DOCUMENT RESUME

ED 053 548 EM 009 127

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TITLE	Annual Progress Report; January 1, 1970 through December 31, 1970.
INSTITUTION	Florida State Univ., Tallahassee. Computer-Assisted Instruction Center.
SPONS AGENCY	Office of Naval Research, Washington, D.C.
PUB DATE	31 Mar 71
NOTE	42p.
EDRS PRICE	EDRS Price MF-$0.65 HC-$3.29
DESCRIPTORS	Abstracts, Anxiety, Automatic Indexing, *Computer Assisted Instruction, *Computer Oriented Programs, Curriculum Development, Educational Psychology, Intermode Differences, Learning Processes, Learning Theories, Programing Languages, *Research Projects, Special Education, Teacher Education, Teaching Models

ABSTRACT

Research and development activities of the Computer-Assisted Instruction (CAI) Center at Florida State University during 1970 are summarized. The Office of Naval Research sponsored research in four areas: learner strategies, training strategies, validation strategies, and computer strategies. Topics subsumed under learner strategies include the effects of task variables such as rules, adaptive processes, the methodology of sequential testing to analyze behavior processes, and subjective organization factors in CAI learning. For each of the four strategies a rationale and direction for study are presented. Twenty-nine abstracts of publications in these areas are included. The center's progress in developing (1) a computer-managed instruction (CMI) program in special education; (2) a new elementary teacher training model, and (3) a program in graduate training in education is reported. Other activities described are a CMI course in educational psychology, CAI problem set activities in chemistry and physics, and the CMI approach to theories of learning. (JK)

ED053548

CAI CENTER

ANNUAL PROGRESS REPORT

January 1, 1970 through December 31, 1970

PREPARED BY:

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FLORIDA STATE UNIVERSITY

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TABLE OF CONTENTS

I. INTRODUCTION

This document concisely describes the research and development activities of the Computer-Assisted Instruction Center, Division of Instructional Research and Service, Florida State University. Basically, there is a bipartite division: a brief narrative indicating the nature and future directions of the various programs of research and abstracts of the studies performed and results accomplished during calendar year, 1970. These abstracts furnish a summary of our CAI/CMI research findings.

Discussion of activities is grouped according to the sponsoring agency: Office of Naval Research, Department of Health, Education and Welfare, and the Division of Instructional Research and Service of Florida State University. More specifically, the R & D activities sponsored by the Office of Naval Research are presented in terms of a brief rationale and direction for each investigatory theme. Subsequently, abstracts of the studies completed in 1970 are presented.

The activities sponsored by the U.S. Department of Health, Education and Welfare include our CAI investigation with Wakulla County under Title III, investigation of computer-managed instruction program in special education, a continuation of a new elementary teacher training model, and, finally, description of our USOE-sponsored Graduate Training Program. The DIRS activities include a description of the CMI course in educational psychology, the CAI problem set activities in chemistry and physics, and the CMI approach to theories of learning.

The report concludes with a description of the personnel and equipment found in the CAI Center. The appendices include a list of all publications, demonstrations for visitors, and project status reports.

II. OFFICE OF NAVAL RESEARCH

Continuing its activities founded by a university excellence award by the Office of Naval Research, Department of Defense in 1968, the FSU CAI Center is proceeding simultaneously in four interrelated research and development areas: learner strategies, training strategies, validation strategies, and computer systems strategies.

A. Learner Strategies

The consideration of learner strategies within the CAI context centrally attempts to specify trainee characteristics, especially in light of those active information manipulation processes which the trainee brings to an instructional event. Research is in progress on several topics. One topic is the investigation of the effects of task variables, such as rules, behavioral objectives, and criterion-test items, on learner strategies and on information organization. A second topic concerns adaptive processes, such as anxiety, as they provide indices for either facilitation of or inhibition of primary information storage and retrieval behaviors. A third topic treats the methodology of sequential testing as an attempt to analyze underlying behavioral processes and prior knowledge effects. In addition, the area of automated testing is being investigated to optimize reliability and validity in a testing situation. Further, the topic of CAI graphics concerns an investigation of the encodement, serial storage, and retrieval of graphic and pictorial information specifications. This is followed by the investigation of subjective organization factors in CAI learning.

1. **Effects of task variables on informational organization and learner strategies.** In considering the effect of task variables on learner strategies, it is assumed that the characteristics of a given instructional or training procedure place differential demands on the learner. Results of earlier studies have shown that task variables such as the availability of rules and/or objectives decrease the time and number of examples required to reach criterion performance and also reduce the dependency of performance on reasoning ability. In addition to replicating earlier studies, two studies are being conducted to investigate the interactive effects of objectives and criterion-test items on state anxiety, latency, and posttest performance. Three further studies are being conducted to elucidate the effects of rules and objectives on the learning process. These studies involve (1) effects of objectives on the learning of incidental materials, (2) effects of objectives on transfer concepts and their retrieval, and (3) relationships between the difficulty of rules and the number of examples required under differential CAI treatments.

2. **Adaptive behaviors and anxiety processes.** The purpose of the anxiety research is to investigate the facilitative or dehabilitative effect of anxiety on performance. The importance of extending research in these directions relates to the need for testing both drive theory and trait-state anxiety theory as theoretical explanations for a wide range of behaviors exhibited in training settings, inasmuch as these theories can suggest techniques to facilitate CAI training. That is, anxiety can be utilized within composite index of mastery plus an aid in the optimization process.

Although supportive of trait-state anxiety theory, results to date indicate that substantial modifications in drive theory are needed. A year's work on the "optimization of computer-assisted instruction performance by varying anxiety levels" is being analyzed and documented.

3. **Sequential testing models.** The general goal of sequential testing is to present the smallest number of test items necessary to accurately classify an examinee into two or more exclusive groups or in conceptual terms, to improve reliability and validity of or the decision process within CAI testing. The number of items presented to an examinee is determined on the basis of a mathematical or decision model similar to those used in quality control plans for acceptance inspection. Utilizing the sequential procedure, a test item is presented to the examinee, and his binary-coded response is employed in the classification model. An attempt is made by the model to classify the examinee within certain preselected risk of misclassification values. Should a classification be impossible following the first item, a second item is given, and so on until a classification is made. Typically, very bright or very dull examinees require few items for classification.

Previous computer-based sequential testing models have been based upon right-wrong measures of performance. The present sequential testing effort differs from previous models in that both invariate and multivariate performance measures are utilized. The Florida Twelfth Grade Test is being employed in the present development of a multivariate model which will utilize item response latency and subjective probability estimates in addition to simple right-wrong measures of item performance. The development of a data base on 58 FSU entering freshmen has been completed as the first phase of this activity. The data base consists of item score, subjective confidence estimates, and item latencies for each examinee on each of the 100 test items. Item

characteristics such as item total correlations and item difficulty parameters are also included in the data base.

A second phase of the effort currently underway consists of the development of a multivariate prediction model which will provide input to the sequential testing procedure. The multivariate prediction model is expected to increase classification accuracy beyond that possible using binary-coded item response data alone. A validation phase will follow plus investigation of the appropriateness of the validated multivariate sequential testing models for other psychological tests.

4. **Automated testing investigations.** Reliability and validity investigations within automated testing procedures have empirically demonstrated the feasibility of this technological approach and have paved the way for further research and development efforts. Presently, our programmatic research in automated testing involves both computer-based intelligence testing and computer-based personality evaluation.

Within the area of intelligence testing, we have developed and are evaluating an interactive computer-based administration and scoring program for the Slosson Intelligence Test. As a continuing part of this research, we are actively exploring the affective impact on trainees of this testing application in terms of attitude and anxiety measures. Future research endeavors will focus on the relation between the obtained IQ scores and multiple response measures such as number and variety of student answers, latency of responses, length of student answers, etc. Careful evaluation of these measures may provide valuable insight into individual student intellectual abilities.

The second thrust of our research in automated testing consists of investigating the feasibility of completely automating the Minnesota Multiphasic Personality Inventory (MMPI). These studies encompass test administration, test scoring, and test interpretation. In addition, the relationship of item response latencies to other MMPI characteristics are being investigated. Future research will focus on comparisons between a computer-administered versus a traditional administration of the MMPI. The affective consequences, as well as performance implications, of computer-based testing procedures are also being investigated within this context.

5. **Learner strategies for information processing of dynamic pictorial and graphic presentations via CAI.** Previously, a framework for understanding the process by which a student processes graphic and pictorial presentations has been approached through the syntactical aspects of dynamic graphic presentations. Our results indicate that the information processing can better be approached from an encoding point of view. Our present investigation concerns the recognition and recall of three classes of stimuli: pictorial (object figures), ideographic (road signs), and symbolic (special graphic characters). The culmination of one study should be a general model of graphic encoding, which will allow for better specification of the kind and sequence of graphics for realistic training materials. A second study focuses on primary and secondary emphasis techniques for the graphic presentations by use of flashing or dynamic CAI movement of a targeted graphic; findings, hopefully, will indicate the most effective manner for the utilization of CAI graphic presentations.

6. **Subjective organization as an individual difference variable.** Current research seeks to develop a refined measure of subjective organization and to employ this measure as a learner variable in an aptitude by treatment study. Data for the first

phase of this study have been collected and are currently being analyzed to develop a new measure of subjective organization. Since the data were collected on a CAI system, it is possible to use additional indices of organization not used by previous researchers, such as the latency factor. Clustering is being considered not only in terms of serial order but also in terms of temporal relationships.

The purpose of the first phase of this investigation is to determine whether subjective organization is a relatively stable individual difference variable. The second phase of the study will investigate the use of this variable in the learning of verbal CAI information.

B. **Training Strategies**

Training strategies represent the translation of the CAI research findings, especially from the learner strategy domain, into the design of viable training systems. The major goal of training strategies is the creation or identification of CAI training systems that result in superior learning outcomes, improved efficiency, and enhancement of performance; in short, the goal is the optimization of the instructional process. Thus, training strategies require the study of new techniques for design, development, implementation, and evaluation of complete computer-based courses of instruction.

Present activities include, first, study of alternative computer-managed instructional models, primarily in terms of the diagnostic prescription process; second, study of linear regression optimization models to discover optimal learning rates and new remedial or enrichment treatments; and third, study of learning games and computer simulation training models focused on multi-person interactions and feedback as they influence the decision process.

1. **Computer-managed instruction.** Our approach to CMI stresses the utilization of the interactive, realtime evaluation, and the branching capability of CAI. The successful implementation of two courses by computer-managed instruction at the FSU-CAI Center has demonstrated the feasibility and worth of this instructional technique, although, as is the case with any instructional innovation, many topics remain to be studied in depth. The optimal instructional strategies, the role of individual differences, and the generalizability across content areas are a few of the areas which require further study in relation to CMI. CMI is now being more fully investigated within the context of a graduate level course and an undergraduate course.

a. **Graduate level - CMI (EDR 537).** The development and evaluation of the graduate level computer-managed instruction course entitled, "Techniques of Programmed Instruction," was fully described in the previous report. The purpose of this course is to teach students the concepts and techniques involved in systems processes and programmed instruction, and to guide students as they use these techniques to develop and document a short programmed instruction text. The course has undergone considerable refinement based on performance and feedback from students enrolled in the course during the Fall, 1970, Quarter. Several references have been updated, ambiguous test items replaced, and review items have been placed at the end of the cognitive section. This course has not only served as a valuable vehicle for investigating computer-managed instruction, but also serves as a vehicle for investigating instructional variables. The effects of the availability of objectives on computer-managed learning performance will be investigated during the Spring, 1971, Quarter.

b. **Undergraduate level CMI.** In an undergraduate health education course with an enrollment of approximately 150 students each term, there is an ample subject pool for programmatic investigations of optimal training strategies within CMI. As a global objective, we are committed to the exploration of those CMI techniques which take advantage of the full range of capabilities afforded by a terminal-oriented instructional system enhancing performance. Implicit in this global goal is the assumption that learner strategies and individual difference variables will quite likely dictate not one but many CMI strategies, resulting in a truly optimal and individualized instructional approach.

In the Fall of 1970, this health education course served as a vehicle for an investigation concerning the effects of selected instructional strategies on student confidence, study time, terminal time, studying strategies, attitudes, and performance. The major experimental variation was the criteria upon which remediation or success within a module of instruction was assessed and prescribed. Three instructional strategies were chosen for investigation. First, in a treatment entitled "Remedial Prescription-Forced Mastery," students who failed to reach criterion (defined as 80% correct on a module posttest) were given online remedial prescription materials and were required to retake the module test until they reached criterion performance before progressing further in the course. In a second condition, "Remedial Prescription-Forced Progression," students who failed to reach criterion were given remedial prescriptions, but were requested to select the next module posttest and proceed through the course without retesting. In a third treatment, "Forced Progression," students were not required to reach criterion nor were they provided the remedial prescriptions. In addition to these three CMI treatments, a pseudo control group of students received instruction by the traditional classroom lecture.

On the basis of this first field testing, results of the investigation described above suggested that: (a) the CMI students performed significantly better than the classroom instruction group on the final examination; (b) the Remedial Prescription-Forced Mastery group performed slightly better than the Forced Progression group on this same instrument; and (c) that the CMI methodology was as effective in promoting positive attitudes toward the course content as was the classroom instructor.

This investigation represents the first effort in a series of programmatic studies in optimal course revision strategies and alternative prescriptive-remediation techniques within the CMI paradigm.

For the second administration of the health education course, the course was revised on the basis of student comments and student performance. The goal of the revision was improved student performance as measured by the criterion test. The amount of material was reduced by about one-third to equate it with the volume of work required for other three hour courses. A condition similar to the Forced Prescription-Forced Progression was used for all students. However, a student could repeat a module test if he wished. In addition to on-line prescriptions, a more detailed off-line prescription was given to each student who did not reach criterion on an objective.

In contrast to the earlier quarter, the conventional lecture sections received the same Student Guide as the CMI group, containing the objectives, sample test items, and assignments. The conventional students had three lecture sessions a week and were given two exams during the quarter. Questions were drawn from the CMI item pool,

and each exam covered half of the course content. CMI students significantly outperformed conventional students on the module tests and on the final exam.

c. **Future plans for undergraduate level CMI.** In the third administration of the Health Education course, the effects of reviews and student pacing will be investigated. The reviews in the experimental procedures will be presented on-line at predetermined points in the course. One group will be presented with reviews spaced evenly throughout the course; a second group will receive the same review material massed early in the course; and a third group will go through the same review materials in one massed review session at the end of the course. Within each of these groups, reviews will either be multiple-choice questions or short paragraphs which match the questions in content.

Although the placement of reviews within the course structure will be controlled, the actual timing of the reviews depends upon the rate at which each student proceeds through the course. For example, the reviews for a student who completes all coursework in the last week of the quarter will tend to be massed no matter what group he is in. Therefore, a pacing index will be developed which will permit the investigation of the effect of student pacing on acquisition performance and review effects.

2. **Optimization of the learning process: A linear regression approach.** Within the instructional process interventions for the purpose of detection and remediation of learning difficulties has in the past been largely an intuitive process which, in most cases, failed to take into account the accumulative data base being developed as the learner proceeded through the program. By using an optimization strategy based on a linear regression model (in which predicated "end of program" performance was the determiner of remediation), we have obtained results showing the superiority of an optimization condition over total remediation and no remediation conditions. The target level of performance for the optimization group was "at or above" the mean of the prior baseline group. The regression model was evaluated periodically for each student, and remediation was prescribed on the basis of empirically derived predictions of final criterion performance. If a student's predicted criterion performance fell below the previously established target level, remediation was provided.

The proposed continuation of this line of research centers around two optimization foci: (1) the specificity, type, and amount of remediation provided, and (2) the determination of optimal periodicity and placement of remediation.

3. **Learning games and simulations.** Learning simulations involve the use of time compression and decision techniques to provide students with an opportunity to learn and to play the role of significant participants. For example, a simulation of the role and decison-making aspects of a business executive through a 20-year time cycle, providing for inflation, depression, and normal business cycle, has been developed at the FSU-CAI Center. Additionally, there has been developed a social role simulation confronting the student with social/political problems that a career diplomat would face in eight different foreign countries, where his actions are simultaneously evaluated by the local government, his home government, his fellow statesmen, and officials of the U.N. Our investigations have shown that this sophisticated approach is highly motivating as well as an enriching preprofessional or professional instructional experience.

Learning games can be considered a variant of a learning simulation in that they represent a form of reality, but, on the other hand, involve competition between two

or more players. Our investigation of a social studies learning game, "IT," and a science education game, "Challenge," indicates that improved inquiry and explanatory behaviors can result from participation in these games. Thus, some higher order abstracting and problem-solving behaviors can be addressed via computer-based learning games.

Finally, current simulation investigations probe the role of formal models in concept acquisition. Using concepts from inferential statistics, we have provided students an opportunity to examine the characteristics of samples drawn from three statistical distributions. This investigation, STATSIM, has shown that complex abstract models can be meaningfully presented via computer simulation.

We now propose to develop a pollution simulation involving the social role and decision-making aspects of a scientist versus a politician, both presented with various case problems of and factors from air and water pollution. The purpose of the study is to investigate conflicting social role decision-making processes. We also propose to use the social studies case study game, "IT," as well as the science education game, "CHALLENGE," to investigate the possibility of forming explanatory behaviors on a minimum of two levels, studying the concepts of partial and complete explanation.

4. **A computer-based learning information retrieval system.** Attempting to determine how to teach students the use of on-line computer-searched coordinate indexes, tools they are likely to encounter in their professional careers, Dr. Gerald Jahoda of the School of Library Science at FSU has prepared a coordinate index on library automation, systems studies in libraries and indexing. The indexing, based on informative abstracts, averages ten or more descriptors per document and has elements of vocabulary control. The School of Library Science students participate in two phases of the project: (1) developing skill in use of information retrieval computer systems, and (2) testing searches of indexes with questions that resemble reference questions and literature searches.

In 1970, the data base for the index was expanded, the index vocabulary was revised, and several index products were prepared and the index was utilized in two School of Library Science classes, LIS 586 - Information Science and Libraries, and LIS 587 - Abstracting and Indexing.

The data base was expanded from 710 to 1856 documents, and a revised and enlarged index vocabulary, the subject authority list, was prepared. Index searching and index preparation exercises written in Coursewriter II were developed for student use. A printed coordinate index was generated from the machine record.

The index has been used both as a teaching aid and as a data collection device in the two graduate courses. LIS 586 students were given a demonstration of the on-line searched coordinate index, and they also used the index in the selection to topics and references for term papers. LIS 587 students used the index as a device for learning how to prepare and search coordinate indexes, and to evaluate the search results obtained from an index in terms of recall, precision and reasons for search failures. Two other uses of the index should be mentioned. The index was made available to all students in the School of Library Science and about twenty searches were conducted as a result. Also, one of the doctoral students in the School is now using the index in a comparison test of classroom lecture vs. multi-media methods for teaching the introductory section on indexing in LIS 586.

Programmed learning will be used in the Spring of 1971 for teaching coordinate indexing and this technique will be evaluated via pre-post tests. Continued use will be made of the on-line searched index by the School of Library Science classes.

C. **Validation Strategies**

CAI represents a major technological systems approach to training which has far reaching implications for the human-oriented training systems that presently exist in the military. The sociological issues seem to reside in the numerous functions possible for the military instructor role. Using social role theory and associated organizational climate concepts, the functional roles of leadership, monitoring, evaluating, and managing are in need of study in relation to CAI/CMI approaches. Cost factors for these roles and their possible shift remain one of the great unexplored domains in the CAI/CMI applications. Thus, validation strategies are mechanisms by which social role and economic factors can be related to the study of the effectiveness of the CAI/CMI models within existing military systems.

Project ENRICH. ENRICH (Experimental Naval Reserve Instruction with Computer Help) has functioned as a multi-disciplinary team of active Naval Reservists who are associated with FSU. Recognizing the need to improve the moment-to-moment management of the training process and to enhance the motivation and commitment of the trainee, ENRICH has evaluated the feasibility and validity of a CMI model for Seamen recruits. Now being documented, this feasibility study with its associated CMI model showed highly promising findings (i.e., improved performance and motivation as well as significant decreases in training time).

We propose to extend the investigation of the sociological implications of this approach through a CMI implementation for the Naval Reserve Program. The primary focus will be on the role of the junior officer under this new CMI model. More specifically, the emerging functions of junior officers as training agents will be analyzed in terms of: (1) leadership, (2) monitoring, (3) evaluation, and (4) managerial functions. Each of these roles will be interpreted within the improved organizational climate resulting from the CMI implementation model.

D. **Computer Systems Strategies**

The recent availability of small, inexpensive, and fast mini-computers has opened the possibility of significantly reducing the equipment cost factor which has always constrained the field of CAI. Additionally, small surplus military computers have become available in large numbers, which will, with the development of operating systems, perform in the CAI/CMI mode. The purpose of the computer systems strategies is to design, program, and implement an inexpensive but effective CAI/CMI system for this class of computer.

1. **D-17 Minuteman I computer.** Engineering phases of the D-17 CAI computer are being completed with the goal of providing this equipment conversion at less than $5000. Since an excess of 2500 of these D-17 computers will be made available by 1975 from DOD surplus, this very small CAI system should allow for a broad dissemination of CAI activity.

In developing the CAI operating system, we include (1) an author language, (2) trainee interactive language, (3) simple data recording language, and (4) operations manual. Our plan for design, implementation, and documentation of a CAI systems language will allow for utilization of the D-17 for training and psychological testing.

2. **Inexpensive 64-terminal CAI system**. Parallel to the development of minicomputers for CAI, we are planning, designing, and specifying the developmental process for a 64-terminal CAI system that should cost less than $200,000. Our goal is to offer a feasibility plan by which CAI instructional cost can be reduced to below 30 cents per terminal hour.

E. **Abstracts of Studies**

Twenty-nine publications were issued from the CAI Center during the year, including technical reports, technical memos, and systems memos. (See Appendix A for complete listings of Center publications.) Each of the publications is largely devoted to one of the four major component areas as described in the preceding section: learner strategies, training strategies, validation strategies, and computer systems strategies. In order to give brief overviews of each study, summary abstracts are presented here, categorized by component area.

1. **Learner Strategies**

a. "Effects of Stress on State Anxiety and Performance in Computer-Assisted Learning," Harold F. O'Neil, Technical Report 6, Florida State University, January 1, 1970.

This study tested hypotheses about the effects of anxiety on learning derived from Spence-Taylor Drive Theory and Spielberger's Trait-State Anxiety Theory. The effects of stress on state anxiety (A-State) and on performance in a computer-assisted learning task were investigated for female introductory college students who differed in anxiety proneness (A-Trait). The Ss were selected on the basis of extreme scores on the A-Trait scale of the State-Trait Anxiety Inventory (Spielberger, et al., 1970).

Stress was induced by feedback concerning performance on a mathematical learning task which was presented by an IBM 1500 CAI system. In the stress condition, Ss received negative feedback about performance. The Ss in the nonstress condition were given a brief rest period in place of the negative feedback.

High A-Trait (HA) Ss in the stress condition showed a significantly greater initial increase in A-State from pretask levels than did the low A-Trait (LA) Ss. During the learning task, HA Ss in the stress condition showed a marked decline in A-State, whereas level of A-State remained relatively constant for LA Ss. In the nonstress condition, the changes in A-State for HA and LA Ss were quite similar. Both groups showed almost the same increase in A-State from pretask levels and approximately parallel changes in the level of A-State during the learning task.

There was no relationship between A-Trait and errors on the CAI learning task. In contrast, Ss with high levels of A-State made more errors than low A-State Ss through the learning task. The differences in the performance of high A-State and low A-State Ss were significant on the easier sections of the CAI task, but not for the most difficult part of the task. These relationships between A-State and errors differed from previous research (O'Neil, Hansen, & Spielberger, 1969).

The findings were consistent with predictions derived from Trait-State Anxiety Theory, but not with derivations from Drive Theory. The failure to find empirical support for Drive Theory was attributed to differences in the male-female motivational structures which affect the relationship of Drive (A-State) and performance.

b. "The Effects of Anxiety on Computer-Assisted Learning," Charles D. Spielberger, Technical Report 7, Florida State University, June 15, 1970.

In this report the nature of anxiety is considered in historical perspective, and the concepts of trait and state anxiety are discussed. Methods for measuring these constructs are also described. In addition, hypotheses about the effects of anxiety on learning were formulated in terms of Spence-Taylor Drive Theory and Spielberger's Trait-State Anxiety Theory, and tested in two experiments on the effects of anxiety on computer-assisted learning. It was found in these studies that state anxiety was a better predictor of performance than trait anxiety, and that performance was an interactive function of A-state and of task difficulty. Some important implications for the classroom teacher of research on anxiety and learning are discussed.

c. "Anxiety, Drive Theory, and Computer-Assisted Learning," Charles D. Speilberger, Harold F. O'Neil, Jr., and Duncan N. Hansen, Technical Report 14, Florida State University, September 15, 1970.

The effects of anxiety on computer-assisted learning were investigated in four studies in which high school and college Ss were presented with science and mathematics materials by an IBM 1500 CAI system. The findings are discussed in terms of their implications for Spence-Taylor Drive Theory and Spielberger's Trait-State Anxiety Theory.

d. "The Primacy Effect of Single-Trial Free Recall," Darryl Bruce and James P. Papay, Technical Memo 19, Florida State University, July 30, 1970.

In three experiments using a single-trial free-recall procedure, Ss were presented a forget cue during a list, meaning that they were not responsible for recalling any of the words which preceded it, only those which followed it. Since the primacy effect over the functional beginning of such lists was not diminished, the proactive inhibition (PI) hypothesis was rejected. The primacy effect may be due to initial list members being relatively free of PI, spending longer time in a limited-capacity rehearsal buffer, or association with stronger retrieval cues. Tests of memory showed consistently depressed retention of items immediately preceding a forget cue. This result was considered to be more in harmony with a rehearsal buffer notion than a stronger-retrieval-cues position.

e. "Effects of Memory Support on State Anxiety and Performance in Computer-Assisted Learning," Barbara L. Leherissey, Harold F. O'Neil, Jr., Duncan N. Hansen, Technical Memo 20, Florida State University, July 15, 2970.

The hypothesis that memory support (MS) reduces state anxiety (A-State) and errors in a computer-assisted learning task was investigated. It was predicted that high A-State students given MS would make fewer errors than high A-State students who were given no memory support (NMS). Low A-State students were expected to perform equally as well with or without MS. Sixty male undergraduates were randomly assigned to MS or NMS conditions. All students received the same learning materials. The MS group was allowed to see their previous incorrect responses to each problem before attempting it again, whereas this information was not available to the NMS group. There were no significant effects of memory support on A-State as measured by the State-Trait Anxiety Inventory. However, the predicted memory support by A-State interaction was found for errors. These findings were compared with the results of previous research on anxiety and memory support.

f. "A Comparison of the Effects of Information Mapped Learning Materials and Traditional Materials on the Learning of Concepts via the Printed Page and Computer Cathode Ray Tube," Paul Geisert, Technical Report 24, Florida State University, October 30, 1970.

The effects of information mapping and information mapped feedback on achievement, time variables, and attitude were investigated in a study utilizing the printed page and computer-assisted instruction. A systems approach was used to develop a set of hierarchically arranged learning materials. Forty-four members of the Army National Guard of Tallahassee served as subjects to compare information mapped materials with traditional materials. No significant differences were found in the comparison of 15 dependent variables. Significant differences were demonstrated for all attitudes toward the materials, with Ss showing more positive attitudes toward information mapped materials than traditional materials. A trend in performance and time variables suggested that information mapped feedback treatment resulted in better performance.

2. **Training Strategies**

a. "Empirical Development of a Computer-Managed Instruction System for the Florida State University Model for the Preparation of Elementary School Teachers," Edward N. Hobson, Technical Report 8, Florida State University, April 2, 1970.

The study involved the design, development, and prototype implementation of a computerized management system as a subcomponent of the Florida State University proposed model for training elementary teachers. The problems examined during this investigation consisted of the development of a data acquisition and instructional system to (1) collect reliable data to assess the management system's actual performance and its acceptability by the trainees, (2) manage a variety of available resources, (3) schedule trainees' activities, and (4) monitor each trainee's progress.

Nineteen elementary education students participated in a three-week field trial of an individualized instructional curriculum similar to that proposed for the operational model program. Their activities included the selection of tasks and resource options, the teaching of concepts to local school children, the taking of quizzes both manually and via a teletype terminal, and the entering of data associated with all these activities at an on-line teletype terminal.

The on-line data-collection system consisted of a KSR-35 teletype terminal connected to an IBM 1500 computer which was located about one-fourth of a mile away. This data acquisition system was utilized to collect thousands of individual data elements, some of which were data on the trainees' progress while others were trainees' individual responses to computer-administered tests and questionnaires. During the field trial, it was found that non-computer oriented trainees could enter quality data with a minimum amount of preparatory training.

The following generalizations, based on empirical data from computer records and quiz and questionnaire responses, may be made: (1) a computer-managed instruction system is technically feasible for use with approximately 1,000 trainees, (2) the volume of data expected to be generated by the model requires computer processing for trainee scheduling and testing as well as overall program management, (3) projections of student loads and operational components for the computer system have been redefined, and (4) technical problems associated with the development and implementation of an on-line data acquisition and computer management system appear to be minimal. Based upon the successful implementation of the prototype model and the data collected in that effort, hardware, software, and personnel requirements of the projected operational

model are made with their respective costs. Further, the management system's interface with the total university information system is discussed.

b. "Development and Implementation of a Computer-Managed Instruction System in Graduate Training," Nancy K. Hagerty, Technical Report 11, Florida State University, June 30, 1970.

The primary objective of this study was to test the feasibility of developing and implementing a graduate level course by computer-managed instruction (CMI). Various approaches to both the management and the individualization of instruction were studied. The instructional logic included a motivational game in which the student bid points on his estimate of how well he could perform on a unit test. The results indicated that the CMI students performed as well as students taught the previous year by conventional class-lecture methods. The group of students who chose their own sequence tended to perform better than the set-sequenced group on the midterm test and final product evaluation. They also had higher attitude scores toward CMI and took less time on the terminal. However, none of these differences was statistically significant.

Developmental costs included acquisition of references and instructional materials, and development and implementation of the CMI logic. This cost was lower than the costs of a comparable traditionally taught class.

c. "An Investigation of Instructional Treatments and Learner Characteristics in a Computer-Managed Instruction Course," Paul Gallagher, Technical Report 12, Florida State University, July 30, 1970.

The primary objectives of this investigation were to answer a number of important questions regarding instructional treatments and learner characteristics in a computer-managed instruction learning environment. An evaluation was conducted in order to ascertain which of four instructional treatments produced the most efficient and effective learning. The treatments varied in terms of sequence of tasks and type of evaluation of instructional materials developed by the students in the course. Sequencing was either student-selected or computer-assigned, while evaluation was conducted by an instructor or by means of a student-computer interaction. Analyses were conducted in order to identify and isolate specific student attitudes, personality characteristics, and background information which was related to course success.

There were no differences among the four instructional treatments on any of the four dependent measures: (1) midterm score, (2) final product score, (3) time to complete the course, and (4) system time. Further analysis indicated that there was a relationship between specific learner characteristics and course success. The students most successful in the course indicated that they liked to be active in the learning situation, admitted to few feelings of anxiety, and expressed positive attitudes toward CMI. Furthermore, a relationship between on-task anxiety state and performance on task quizzes was found.

d. "An Investigation of the Relative Effectiveness of Two Methods of Instruction, Including Computer-Assisted Instruction, as Techniques for Changing Parental Attitudes of Negro Adults," Francis W. Scanland, Technical Report 13, Florida State University, July 15, 1970.

An investigation was designed to probe the possibilities of applying computer-assisted instruction to the task of changing attitudes of Negro parents toward the value of education for their children. The expectation was that more positive

attitudes would aid in solving the social problem of low educational achievement of Negroes in the South. A program of instruction was written, and, after translation into Coursewriter I computer language, entered in an IBM 1440 computer. A remote terminal located in a rural school was used by the subjects, all Negro parents of school children. Concurrently the same material was given to a similar group by lecture/discussion method, and there was a third group which received no instruction. All subjects were administered pre- and posttests designed to measure attitudes toward education and related matters, as well as an achievement test following the instruction phase.

The tests indicated that the subjects' attitudes were changed significantly and positively by the CAI, but were not changed significantly by the lecture/discussion instruction. The conclusion was drawn that computer-assisted instruction is a technique with high potential for application to adult education. Continued investigation in this area is indicated.

e. "The Development and Implementation of a Model for the Design of Individualized Instruction at the University Level," James G. Lipe, Technical Report 15, Florida State University, October 29, 1970.

This study involved the development and implementation of the Production, Implementation, Evaluation, and Revision of Instructional Modules (PIERIM) model for the design of individualized instruction. PIERIM is designed as an interactive model with activities explicitly prescribed for the instructor and the educational technologist. PIERIM'S purpose is to provide a means by which the content of existing teacher training programs can be transformed into a format (i.e., the instructional modules) which is compatible with an individualized teacher training program.

Based on experience gained through implementation of the model, the activities were evaluated and PIERIM (second edition) represents an operational definition of the job descriptions for the instructor and educational technologist. The major identified weakness of a set of instructional modules produced by the PIERIM model remains: the relevance of the set of instructional modules, when compared to a specific teacher competency, cannot exceed the relevance of the subject matter from which the modules were derived.

f. "A Study of the Cognitive and Affective Outcomes of a Collegiate Science Learning Game," William L. Harvey, Technical Report 17, Florida State University, November 15, 1970.

The objective of this study was to determine the effect of playing a science education game on the cognitive and affective processes of black graduate students at Florida A and M University. The effects measured were changes in attitude toward science, general confidence in mastery of science, general achievement in science, and mastery of specific scientific concepts. The usefulness of background and personality variables in predicting success in the two treatments was also investigated. The results suggest that a learning game of this type may be an effective agent in providing a learning environment that fosters growth in both the cognitive and affective domains.

g. "The Behavior of Teachers Involved in Two Simulated Inquiry Environments: A Social Simulation Game and a CAI Based Information Retrieval System," Charles Adair, Duncan Hansen, Gail Rayner, and Adesh Agarwal, Technical Memo 16, Florida State University, May 30, 1970.

Building upon the earlier collection of 5312 social science generalizations and the development of a taxonomic retrieval system, this study has implemented the

Information Retrieval (IR) system within a 1500 CAI system, developed a social simulation game, constructed an attitude scale to appraise three affective factors within the game and IR learning tasks, and studied teachers' inquiry behavior. An experiment was designed and executed within the game and IR system to further examine the outcomes of the attitude scale and to examine human inquiry behavior more closely. The results indicated that primarily the IR system experience leads to improved inquiry behaviors. The feasibility and the associated positive reaction of students to both the game and the IR system were established. A discussion of factors to be considered for further study was presented.

h. "Computer-Assisted Instruction in Engineering Dynamics," John W. Sheldon, Technical Memo 18, Florida State University, May 30, 1970.

The Florida State University School of Engineering Science, in cooperation with the Computer-Assisted Instruction Center, has provided 29 undergraduate students with a ninety-minute CAI unit course, supplemented by a one-hour class lecture, on the dynamic nature of three dimensional rotations and Euler angles. The area of Euler angles was selected because, despite its essentiality in problem working in three-dimensional rotations of a rigid body, it has been a stumbling block to students in dynamics. Euler angles are difficult to visualize and have mathematical properties which are unfamiliar to most undergraduates. Utilizing graphic presentations and branching capabilities of CAI to combat these learning difficulties, the CAI program contained three problems in ascending order of difficulty, designed to link the physical geometry of the problem situation with the vector equation derived in class lecture. Although the final problem was typical of previous homework problems, students indicated that they did not consider the questions difficult. In addition, students indicated that they considered the CAI program an interesting and effective teaching aid which they would like to see further utilized.

i. "The Development of an On-line Searched Coordinate Index for Use in Teaching and Research," G. Jahoda and Ferol A. Foos, Technical Memo 22, September 30, 1970.

A model was developed for teaching coordinate index searching and preparation as well as for determining the effect of index and question variables on index performance. In this model, coordinate index searching and preparation are considered as a series of decision-making steps. A coordinate index was prepared to 710 documents on library automation, library systems studies, and indexing. The coordinate index has elements of vocabulary control but does not use roles, links, or weighting of index terms. Coordinate index searching and preparation were taught to library school students using classroom instruction, computer-aided instruction and on-line searching of test questions.

j. "Conference on Computers in Undergraduate Science Education: A Computer-Assisted and Managed Course in Physical Sciences," O. M. Kromhout, D. N. Hansen, and G. Schwarz, Technical Memo 23, Florida State University, September 30, 1970.

Computer-based approaches to physics instruction have been explored at a number of research and development centers throughout the world. This presentation briefly reviews the Florida State University efforts in this area, with emphasis on the development of an autonomous multi-media computer-assisted instruction (CAI) general

education physics course. Based on a one-term conventional lecture course which has been given successfully at FSU for several years, the CAI course made use of an IBM 1500 Instructional System to guide the student through a self-paced program of textbook reading assignments, audiotaped lectures, PSSC movies, and cartridged films of demonstration experiments. The student had to pass a diagnostic quiz administered by the computer on the reading assignment before beginning each lesson. At the end of each unit, he was questioned by the computer on the main points of the lesson before proceeding to the next unit.

Propositions relating the critical factors in developing computer-based physics tutorial material are reviewed in this memo, and recent tutorial approaches at FSU to simulating physics laboratory instruction are described. The paper concludes with a description of how computer-managed instruction (CMI) with embedded computer-assisted instruction (CAI) provides for a very cost-effective approach in this area.

k. "Multi-Media Simulation of Laboratory Experiments in a Basic Physics Lesson on Magnetism," Darol Graham, Technical Memo 25, Florida State University, November 1, 1970.

Laboratory and simulated laboratory experiences were developed and integrated with a CAI physics lesson on magnetism. The relative effectiveness of actual and simulated concrete referents as an aid to learning abstract concepts and principles was investigated for college students in a basic physics course. No differences were detected between the two conditions with respect to posttest performance or total instructional time. A post hoc analysis of learning by objective was conducted to determine the existence of transfer effects in accordance with a predicted hierarchy of conceptual development. Although inconclusive, the evidence appeared indicative of positive transfer in the predicted manner, and suggested resequencing of the lesson as an initial step toward optimal learning.

3. **Validation Strategies**

a. "Information Structure in Military History: An Application of Computer-Assisted Instruction," Richard Lee, Technical Memo 14, Florida State University, March 30, 1970.

This report analyzes the course content of Army ROTC Military History, and reports the results on an experimental investigation into the psychological interdependencies among different levels of information. The study also reports two methods of computer-assisted instruction used to teach the principles of war. No differences in criterial behavior were found between two methods of principle learning. No relationship was found between the **S**'s mastery of historical detail and the ability to apply the principles of war to accounts of specific battles. On the other hand, methodological approaches to the utilization of CAI for studying inference making were developed.

b. "Project ENRICH Report," prepared by William Maloy, Charles Spielberger, Richard Dunham, and Mark Levin.

This report describes Project ENRICH, which tested the concept that Naval reservists with scientific and technical skills could make unique and significant contributions in support of Naval Reserve programs. Since November, 1968, ENRICH personnel have conducted projects concerned with the evaluation of FITS packages,

the development of computer-supported cadre-training programs, and the development and evaluation of a computer-managed curriculum for the training of seaman recruits. This latter project is described in detail in this report. It involved a collaborative effort with the Naval Reserve Training Facility, Tallahassee, Florida, NRSD, 6-37S, and the Computer-Assisted Instruction Center of Florida State University. Two groups of SRs trained by computer-managed instruction (CMI) took less time to proceed through the curriculum and to advance to SA than is typically the case in Naval Reserve Training Centers. Moreover, the second group of ENRICH trainees made higher scores on the advancement examination than a control group of SRs trained at NRTF, Tallahassee, during previous years. The CMI approach proved most beneficial for trainees with low ability as measured by the Navy standard classification test battery. Interviews with trainees conducted after the conclusion of the CMI program indicated that they spent more time in preparation for each drill (lesson) and that they preferred the CMI approach to the traditional lecture method.

4. **Computer Systems Strategies**

a. "Existing CAI Curriculum Materials at the FSU-CAI Center," Duncan N. Hansen, Betty J. Wright, Barbara Johnson, Technical Memo 13, Florida State University, June 30, 1970.

Over 100 different sets of CAI learning materials developed at the Florida State University CAI Center are briefly described. These CAI materials are listed and annotated in order that other investigators may save time and energy by utilizing the materials as a starting point for their own research and development efforts.

b. "The Role of Computers in Education During the '70's," Duncan N. Hansen, Technical Memo 15, Florida State University, May 15, 1970.

The concept of an information management system is presented in order that the major educational functions can be conceptionally and operationally integrated within one computer center during the seventies. These major informational functions include: (1) information retrieval of administrative data, (2) scientific computing, and (3) computer supported instruction via computer-managed instruction, computer-assisted instruction, and learning simulation. The primary need for more sophisticated training of professional staff and support for a personnel within educational institutions is discussed in great detail. The paper concludes with an economic analysis of some of the computer alternatives opened for support of instruction.

c. "Current Research Development in Computer-Assisted Instruction," Duncan N. Hansen, Technical Memo 17, Florida State University, February 15, 1970.

Computer-Assisted Instruction (CAI) is surveyed in terms of both the extent of research progress as well as the degree of utilization for this new technological approach to education. After a brief review of some of the critical terminology used to describe research progress within CAI, the paper develops a conceptual framework by which to consider current investigative efforts. The first section deals with the psychological nature of the CAI situation. The second introduces concepts of CAI provision for individualization of instruction. Third is an introduction of the procedures and research findings for the use of instructional strategies. The paper concludes with a discussion of learner strategies and their growing importance within CAI in learning investigations.

d. "Documentation for the Edit and Data Preparation Programs," Harold F. O'Neil, Jr., Duncan N. Hansen, Bruce Freed, Eugene Wester, George W.

Hogshead, III, and Wilburn Robinson, Systems Memo 1, Florida State University, June 15, 1970.

This document has been prepared for the prospective users of two additions to the Data Management System of the Florida State University Computer-Assisted Instruction (CAI) Center. These two additions are the Edit Program and the Data Preparation Program. It is assumed that the user has an operational Florida State University Data Management System (DMS) for the IBM 1500/1800 system. The manual is divided into two sections, a users' manual and a programmers' manual. Examples of output generated by authors of CAI materials are included. However, the output of these programs is still raw data. A statistical system is needed to make descriptive or inferential statements about the data. These extensions of the DMS hopefully will insure greater reliability, be user-oriented and offer more flexibility of output for CAI data than the existing set of Florida State University CAI programs.

e. "Supplementary Documentation of Coursewriter II Functions," Harold F. O'Neil, Jr., Sharon Papay, and Duncan N. Hansen, Systems Memo 2, Florida State University, June 30, 1970.

Various IBM 1500 users' functions were examined and rewritten to clarify for the uninitiated the functions' operations and applications. The functions most frequently used at the Florida State University's CAI Center were selected for the revised documentation. The documentation for each function was divided into six parts: (1) the purpose, (2) the description, (3) the example(s), (4) the format, (5) the diagnostic message, and (6) the author of the function. The revised document served as an instructional aid to trainees and others in Computer-Assisted Instruction at the Florida State CAI Center. Their reflections and opinions served as a guide for further revisions. It is felt that this document may further serve other users of the IBM 1500 system. If this proves to be the case, further functions will be added to this document in the future.

f. "Manual of APL/1500 Functions," Henry T. Lippert, Edward V. Harris, David B. Thomas, Thomas D. McMurchie, Systems Memo 3, Florida State University, June 15, 1970.

This manual of APL functions contains an organizational taxonomy for the manual, the identification scheme for individual functions, and instructions for use of the directory on the Florida State University APL 1500 system. The functions are listed in five categories: programming aids, statistical analysis, character handling, numerical, and graphics. A total of forty-four functions are documented and listed.

g. "APL: An Alternative to the Multi-Language Environment for Education," Henry T. Lippert and Edward V. Harris, Systems Memo 4, Florida State University, August 15, 1970.

The diverse requirements for computing facilities in education place heavy demands upon available resources. Multiple or very large computers can supply such diverse needs, but this is not a possible solution for many institutions because of cost factors. Small computers which serve a few specific needs may be an economical answer. However, to follow this second approach in an attempt to serve operationally a significant segment of students, the multiplicity of computer installations with their operations staffing requirements will probably prove to be a false economy. A programming language, or "APL" as it is commonly known, is examined as an alternative to the dilemma facing

the computing center director. The elegance, simplicity, and power of APL is illustrated by examples in the areas of instruction, computer science, and data processing. The fact that all of these types of applications are available simultaneously under the APL system makes it an attractive alternative that must be considered when planning for computer systems in education.

h. "Teleprocessing: A DEC 680 Interfaced to an IBM 1500," Bruce H. Freed, Harold F. O'Neil, Jr., Lloyd Lauffer, and Robert Lushene, Systems Memo 5, Florida State University, June 15, 1970.

At the Florida State University Computer-Assisted Instruction Center, we felt a need to add a teleprocessing capability to an IBM 1500 system. Since there was no cost effective way to attach remote terminals within the current framework of the IBM hardware, a DEC 680 communication system served as a basis for a uniquely designed hardware and software system for teleprocessing with the 1500 system. An efficient system has been in operation since March, 1969, with no hardware or software failures.

i. "Human-Computer Interactions Involved in Analysis of CAI Data," Duncan N. Hansen, James Papay, Harold F. O'Neil, Jr., and Dave Danner, Systems Memo 6, Florida State University, June 30, 1970.

The world of Computer-Assisted Instruction (CAI) involves a set of complex multi-role human computer interactions. One important aspect of this human computer interaction concerns the analysis of response data for scientific or instructional purposes. This paper describes the human computer operational interactions that the personnel at the Florida State University CAI Center have found necessary to efficiently analyze CAI data. The roles of critical personnel and processes that are allowed for implementation of a data anlaysis request are specified in detail, as we believe these roles can be generalized to any setting that allows for non-technical personnel to request data. This paper attempted to characterize how a data analysis request moves from initial verbal input request from a user to system personnel, through machine processing, and finally to some form of output to the user.

J. "A Programming Language/1500," Thomas D. McMurchie, Scott E. Krueger, and Henry T. Lippert, Systems Memo 8, Florida State University, November 30, 1970.

This document describes the implementation of APL (A Programming Language) for the IBM 1500 Instructional System. It is a revision of the original User's Guide supplied with the first release of the APL System for the 1500.

This revised document incorporates a number of extensions to the implementation of APL, particularly the inclusion of the light pen and file handling capabilities. The file items are variable-length, index sequential, randomly accessible, and can be any arbitrary APL array (characters or numbers as a scalar, vector or matrix). The full APL is implemented on the 1500 system with only minor restrictions, primarily relating to the smaller size of the workspace as compared to the IBM 360 implementation. Extensions, in addition to the files, include operation of the special terminal hardware of the 1500, primarily the CRT and the film image projector.

k. "FOCAL Manual for CAI Coding on the TSS/8 System," H. Dewey Kribs, Betty J. Wright, and Edna C. Reynolds, Systems Memo 9, Florida State University, December 31, 1970.

This document is intended to provide the basic information needed for coding CAI applications in the language FOCAL (Formulating On-Line Calculations in Algebraic Language). This language is available on the Digital Equipment Corporation Time-Sharing 8 System. While FOCAL is oriented toward solution of algebraic problems, it is flexible enough to be used as a CAI coding tool. This document provides explanations and examples of those features in FOCAL most obviously useful for CAI coding. The document also provides information needed for utilizing the time-sharing system on which FOCAL operates. Since this manual could not demonstrate all possible coding techniques or anticipate all possible applications, the reader is also directed to more comprehensive sources.

III. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

A. The Wakulla County Computer-Related Instructional Technology Project
(Walter Dickson, Director)

The Wakulla County Title III project focuses on two primary goals: (1) implementation of computer-assisted instruction in mathematics and reading for Southern rural students, and (2) development and implementation of instructional language materials to add standard speech patterns to the colloquial speech patterns of these Southern rural Ss. Begun in July, 1968, the project is a joint undertaking of the Wakulla County, Florida, Board of Instruction and the FSU-CAI Center. By the Spring of 1970, Ss in Shadeville Elementary School and selected seventh and eighth grade Ss at Medart High School were receiving two to three computer-assisted instruction lessons per week in reading and/or mathematics. Elementary Ss participated in daily oral language drills. Math materials had undergone revision, and reading lesson assignments had been varied to best accommodate needs of the Ss.

As in the Spring of 1969, testing results in the Spring of 1970 indicate that Ss who participated in the CAI instruction and oral language lessons showed positive gains in both reading and mathematics. In addition, attitude measures completed on teachers and Ss involved with the computer instruction demonstrated positive reactions to computer-assisted instruction. In the Fall, assessment instruments previously used were eliminated because it was felt that they did not measure the effects of the instruction; and individualized reading tests and a criterion-referenced test, constructed from sample CAI reading items, were administered by project personnel. Spring posttest results on these instruments and the regularly administered standardized achievement tests will be analyzed for both the experimental elementary school and the control school. High school classes, both control and experimental, are also being evaluated.

At the conclusion of the project activities in 1971, overall effectiveness of the instructional materials, when applied to a rural student population, will be assessed. The final project report will be affected by the change in population in the experimental school from 100% black to 70% white in the 1970-71 school year.

B. Improving Social Work Education Through Computer-Managed Instruction
(HEW Social Rehabilitation Services, Division of Research on Manpower. Grant +20-P-20009/4-02 to Florida State University School of Social Welfare, Department of Social Work, Walter H. Ehlers, Project Director.)

Awarded an HEW grant to improve social work education through the use of new and improved methods and the latest educational technologies, the School of Social

Welfare at FSU began the second year of this project in 1970. High priority tasks are the writing of social work programs using computer-assisted instruction and of programmed texts using the "scrambled text" technique combined with the audio-visual-tutorial (AVT) method. Curriculum problems such as knowledge and personality testing which are manpower related are also concerns of the project.

Project personnel are pursuing the following objectives:

1. To develop computer programs to test the strengths and weaknesses in the preparation of students at the time of their admission to both undergraduate and graduate programs.

2. To develop computer-assisted instruction and related, technologically advanced methods for accelerated learning in the problem areas discovered by computer-managed testing.

3. To test the value of such diagnostic methods and accelerated learning technologies in the education of the disadvantaged for social work.

4. To test the value of such diagnostic methods and learning technologies in the development of a continuum between undergraduate and graduate education, which might reduce the time needed to earn the Master of Social Work degree or permit student exemption from certain courses which might then be replaced with selected, enriching electives.

Knowledge and personality testing. In line with its objective to develop computer programs to test the strengths and weaknesses in preparation of students, the project emphasizes pre- and posttesting in three knowledge areas: Human Behavior, Research, and Policy. Pretests, administered in September at the CAI Center, and posttests, administered in December, are being analyzed and evaluated. Completed findings will be disseminated both within FSU and to the wider academic community.

Personality testing, as a tool toward a more flexible curriculum allowing for exemptions, electives, and directed individual study, is being evaluated.

Individualized instruction. A programmed text, **An Introduction to Mental Retardation**, was completed by the project staff and is now available to eight departments at FSU. Three other programmed courses are in preparation.

Future concerns. Development of simulation experiences which will reflect real life situations is a major concern of the project, and a new course in Administration in Social Work is being considered as a vehicle for use of simulations of administrative situations. A problem-solving capability which can be written into a computer-assisted program is being considered as one approach to the administration simulation. The project also sets the goal of finding, through computer-managed instruction, "ways to substitute measures of concept mastery for course and time requirements."

C. **Clinical Teacher Preparation Program for Interrelated Areas of Special Education** (Bureau of Handicapped Children, U.S. Office Education, Louis Schwartz and Andrew Oseroff.)

The Department of Habilitative Sciences has been awarded a USOE grant to develop a prototype training model and evaluative design for the Clinical Teacher of Interrelated Areas of Social Education. Under the direction of Dr. Louis Schwartz, the project team is designing a fully individualized, performance-based, multi-media, computer-managed instructional system to train future clinical teachers in the areas of systematic observation, diagnosis, intervention, and evaluation of exceptional children. Presently,

a group of 15 university students is going through its first year of the three-year training program.

Committed to the fundamental concept of individualizing instruction for both the clinical teacher trainee and (eventually) the exceptional child in the public school, the model provides: (1) behaviorally defined specifications of competencies desired, (2) criterion measures for assessing entry behaviors and proficiency, and (3) instructional options for achieving the objectives. Organized in instructional modules, many of them presently ready with others in preparation, the program will be converted to a computer-managed instruction system (CMI) which will monitor the trainee's progress. A significant portion of the program will be sufficiently refined for conversion to the system by next Spring, while the full program should be operative in CMI by next September. The feedback provided through the CAI system will permit revision and improvement of the individual instructional modules as the program goes through its successive field-trials over its five-year funding period.

D. **FSU Elementary Teacher Training Model.** National Center for Research U.S. Office of Education, (Norman Dodl)

Over the past two years, the U.S. Office of Education's comprehensive Elementary Teacher Preparation Project has succeeded in bringing several different and challenging concepts of program development to the field of teacher education. The initial step was to develop the specifications-- referred to as "model"--of possible new teacher education programs. These models were then subjected to rigorous tests for their feasibility. The educational, fiscal, management, and community resources necessary to implement such a forward look into programs were determined through pilot implementations and cost effectiveness techniques. In regard to conceptual substance, many prior improvements were considered that employed such innovations as multi-media alternatives, simulated observations, improved subject matter for preparation, and new approaches to human relations skill. The approach of the FSU model was to incorporate all these new techniques and content into a consistent framework; thus the major goal of the FSU model allows for rethinking of the total program of teacher education and provides a vehicle for exploring new concepts and approaches.

The FSU model identifies the following generalized training goals:

1. The teacher will plan for instruction by formulating objectives in terms of behaviors which are observable and measurable.
2. The teacher will select and organize content to be learned in a manner consistent with both the logic of the content itself and the psychological demands of the learner.
3. The teacher will employ appropriate strategies for the attainment of desired behavioral objectives.
4. The teacher will evaluate instructional outcomes in terms of behavioral changes.
5. The teacher will demonstrate the competence and willingness to accept professional responsibilities and to serve as a professional leader.

As a primary support system for operationalizing these goals, the FSU model employs computer-managed instruction. The operational design specifications for implementing the model are as follows:

1. Preparation for teaching is viewed as a series of learning experiences designed specifically to enable trainees to meet stated performance criteria. The usual course format for professional training is rejected as inappropriate for providing experience to trainees.

2. Trainees should move from one experience or set of experiences to the next as they demonstrate ability to meet performance criteria. This means that performance rates should be individualized, not group based.

3. Provision should be made throughout the program for immediate application of theoretical ideas about teaching to the act of teaching itself.

4. Trainee progress must be carefly monitored and recorded to make possible the operation of an instructional program tailored to diagnose needs and learning styles of individual trainees.

5. The total training program should be a regenerative one. Therefore, trainee performance information must be available regularly for comparison with information such as cost of providing the necessary instruction.

6. Trainees should become actively involved in the act of teaching early in their preprofessional training. This involvement should be continuous throughout the entire preprofessional phase of the program and should progressively approximate the full range of anticipated teaching performances.

7. Multiple paths to learning must be provided to accommodate trainee differences in levels of commitment, interests, effective rates of performance, acquisition of knowledge, and styles of learning.

8. For somewhat the same set of reasons as those in number 7, and because of the desirability of creating an attitudinal set which would enhance the maximum trainee determination of personal goals and learning experiences, it is necessary to create an instructional scheme which would provide trainees with a maximum freedom of instructional choice at all levels.

In order to move ahead with the R & D bases for the FSU model, a unit in evaluation was prepared by FSU model and CAI Center staff. This unit runs under the conventional CMI paradigm. During the Fall quarter, a number of undergraduate students participated in working through this two-week unit of study. The substance of the unit of study can be reviewed by obtaining the technical report prepared by Dr. Gary Lipe. The current analysis of the outcomes indicate both good learning mastery, as well as positive attitudes on the part of students. Similar CMI modules are being prepared and will be utilized by the conventional course offerings in elementary education at FSU.

E. **Graduate Training**

1. **Institute in Computer-Related Multi-Media Instruction for Administrators and Faculty in Junior Colleges and Universities.** The CAI Center's third academic year institute, sponsored by USOE, ended in June, 1970, having provided 20 participants with the opportunity to acquire in-depth understanding of all aspects of computer-based multi-media instruction in collegiate level education. This year's institute featured greater individualization than two previous institutes, specifically through preinstitute learnings via programmed instruction, a total course taught by computer-managed instruction, and numerous CAI units individually designed and implemented by participants. Evaluative information gained by the faculty during the previous two institutes made

it possible to maximize the value of each course offered, in terms of its appropriate placement in the sequence of development of conceptual capabilities on the part of the trainees.

All of the institute's objectives were met through a combinationof coursework and hands-on experiences. All participants became acquainted with the principles of systems analysis, media-by-learner interactions, and developed high degrees of proficiency in the utilization of computer-based instructional information systems. Also, participants obtained information about the latest instructional strategies involving multi-media instruction, and had the opportunity to author CAI multi-media courses on the FSU-CAI system and to evaluate efficiency. The institute provided instruction about and experiences with newer technological approaches to data analysis, for decision making as related to instructional design as well as research questions, and instructed participants in how to administer an educational research center with understanding of operational factors of cost, time-scheduling, course development, and personnel.

2. **Current Graduate Program.** The training program developed as part of the Institute in Computer-Related Multi-Media Instruction has been basically integrated into the Instructional Systems program of the Department of Educational Research at the Florida State University. The Instructional Systems program in the Department of Educational Research provides training in research, development, and evaluation of instructional systems for promoting effective learning. The program presently provides for specialization in use of operation analysis techniques for developing means for individualized instruction, multi-media instruction, and educational applications of computers. A groundwork in educational research methodology and evaluation is required of all candidates. In addition to formal coursework, hands-on practical developmental research activity is required of all graduate students. Each student is assigned to a project as an integral part of the learning experience during his entire graduate program.

Four students who entered the program during the Fall Quarter, 1970, have been assigned to assist on various projects at the CAI Center. These students who will actively participate in CAI Center projects will complete their training programs and receive their Ph.D.'s during the next three years. Each of these students will be placed in a position directly related to his or her graduate training.

IV. DIVISION OF INSTRUCTIONAL RESEARCH AND SERVICE SPONSORED ACTIVITIES

Major research and development projects, plus service instructional components on campus, are housed and administered at FSU by the Division of Instructional Research and Service (DIRS). Instructional television, testing service, media center, etc., are components of DIRS, which also encompasses a research unit in which the CAI Center is administratively included. Thus the CAI Center has immediate access to a large pool of multi-media equipment and staff, facilitating both the research and the developmental aspects of its program.

The CAI Center contributes, through DIRS, to both research and service functions which concentrate on offering the best instruction available at the University. An example, briefly described in Section II, is a CMI course titled "Techniques of Programmed Instruction," which provides all instruction for graduate students enrolled in EDR 537. In the undergraduate area, the CMI model for educational psychology

is described. The CAI and problem exercises in chemistry and physics are also included. Finally, the description of a CMI contingency approach to an animal learning course is also presented.

A. **Individualized Course in Educational Psychology**: Duncan N. Hansen

The Educational Psychology project has focused on converting the Psychology 317 course into a computer-managed instruction individualized format. At present, there are three major activity components: (1) CMI units, (2) issue-oriented small group discussions, and (3) student field roles for practicum experience in local schools.

In regard to the computer-managed instruction units, twelve topics have been prepared with behavioral objectives, criterion items, and associated learning resources. The resources primarily consist of references to readings in books and articles, although we are beginning to use alternative media. The topics are as follows:

1. Instructional Theory
2. Objectives, Entering Behaviors, and Individual Differences
3. Evaluation: Construction and Use of Tests
4. Standardized Evaluation: Interpreting Tests
5. The Nature and Measurement of Intelligence
6. Personality Processes: Motivation, Anxiety, and Curiosity
7. Learning Theory Applied to the Classroom Situation
8. Learning of Intellectual and Motor Skills
9. Instruction in Concepts and Principles
10. Instruction in Problem-solving and Heuristic Behaviors
11. Education of the Disadvantaged
12. Developmental Models for School Learning

In terms of course requirements, the first four units are required of all students. The student then selects six additional units out of the remaining list of modular topics. Within each modular topic there are appropriate behavioral objectives. Criterion-test items are randomly drawn by the computer system and presented to a student when self-scheduled. If a student fails a specific module, he is provided with a learning prescription and required to come back until each behavioral objective is passed. Thus, the CMI modules ensure appropriate cognitive coverage of the essential topics commonly found in educational psychology.

For the issue-oriented small group discussions, a series of highly relevant topics such as the Nature of Violence in our Schools, The Right-To-Read Program, Head-Start, etc., have been identified. Brief introductory articles are offered to each small group prior to the group session. The issue is analyzed, and two or more psychological frames of reference are applied in terms of the analysis and proposed solution. For example, in terms of The Right-To-Read Program, class discussion would lead to a proposed analysis and solution from a developmental psychology point of view, from a cognitive psychology point of view, and from a Skinnerian or behavioral modification point of view. The remainder of the discussion hour is given over to student identification of those propositions to which they subscribe and provision of rationale for their selection. The lively discussions and personal application of psychological concepts to educational problems have made this one of the most popular components within the course.

The students may enroll for an additional course credit and receive 5 hours per week of practicum assignment in our local public schools. At least the following three

alternatives are offered to them in terms of these practicum situations: First, they may identify three children who are in need of tutorial help. This tutorial role consists of identifying present learning difficulties and providing specific instruction to overcome them. Secondly, the student may identify a child and prepare a case study on both the family as well as the child. The intent is to prepare a plan of action by which the parents may intervene in the informal educational process so as to better prepare their child for success in the classroom. Third, the student may act as a teacher aide. This typically consists of leading instruction, providing instructional help or reading discussions, and supporting many of the managerial functions found within classroom teaching.

The Educational Psychology project should be considered in its infancy. We are both extensively revising the concepts and associated behavioral objectives as well as looking for new and more appropriate media alternatives. In addition, the small group discussions will be constantly updated each quarter. Moreover, we are working on more systematic plans for appropriate placement and supervison of the field practicum experience.

B. **Chemistry and Physics**

1. **COMPUCHEM: CAI in Chemistry at the University School** (Dupont Grants Program and the Research Council of Florida State University. Lee Summerlin, Coordinator.)

In an attempt to extend the concept of individualized instruction in chemistry, the FSU University School now has an operational computer-assisted instruction program in chemistry. After two years of testing in a programmed instruction format, the CAI program was validated with pilot groups of students and incorporated as an integral part of the chemistry program in the Fall Quarter. Faculty of the University School science department, FSU CAI Center, and the FSU Department of Chemistry teamed to write course material, insure course content accuracy, and code the material using Coursewriter II for use with the FSU IBM 1500 computer system.

Complete data on the CAI program have been gathered, including comparative posttest performance with a control group of chemistry students, attitudes toward CAI, and time-economy measurements. Results of these studies are to be published and to be presented at the National Science Teacher's Association Convention and the American Chemical Society Convention. Based on results from this year's program which showed the program to be effective and student attitude to be very favorable, plans are underway to extend the CAI program in chemistry and to add biology. A feasibility study of enlarging the CAI program into a computer-managed instructional system for the total science program is also underway.

2. **Computer-Based Remedial and Drill Material in General Chemistry** (E. K. Mellon and J. B. Dence)

Science students are now able to supplement their regularly scheduled lecture and recitation periods in the first-quarter chemistry course with computerized remedial and drill materials at the FSU-CAI Center. Performance-based materials in Mathematics Introduction, Ideal Gas Calculations, Mole Concept and Stoichiometry, and Atomic Structure have been programmed, field tested, and evaluated.

A program report, available through the FSU Department of Chemistry, describes program development through utilization of the systems approach in defining behavioral

objectives for material design and revision through formative evaluation strategies. Computer facilities are described, including cost and implementation factors.

Preliminary field test results over two quarters of experimentation have provided insight into some of the problem-solving difficulties encountered by beginning chemistry students. Individual remediation through CAI appears to offer considerable potential for bringing more students to a criterion level required for progress through the chemistry sequence.

3. **Physics Review**

The development of test-review sessions in Physics 107 followed the use of a multi-media CAI undergraduate physics course, offered for credit in two previous years. In 1970, a large number of FSU undergraduates again interacted with these 55 problem sets, consisting of questions on different topics within the Physics 107 course. Students come to the CAI Center on a voluntary basis, and spend an average of two hours at the teletype terminals of the PDP-8 TSS. The service, which is offered during the week preceding each exam, is well used. Teletype printouts can be retained by the student for further study.

C. **Computer-Assisted Contingency Management in an Advanced Level Undergraduate Course.** (Perrin S. Cohen, Department of Psychology)

During the previous academic year (1969-70), a contingency management technique involving self-pacing, unit criterion mastery, and undergraduate proctors was adapted for an advanced level undergraduate course in animal learning (Psychology, 311). Students in the course were assigned to a proctor, informed of the course requirements, and given a study-guide and reading list for the first unit of material.

After studying, a student was administered a 2-minute oral quiz by a proctor. If the student comprehensively answered the question, he qualified for a written objective quiz; if not, he took additional oral quizzes until he qualified. Each written quiz consisted of questions randomly selected from pools of questions covering different aspects of the unit. If a student correctly answered all questions, he proceeded to the next unit; if not, he took additional quizzes until he qualified. When a student completed ten units, six laboratory exercises, and a retention test, he earned an "A." Over four quarters, the grade distribution was 120 A's, 2 B's, 2 D's, 6 F's, and 1 withdrawal. Responses to course evaluation questionnaires were extremely positive.

To effectively administer and evaluate this course, each proctor diverted 50-75% of his classroom time away from individualized instruction to administering and scoring quizzes and analyzing data. Over the past two quarters (Fall, 1970 and Winter, 1971), a computer-assisted contingency managed technique was introduced. This was identical to the procedure described above except that a computer, via a teletype machine, administered, scored, and analyzed responses to true-false and multiple-choice questions on the written quiz. This innovation allowed a proctor to either devote more time to individualized instruction or to supervise more students. In addition, it increased the quality and flexibility of course administration and evaluation. Again, 90% of the students earned A's and responses to course evaluation questionnaires were extremely positive.

V. COMPUTER-ASSISTED INSTRUCTION CENTER

A. Personnel

Seven resident faculty members and seven FSU faculty members have worked with

graduate students and research support personnel throughout the year in the research and training programs of the Center.

Center Director

Duncan N. Hansen, Ph.D., 1964, Educational Psychology, Stanford University, Associate Professor of Educational Research and Psychology, FSU.

Resident Research Faculty

Walter Dick, Ph.D., 1965, Psychology, Pennsylvania State University, Research Associate in the CAI Center and Assistant Dean for Research and Development, FSU.

Henry T. Lippert, Ed.D., 1967, Education, University of Illinois, Research Associate in the CAI Center and Assistant Professor of Educational Research, FSU.

Bobby Richard Brown, Ph.D., 1969, Psychology, Pennsylvania State University, Research Associate in the CAI Center and Assistant Professor of Educational Research, FSU.

Harold F. O'Neil, Jr., Ph.D., 1969, Psychology, Florida State University, Research Associate in the CAI Center and Instructor in Educational Research, FSU.

Paul Merrill, Ph.D., 1970, Educational Psychology, University of Texas, Research Associate in the CAI Center and Assistant Professor of Educational Research, FSU.

FSU Research Investigators

All of the above resident research faculty plus the following:

Guenter Schwarz, Ph.D., 1942, Physics, Johns Hopkins University, Professor of Physics and Director for Research in College of Instruction of Science and Mathematics, FSU.

Walter H. Ehlers, DSW, 1962, Social Welfare Administration, Brandeis University, Professor of Social Work, FSU.

Charles H. Adair, Ed. D., 1961, Social Science, Florida State University, Associate Professor of Social Science Education, FSU.

William L. Maloy, Ed.D., 1958, Secondary and Teacher Education, Florida State University, Educational Consultant to Governor Claude R. Kirk, Tallahassee, Florida.

Darryl Bruce, Ph.D., 1966, Psychology, Pennsylvania State University, Assistant Professor of Psychology, FSU.

Gerald Jahoda, D.L.S., 1960, Library Education, Columbia University, Professor in the School of Library Science, FSU.

M.C. Riser, Jr., Ph.D., 1954, Educational Administration and Supervision and Public Health, University of North Carolina. Associate Professor of Health Education, FSU.

Graduate Students

Third Year	Second Year	First Year
Thomas Dunn	Ed Durall	Phil Duchastel
Paul Gallagher	Paul Geisert	Darlene Heinrich
Lorraine Gay	Wallace Hannum	Nelson Towle

Third Year

Darol Graham
Nancy Hagerty
John Hedl
Arthur King
Mike Lawler
Barbara Leherissey
Gary Lipe
Jim Papay
Gail Rayner
Lee Rivers
Dave Thomas

Second Year

Ed Harris
Tom James
Barbara Johnson
Ora Kromhout
Merle Morgan
Chuck Sisson
Peter Stoycheff
Bill Whaley

First Year

Susan Taylor

CAI Research Support Staff

Data Systems Director
Bruce H. Freed

Director of Systems Operations
Gene Wester

Programmers

Dewey Kribs
Katherine Jacobsen
George Hogshead

Operators

Dave Danner
Jim Guerry
Ray Frost

Coders

Betty J. Wright
Dennis Adair
Edna Reynolds

Program Documenter

Beth Lines
Sharon Papay

B. Equipment Configuration

Florida State University's CAI Center currently supports three computers dedicated to research on all aspects of the use of computer technology for the furtherance of educational goals. Research on computer-assisted instruction, computer-managed instruction, CAI system development, testing paradigms, human learning, and other problems characterize this commitment.

Available equipment, as diagrammed in Figure 1, includes an IBM 1500 Instructional System consisting of an 1800 central processor, a 1502 station controller, sixteen 1510 CRT displays each with a keyboard and a light pen, one 1518 typewriter, and five 2310 disk drives with removable disk packs of 1.024 million bytes. Additional peripherals include two 2401 tape units, one 1442 card reader/punch, and one 1443 line printer.

Furthermore, the CAI Center has interfaced a Digital Equipment Corporation PDP-8 680 Communications System to the IBM 1500. The purpose of this is to provide the 1500 with the capability of supporting a mix of sixteen remote or local teletypes. Also, in mid-1970, PDP-8 TSS/8 time-sharing system was installed which on its own supports sixteen teletypes. Moreover, to provide maximum flexibility the TSS/8 is connected to the 680 via a 100,000 baud channel.

CAI Center equipment is equipped with an instructional support system for the 1500 system upon which all student responses are uniquely identified and recorded, and the Center staff has developed a data management system which compresses, sorts, merges, and summarizes this data for analysis purposes. The staff has also converted the IBM 1500 system with CAI data. and has developed special analysis programs in FORTRAN IV.

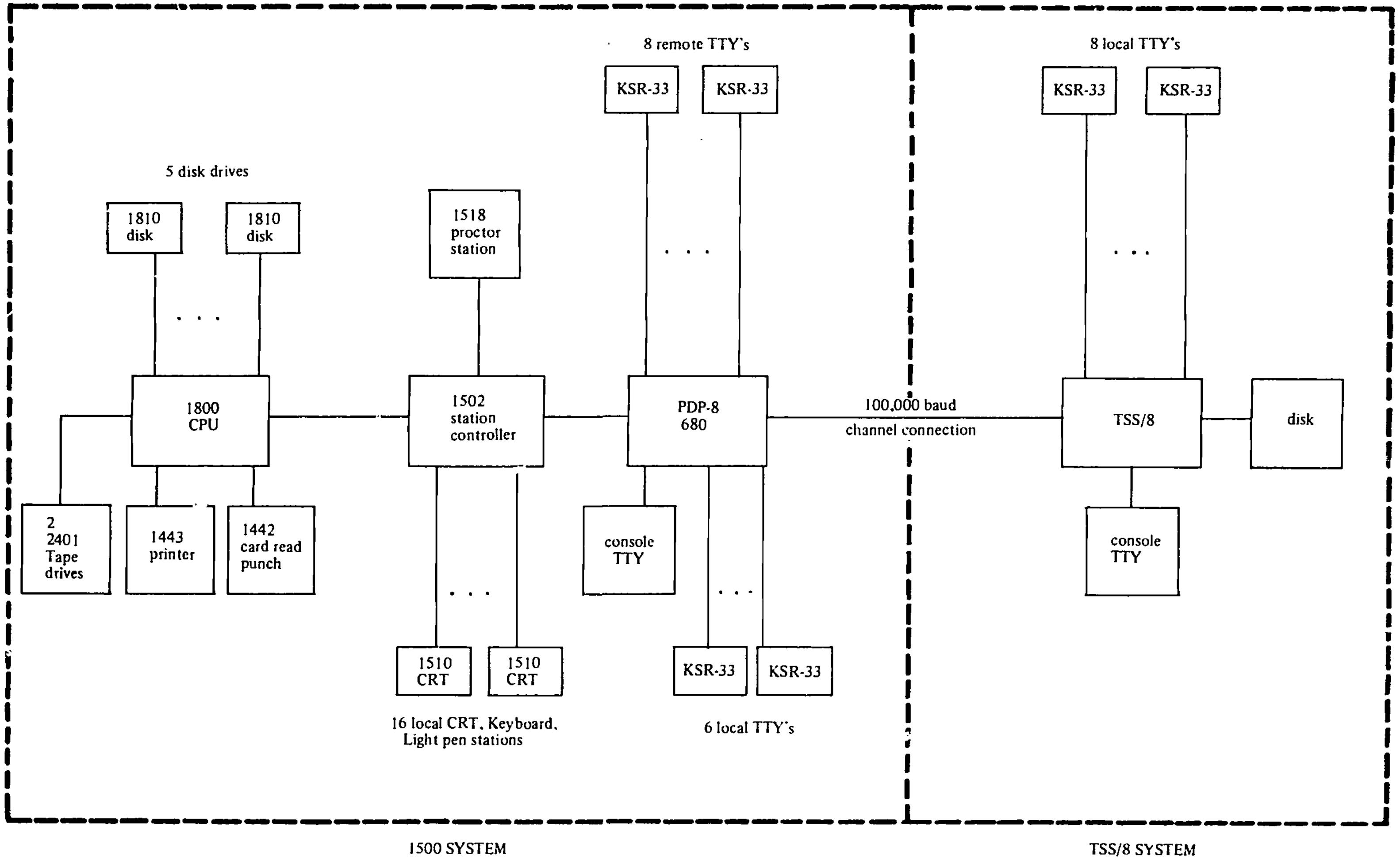

Figure 1.–System Configuration

APPENDIX A

Publications

The following publications by the FSU-CAI Center staff and students have appeared or have been accepted for publication in the period, January 1, 1970 to December 31, 1970. In addition, prior publications are also listed. The Center will try to supply the articles to interested and qualified researchers.

JOURNAL ARTICLES PUBLISHED

Hansen, D. N., and Harvey, W., Impact of CAI on classroom teachers, *Educational Technology*, X(2), February, 1970.

Hansen, D. N., Mathis, A., and Smith, T., College student's attitudes toward computer-assisted instruction, *Journal of Educational Psychology*, 1970, 61(1), 46-51.

Hansen, D. N., and O'Neil, Jr., H. F., Empirical investigations versus anecdotal observations concerning anxiety in computer-assisted instruction, *Journal of School Psychology*, 1970, 8(4), 315-316.

JOURNAL ARTICLES ACCEPTED

Hansen, D. N., Hedl, Jr., J. J., and O'Neil, Jr., H. F. Computer processes within education. *Computers and Automation*.

Hansen, D. N., Majer, K., and Dick, W., The effects of individualized verbal feedback in computer-assisted learning. *Psychological Reports*.

Leherissey, B., O'Neil, Jr., H. F., and Hansen, D. N., Effects of memory support upon anxiety and performance in computer-assisted learning. *Journal of Educational Psychology*.

TECHNICAL REPORTS PUBLISHED

A Study of Computer-Assisted Multi-Media Instruction Augumented by Recitation Sessions, Kenneth Majer, Tech Report 1, Florida State University, Tallahassee, 1969.

Educational Applications of Instructional Computer Systems, Duncan Hansen and Kenneth Majer, Tech Report 2, Florida State University, Tallahassee, 1969.

Research and Implementation of Collegiate Instruction of Physics via Computer-Assisted Instruction, Duncan N. Hansen, Walter Dick, and Henry T. Lippert, Tech Report 3, Florida State University, Tallahassee, 1968.

A Systematic Investigation of Three Facets of Programmed Instruction: Tutorial Assistance of Study, Explanation of Incorrect Answers and the Spacing of High Difficulty Frames, John Hedl, Tech Report 4, Florida State University, Tallahassee, 1969.

Individual Versus Paired Learning of an Abstract Algebra Presented by Computer-Assisted Instruction, William Love, Tech Report 5, Florida State University, Tallahassee, 1969.

Effects of Stress on State Anxiety and Performance in Computer-Assisted Learning, Harry F. O'Neil, Technical Report 6, Florida State University, January 1, 1970.

The Effects of Anxiety on Computer-Assisted Learning, Charles D. Spielberger, Technical Report 7, Florida State University, June 15, 1970.

Empirical Development of a Computer-Managed Instruction System for the Florida State University Model for the Preparation of Elementary School Teachers, Edward N. Hobson, Technical Report 8, Florida State University, April 2, 1970.

Annual Progress Report, Duncan N. Hansen, Harold F. O'Neil, Bobby R. Brown, Arthur D. King, and LeRoy C. Rivers, Technical Report 9, Florida State University, February, 1970.

Development and Implementation of a Computer-Managed Instruction System in Graduate Training, Nancy K. Hagerty, Technical Report 11, Florida State University, June 30, 1970.

An Investigation of Instructional Treatments and Learner Characteristics in a Computer-Managed Instruction Course, Paul D. Gallagher, Technical Report 12, July 30, 1970.

An Investigation of the Relative Effectiveness of Two Methods of Instruction, Including Computer-Assisted Instruction, as Techniques for Changing the Parental Attitudes of Negro Adults, Francis W. Scanland, Technical Report 13, Florida State University, July 15, 1970.

Anxiety, Drive Theory, and Computer-Assisted Learning, Charles D. Spielberger, Harold F. O'Neil, Jr., and Duncan N. Hansen, Technical Report 14, Florida State University, September 15, 1970.

The Development and Implementation of a Model for the Design of Individualized Instruction at the University Level, James G. Lipe, Technical Report 15, Florida State University, October 30, 1970.

An Application of Simulation Techniques to an Innovative Teacher Training Program, Arthur D. King, Technical Report 16, Florida State University, November 1, 1970.

A Study of the Cognitive and Affective Outcomes of a Collegiate Science Learning Game, William L. Harvey, Technical Report 17, Florida State University, November 15, 1970.

TECHNICAL MEMOS PUBLISHED

Implementation of CAI at Florida State University, Walter Dick, Tech Memo 1, Florida State University, Tallahassee, May, 1969.

Current Issues in CAI, Duncan N. Hansen, Tech Memo 2, Florida State University, Tallahassee, June, 1969.

Computer Applications in School Psychology, Duncan N. Hansen, Tech Memo 3, Florida State University, Tallahassee, June, 1969.

CAI in Social Work, Walter Ehlers, Tech Memo 4, Florida State University, Tallahassee, June, 1969.

Comparative Effects of Ability and Presentation Mode in Computer-Assisted Instruction and Programmed Instruction, Walter Dick and Raymond Latta, Tech Memo 5, Florida State University, Tallahassee, July, 1969.

Institute in Computer-Related Multi-Media Instruction for Administrators and Faculty in Junior Colleges and Universities, Duncan N. Hansen, Walter Dick, and Henry T. Lippert, Tech Memo 6, Florida State University, Tallahassee, July, 1969.

A Guide to Running a Study in the CAI Center, Duncan Hansen, Betty Wright, and George Hogshead, Tech Memo 7, Florida State University, Tallahassee, September, 1969.

The Data World of CAI, Duncan Hansen and Walter Dick, Tech Memo 8, Florida State University, Tallahassee, September, 1969.

An Overview of CAI for Adult Educators, Walter Dick, Tech Memo 9, Florida State University, Tallahassee, October, 1969.

Impact of CAI on Classroom Teachers, Duncan Hansen and William Harvey, Tech Memo 10, Florida State University, Tallahassee, October, 1969.

Development Processes in CAI Problems, Techniques and Implications, Duncan N. Hansen, Tech Memo 11, Florida State University, Tallahassee, October, 1969.

An Investigation into the Differential Effectiveness for Males and Females, of Three CAI Treatments on Delayed Retention of Mathematical Concepts, Lorraine R. Gay, Tech Memo 12, Florida State University, Tallahassee, November, 1969.

Existing CAI Curriculum Materials at the FSU-CAI Center, Duncan N. Hansen, Betty J. Wright, and Barbara F. Johnson, Tech Memo 13, Florida State University, June 30, 1970.

Information Structure in Military History: An Application of Computer-Assisted Instruction, Richard R. Lee, Tech Memo 14, Florida State University, March 30, 1970.

The Role of Computers in Education during the '70's, Duncan N. Hansen, Tech Memo 15, Florida State University, May 15, 1970.

The Behavior of Teachers Involved in Two Simulated Inquiry Environments: A Social Simulation Game and a CAI-Based Information Retrieval System, Charles Adair, Duncan Hansen, Gail Rayner, and Adesh Agarwal, Tech Memo 16, Florida State University, May 30, 1970.

Current Research Development in Computer-Assisted Instruction, Duncan N. Hansen, Tech Memo 17, Florida State University, February 15, 1970.

Computer-Assisted Instruction in Engineering Dynamics, John W. Sheldon, Tech Memo 18, Florida State University, May 30, 1970.

The Primacy Effect of Single-Trial Free Recall, Darryl Bruce and James P. Papay, Tech Memo 19, Florida State University, July 30, 1970.

Effects of Memory Support on State Anxiety and Performance in Computer- Assisted Learning, Barbara L. Leherissey, Harold F. O'Neil, Jr., Duncan N. Hansen, Tech Memo 20, Florida State University, July 15, 1970.

Institute in Computer-Related Multi-Media Instruction for Administrators and Faculty in Junior Colleges and Universities, Duncan N. Hansen, Bob Brown, Henry T. Lippert, Harry O'Neil, Tech Memo 21, Florida State University, July 15, 1970.

The Development of an On-line Searched Coordinate Index for Use in Teaching and Research, G. Jahoda and Ferol A. Foos, Tech Memo 22, Florida State University, September 30, 1970.

Conference on Computers in Undergraduate Science Education: A Computer-Assisted and Managed Course in Physical Sciences, O.M. Kromhout, D. N. Hansen, and G. Schwarz, Tech Memo 23, Florida State University, October 30, 1970.

A Comparison of the Effects of Information Mapped Learning Materials and Traditional Materials on the Learning of Concepts via the Printed Page and Computer Cathode Ray Tube, Paul Geisert, Tech Memo 24, Florida State University, October 30, 1970.

Multi-Media Simulation of Laboratory Experiments in a Basic Physics Lesson on Magnetism, Darol Graham, Tech Memo 25, Florida State University, November 1, 1970.

The Complete Automation of the Minnesota Multiphasic Personality Inventory and a Study of Its Response Latencies, Thomas G. Dunn, Robert E. Lushene, and Harold F. O'Neil, Jr., Tech Memo 28, Florida State University, January 30, 1970.

Review of Automated Testing, Duncan N. Hansen, John J. Hedl, Jr., and H. F. O'Neil, Jr., Tech Memo 30, Florida State University, February 26, 1971.

Two Applications of Simulation in the Educational Environment, David B. Thomas, Tech Memo 31, February 26, 1971.

SYSTEMS MEMOS PUBLISHED

Documentation for the Edit and Data Preparation Programs, Harold F. O'Neil, Jr., Duncan N. Hansen, Bruce Freed, Eugene Wester, George W. Hogshead, III, and Wilburn Robinson, Systems Memo 1, Florida State University, June 15, 1970.

Supplementary Documentation of Coursewriter II Functions, Harold F. O'Neil, Jr., Sharon Papay, and Duncan N. Hansen, Systems Memo 2, Florida State University, June 30, 1970.

Manual of APL/1500 Functions, Henry T. Lippert, Edward V. Harris, David B. Thomas, Thomas D. McMurchie, Systems Memo 3, Florida State University, June 15, 1970.

APL: An Alternative to the Multi-Language Environment for Education, Henry T. Lippert and Edward V. Harris, Systems Memo 4, Florida State University, August 15, 1970.

Teleprocessing: A DEC 680 Interfaced to an IBM 1500, Bruce H. Freed, Harold F. O'Neil, Jr., Lloyd Lauffer, and Robert Lushene, Systems Memo 5. Florida State University, June 15, 1970.

Human-Computer Interactions Involved in Analysis of CAI Data, Duncan N. Hansen, James Papay, Harold F. O'Neil, Jr., and Dave Danner, Systems Memo 6, Florida State University, June 30, 1970.

A Programming Language/1500, Thomas D. McMurchie, Scott E. Krueger, and Henry T. Lippert, Systems Memo 8, Florida State University, November 30, 1970.

FOCAL Manual for CAI Coding on the TSS/8 System, H. Dewey Kribs, Betty J. Wright, and Edna C. Reynolds, Systems Memo 9, Florida State University, December 31, 1970.

APL/1500 File Access Subroutine Package, Thomas D. McMurchie, David B. Thomas, Systems Memo 10, Florida State University, February 1, 1971.

Manual of APL/1500 Functions: System Functions, Thomas D. McMurchie and David B. Thomas, Systems Memo 11, Florida State University, February 1, 1971.

APPENDIX B

Demonstration Report

Florida State University	Number Demos	Number Participating
Speech Education Dr. Deems Brooks	1	5
Physical Education Dr. Peter Everett	1	8
Science Education Dr. Wm. Snyder	2	5
Habilitative Sciences	1	3

Other Demonstrations

North Florida Junior College	1	13
South Carolina State College at Orangeburg	1	5
Miami Model Cities Personnel	1	5
Florida Family Services Div. & HEW Social Rehabilitive Services Div.	1	4
Representatives from International Computer Conf.	1	6
W. T. Moore Elementary School 5th and 6th graders	3	35

Other participants not mentioned in previous categories:

Dr. Ulrich	Germany
Dr. Shroeder	Germany

Other visitors to the FSU-CAI Center, but not included in the preceding list, include the following:

Maria D. Lenezakis, Stanford University School of Education
Judith B. Spellman, Stanford Univ. School of Education, California
Jim Scott, Dept. of Education, Tasmania, Australia
Richard P. Hemenger, Dept. of Physics, Tuskeegee Inst., Alabama
I. Kothari, Dept. of Physics, Tuskeegee Inst., Alabama
M. A. Rowe, U. S. Army, AC of S-CE, Ft. Rucker, Ala.
B. W. Addy, U.S. Army, Dept. of Rotary Wing, Ft. Rucker, Ala.
F. A. Petty, USAF, Squadron Officer School, Maxwell AFB, Ala.
P. Resta, SWRL, Inglewood, Calif.
Arlan R. Koch, College Science, Univ. Mo., Rolla
Bill Gillett, College Science, Univ. Mo. Rolla
John Loughlin, Lane Comm. College, Eugene, Oregon
Bert Mendelson, Smith College, Northampton, Mass.
G. Ralph Strohl, Jr., U.S. Naval Academy, Annapolis, Md.
T. J. Benac, U.S. Naval Academy, Annapolis, Md.
Robert W. Gibson, Auburn University, Auburn, Ala.
Harold Hanes, Earlham College, Richmond, Indiana
Charles Taylor, Satrich College, Yellow Springs, Ohio
Peter Russell, Morehouse College, Atlanta, Ga.
J. Don Jones, Naval Ship Res. and Dev. Lab, Panama City
Karen Coates, Mills College, Oakland, Calif.
Catherine Verhey, Webster College, St. Louis, Mo.
Mr. and Mrs. Albert J. Herr, Drexel University, Phila., Pa.
Martin Reno, Heidelberg College, Tiffin, Ohio
Dudley B. Selden, Hampden-Sydney College, Va.
Paul P. Szydlik, State Univ. College, Plattsburgh, N.Y.
George F. Sheats, State Univ. College, Plattsburgh, N.Y.
Robert Roden, Univ. of Waterloo, Waterloo, Ont., Canada

Cdr. J. R. Collins, CNRTC, Fort Omaha, Nebr.
Capt. John J. Stusnich, CNRTC, Fort Omaha, Nebr.
Capt. W. J. Willa, Naval Researve Training Command
Capt. P. W. Rohn, Naval Reserve Training Command
Mary F. Robek, Prof. Bus. Ed., Eastern Mich. Univ., Ypsilanti, Mich.
John Gilligen, ICL Ltd., Bucks, England
Bertram Banks, Ridgewaye School, Southborough, Kent, England
Dr. Andy Preston, P. O. Management Institute, Washington, D.C.
Dr. Marshall J. Farr, Office of Naval Research, Washington, D.C.
Dwayne S. Rogers, USAID, El Salvador, Spain
Shelton MacLeod, AF Human Resources Lab, Air Univ. Maxwell AFB, Ala.
Dr. Hepner, Director of Health Services
Dr. Enterline, Bio-Statistician
Dr. Ken McCafrey, Economist
Robert Robinson, Internist & Dir. of Data Processing
Dr. Gloria Cominski, NIMH
Dr. Arthur L. White, Sci. Educ. Arps 252
Douglas D. Smith, Ohio State Univ., Columbus, Ohio
Dr. Jim Regan, NTDC, Orlando
Dr. Vic Fields, ONR, Washington, D.C.
Mr. Larry Harding, Naval Air Station, Washington, D.C.
Mr. Raymond Williams, ONR, Washington, D.C.
Mr. Ed Shute, ONR Representative, Gainesville
Dr. John Ford, San Diego, Calif.
Lynot Walker, Centre for Science Educ. London, England
Rob Walker, Centre for Science Educ. London, England
Erich Schmid Univ. A., Fribringen, Germany
D. K. Sinka, Dept. of Math, Jadavpur Univ., Calcutta, India
M. R. Purl, Jammu, Kashmir-India
Dr. Robert Lyons, Arizona State College
Dr. A. Romand, Univ. of BARI, Italy
Mr. Simon, University in Germany
A. Jones, Univ. of Louvain, Belgium
Camille Bellillant, University in France
Walter Ullrich, Technische Hochschule, Aachen, Germany
Wolfgang Schrader, Technische Hochschule, Aachen, Germany
M. L. Lakhanpal, Panjab Univ., Chandigarh, India
M. R. Suxena, Prof. and Head of Dept. Panjab Univ., Chandigarh, India
Dr. Mildren Abshier, Prairie View A & M College, Prairie View, Texas
Col. Walt Murphy, Human Resources Lab, Lowry AFB, Col.
Dr. Marty Rockway, Human Resources Lab, Lowry AFB, Col.
Prof. Sampow Varangoon, Chulalongkorn Univ., Bangkok, Thailand
Shiro Hliyzaki, Supervisor of Tokyo Metro Board of Education, Tokyo, Japan
David Geeseka, Texas Christian Univ., Ft. Worth, Texas
W. H. Biggs, Jr., LCDR, NRTG, Gainesville, Fla.
Z. T. Wakefield, Capt., USNRR, Florence, Ala.
Lcdr. J. M. Wilkins, USNR, Surface Program Officer, Charleston, S.C.
Radm, H. J. Kosselor, USN, Commandant Sixth Naval District, Charleston, S.C.
Radm, E. M. Rosenberg, USN, Commander Naval Reserve Training, Omaha, Nebr.
Lcdr., H. Kiser, USN, Aide to Radm. Kosselor, Charleston, S.C.

APPENDIX C

Project Status Report

Project Number	Title	Phase*
0062	Subjective Organization in Free Recall as an Individual Difference Measure (logos)	V
0063	An ROTC Study Session on An Analysis of Battles Using the Nine Principles of War (rotc)	V
0064	Computer-Managed Instruction Implementation of Programmed Instruction (cogni)	V
0065	Productive Aspects of Programmed Instruction using Computer-Managed Instruction (prod)	V
0066	Development of the Automated Slosson Individual Intelligence Test (sit)	V
0067	An Investigation into the Effectiveness and Optimal Temporal Position of Reviews for Rule Learning	V
0068	Physics Lab Simulation (fysik)	IV
0069	Learning Experimental Game Simulation (legs)	V
0070	Florida State University On-Line Coordinated Index Use Study	V
0071	Finding Roots of Polynomial Equations and Related Concepts (alg)	V
0072	Development of a methodology for maximizing achievement and minimizing time	V
0073	Sequential In-Basket Exercise	V
0074	Individualized Instruction: Efficient Use of Teaching Assistants in College Psychology Instruction (pest)	V
0075	The Effect of Dogmatism and Trait Anxiety On State Anxiety During Computer-Assisted Instruction (psy7)	V
0076	Simulation of Cultural Problem Effects on a Diplomatic Career (mispo)	V
0077	Criterion Reference Instructional Modules Evaluation (crime)	V
0078	Computer Based Sequential Testing (seqt)	V

0079	A Demonstration of the Effectiveness of an Automated Health History Presented In a Student Health Facility (fpmh)	V
0080	Objective Test Item Study (obtst)	V
0081	Computer Assisted Instruction in Chemistry for High School Students (stra)	V
0082	Health Education 319 Presented via CMI (heed)	V
0083	Short-term Memory in Children as a Function of Stimulus Class and a Multiple Match Procedure (man)	IV
0084	Computers in Education - EDR 536 (cie)	V
0085	An On-line Computer Managed Introduction to Indexing (index)	V

* IV = checkout and revision
V = experimentation and analysis