewis, Gertrude, 'The Evaluation of Teaching,' and Amidon, E. and E. Hunter, 'Improving Teaching: The Analysis of Classroom Interaction.'" *Journal of Teacher Education,* 18, Winter 1967, 503-505.

"Computer: Like Drugs and Atomic Power." Review of Bushnell, D. D. and D. W. Allen, *The Computer in American Education, Phi Delta Kappan,* XLIX, 8, April 1968, 464.

Revised: July 1973

VITA

Marjorie Ellen Ward
Assistant Professor of Special Education
The Pennsylvania State University
University Park, Pennsylvania 16802

EDUCATION

Wilkinsburg High School Pittsburgh, Pa. 15221	1957	
The College of Wooster Wooster, Ohio	B.A.–1961	Major: English Minor: Speech, Secondary Education
University of Pittsburgh Pittsburgh, Pa. 15213	M.Ed.–1965	Major: Special Education and Rehabilitation (Visually Handicapped)
University of Pittsburgh Pittsburgh, Pa. 15213	Ph.D.–1972	Major: Special Education Minor: Educational Communications and Technology
University of Hawaii Honolulu, Hawaii	1963	Summer Session
University of Alaska College, Alaska	1965	Summer Session
Sorbonne (Temple University Paris, France	1966	Summer Session

CURRENT POSITION

Assistant Professor, Department of Special Education, The Pennsylvania State University.

Responsibility: Coordination of CARE course development activities in Computer Assisted Instruction Laboratory; Monitor of EEC 400, 401, 460 (CAI courses).

TEACHING EXPERIENCE

Wilkinsburg Jr. High School Pittsburgh, Pa. 15221	1961–1963	Teacher of 8th Grade English
Allegheny County Schools Pittsburgh, Pa. 15222	1963–1967	Itinerant Teacher of Visually Handicapped Children (K-12)

TEACHING EXPERIENCE – Continued

Dauphin County Schools Harrisburg, Pa. 17110	1967–1969	Initiated County Itinerant Program for Visually Handicapped Children (K-12)
Illinois State University Normal, Illinois	1970	Intern/Instructor in Department of Special Education and Supervisor of Student Teachers
The Pennsylvania State University University Park, Pa. 16802	1972–	Assistant Professor, Department of Special Education

NON-TEACHING EXPERIENCE

Consultant to Dauphin County Schools (1968) during preparation of proposal to establish the Central Pennsylvania Special Education Resource Center; traveled to the Illinois State Instructional Materials Center for Visually Handicapped, the IMC at Michigan State University, and the American Printing House for the Blind to gather information; assisted in writing the proposal.

Intern at the Illinois State Instructional Materials Center for Visually Handicapped during June 1970.

Research Assistant and course author for a special project funded to develop a course entitled "Education of Visually Handicapped Children" for regular classroom teachers in rural areas (performed pursuant to a grant under Title VI of the Education of the Handicapped Act, PL 91-230, Special Project Grant OEG-0 71-1604, at the University of Pittsburgh in the Department of Special Education and Rehabilitation in cooperation with the Computer Assisted Instruction Laboratory at The Pennsylvania State University, June 1971 – August 1972.

PERMANENT CERTIFICATION IN PENNSYLVANIA

Secondary Education	
English	1961
Speech	1961
Special Education	
Sight Conservation Classes	1964
Visually Handicapped	1968
Instructional Media Specialist II	1971

DISSERTATION TOPIC

Examination and Application of Formative Evaluation for Author Utilization During the Preparation of a CAI Course.

PROFESSIONAL ORGANIZATIONS AND ACTIVITIES

American Association for Educators of Visually Handicapped
- Member
- Speaker at Biennial Conference in 1968
- Registration Chairman for 1967 Regional Conference
- Member of Certification Committee (1969-72)

Council for Exceptional Children
- Member

CEC Division for Visually Handicapped: Partially Seeing and Blind
- Member
- Director
- Chairman of Membership Committee (1970-73)
- Treasurer (1973-)

Pennsylvania Division for Visually Handicapped
- Member of Inservice Planning Committee

Association for Development of Instructional Systems
- Member

Association for Special Education Technology
- Member

Phi Lambda Theta

HONORS

Received an Honor Grant for four years at The College of Wooster.
Received National Society for the Prevention of Blindness Grant for summer study at the University of Pittsburgh in 1962
Received National Society for the Prevention of Blindness Scholarship for an Advanced Institute at the University of Pittsburgh in 1964
Received Frick Scholarship for summer study and travel in 1963
Received Fellowships under PL 85-926 and PL 91-230 for Post-Master's study at the University of Pittsburgh during 1969-72.
Named an Outstanding Young Woman of America in 1971

FOREIGN TRAVEL

Summer 1966
- Norway, Denmark, Sweden, England, France, Iceland. Attended the Sorbonne for four weeks of French language study through Temple University

Summer 1967
- Society Islands, New Zealand, Australia, Fiji, American Samoa, Hawaii. Earned University of Hawaii credits for course entitled "Literature of the Pacific" given during a six week study/cruise.

PUBLICATIONS

Ward, Marjorie E. and Cartwright, G. P. *Some Contemporary Models for Curriculum Evaluation* Paper presented at Association for the Development of Instructional Systems, Quebec City, August 1972.

Ward, Marjorie E. and Peabody, Ralph L. *CARE 4 Handbook: Education of Visually Handicapped Children.* CAI Lab Report, The Pennsylvania State University, 1973.

Ward, Marjorie E. and Peabody, Ralph L. CARE 4 course documentation on computer tape. Computer Assisted Instruction Laboratory, The Pennsylvania State University, 1972

Ward, Marjorie E., Cartwright, G. P., and Cartwright, C. A. *Computer Assisted Remedial Education: Diagnostic Teaching of Preschool and Primary Children.* University Park, Pa.: The Pennsylvania State University, Report 54, 531 pages.