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ABSTRACT

Research and development activities during 1971 of the Computer Assisted Instruction Center at Florida State University are summarized in this report. Discussions of activities are grouped under sponsorship categories: the research areas and project efforts which are described under the sponsorship category of the Office of Naval Research are organized according to subject areas, such as learner strategies, training strategies, validation strategies, and computer systems strategies. Abstracts of 1971 Center publications are also included in this section. Eight federally funded projects are reported on and the Center's current graduate program is briefly described. An overview of the Center's Division of Instructional Research and Service Sponsored Activities is presented, followed by an outline of Center personnel and equipment. Appended are a list of all 1971 Center publications and demonstrations. (SH)

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CAI CENTER

ANNUAL PROGRESS REPORT

January 1, 1971 through December 31, 1971

The Computer Assisted Instruction Center
Division of Instructional Research and Service
The Florida State University

April 1, 1972

Prepared by:

Duncan N. Hansen
Sally A. Luttrell
Bobby R. Brown
Paul F. Merrill
Barbara F. Johnson

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FLORIDA STATE UNIVERSITY

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I. INTRODUCTION

This report summarizes the research and development activities during 1971 of the Computer Assisted Instruction Center, Division of Instructional Research and Service, The Florida State University. Description of specific research areas and various project efforts are centered around objectives, rationale, and accomplishments, as well as future directions of investigations. Additionally, abstracts are provided for all 1971 publications, as informative summaries of our computer-assisted and computer-managed instructional research findings.

For purposes of clarity, reports of activities are grouped according to the following sponsorship categories: (a) Office of Naval Research; (b) Federally Funded Projects, including the Department of Health, Education, and Welfare, U.S. Office of Education, National Endowment for the Arts, U.S. Department of Labor, and the Air Force; and (c) Division of Instructional Research and Service of The Florida State University. Additionally a survey of developmental progress and objectives for the Center's current graduate program is examined.

Activities sponsored by the Office of Naval Research are presented under a bipartite schema: first, a prototypic definition of four generalized areas, including learner strategies, training strategies, validation strategies, and computer systems strategies; second, within each of the four areas, a particularized discussion of specific research and development progress and rationale.

Data on personnel and equipment configurations within the Center conclude the report. The appendices are comprised of (a) a cumulative listing of Center publications, (b) annual listing of articles published and papers presented by Center personnel, and (c) demonstrations given to visitors.

II. OFFICE OF NAVAL RESEARCH

Under the sponsorship of the Office of Naval Research, Department of Defense, the Florida State University Computer Assisted Instruction Center simultaneously conducts research and development in four interrelated 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 optimal sequence and placement of review materials 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 of testing instruments and in testing situations. Further topics are the CAI dynamic pictorial and graphic presentations as elements of information learning behavior, and the investigations of subjective factors in CAI learning.

1. **Effects of Task Variables on Informational Organization and Learner Strategies.** Several research studies have been conducted to investigate the interactive effects of learner characteristics and task variables on learner strategies. One of our

major areas of focus has been in the investigation of learner strategies in rule learning tasks. Results of an earlier study using an imaginary science as the learning task 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. Another study was conducted using rules from the APL programming language as the learning task in an attempt to replicate and extend the results of the previous study. In general, the effects of the earlier study were replicated. However, an interaction between reasoning ability and instructional treatments was not found. The results of this study also revealed that the availability of rules decrease the level of within-task state anxiety. A further study was conducted to investigate learner strategies in learner-control situations where the subjects have the option of receiving additional examples of rules irrespective of whether criterion performance has been met. Preliminary results indicate that there may be an interaction between the availability of objectives and the availability of learner control. Under computer control, subjects who received required fewer examples to reach criterion performance than those who did not receive objectives. Under learner control, subjects who received objectives took more examples than those who did not receive objectives.

Since the studies described above were designed to bring all subjects to a minimum criterion performance at each level of the task before they were allowed to go on to the next level, the effects of objectives and intra-task criterion test items could not be determined. Therefore, a third study was conducted to investigate the differential and interactive effects of the availability of behavioral objectives and criterion test items on the learning process. The results of this study indicated that objectives increase the amount of time subjects spend studying example displays. Differential relationships between state anxiety, reasoning ability, and treatment were also observed.

Future research will investigate the structural and sequence format of multiple examples and practice items on strategies for learning rules.

Additional study of variables in information organization encompassed the manipulation of words, phrases, and sentences within an immediate memory paradigm. Pilot testing and coding of the stimulus material was completed.

2. Adaptive Behaviors and Anxiety Processes. Because anxiety and adaptive behavior processes are integral to learner behavior in instructional situations, study and eventual control of these behaviors are essential to learners' strategies. Typically, CAI Center research investigates facilitative or debilitating effects of anxiety or attitude on performance. Extensions of this basic research include (a) examination of training behaviors in terms of drive theory and trait-state anxiety theory, and (b) eventual amelioration from this data of CAI training techniques. As with most Center activities, optimization is the global objective.

During 1971, five areas of research in adaptive behaviors and anxiety processes were pursued. In a combinative study on effects of anxiety, response mode, subject matter familiarity, and learning times on CAI learning achievements, goals were to (a) replicate previous findings on anxiety and response modes on achievement; and (b) extend these findings by creating a shortened instructional treatment designed to reduce state anxiety and task time, and thereby improve performance. Within the framework of a trait-state anxiety theory, data indicates the need to examine more

closely the intrinsic differences in the nature of CAI learning tasks, including differential affective and cognitive effects. In a second study, efforts were directed toward synthesis of standardized instructional materials, and concomitant recommendations for future use and/or revision of these materials in individualized instructional programs.

Study on effects of response mode, distraction and their interaction on CAI achievement was performed in context of medium variances between CAI and programmed instructional materials. Program modification designed to maximize CAI system capacity provided framework for study on (a) achievement level comparison from constructed response and reading administrations, and (b) effects of distraction and diversion intensity on achievement. CAI learning produced superior achievement; results suggest distraction is directly related to administration medium. The dual purpose of a fourth investigation was to ascertain the effect of behavioral objectives on achievement, and the effect of program sequence. Data suggests that objectives presented at the terminal or CRT would be more effective than those auxiliary to CAI; and that frame sequence does facilitate achievement, particularly in unfamiliar materials.

A study of the application of an adaptive strategy to reading rate was performed and the data have been analyzed. Results of the study indicate a more rapid information-processing rate under a performance-contingent condition coupled with the absence of any observable, undesired effects on anxiety or attitude. A paper reporting the results of this study will soon appear as a technical memo and has been accepted for presentation at the 1972 convention of the American Psychological Association. Continuing research in this area will concern the modification of pacing algorithms and the investigation of reading rate and comprehension as well as factual recall.

3. **Optimal Sequence and Placement of Review.** A major goal of instruction is the optimum retention of the learning material. A popular but relatively underdeveloped method of facilitating retention has typically been schedule of reviews; research indicates that such review has been effective in traditional courses.

With the recent emphasis on the design and planning of individualized instruction, concurrent need for development of systematic planning of review procedures is evinced. Present investigation areas for review procedures include quantity of review, repetition frequency in review, placement of review, and format of the review materials. In addition, since a good number of individualized courses allow students to self-pace, review models reflect a consideration of the possible relationship between placement of reviews and student pacing. A further consideration is that of student reaction to the course alterations, resulting from these reviews.

Previous computer-based review sequences have involved only short reacting passages. The present effort differs from previous models in that reviews are incorporated within individualized computer-managed instruction, and examination is made of the effectiveness of reviews in individualized, self-paced instruction.

The development of a data base on 124 FSU undergraduate students has been completed in this phase of research activity. The data base consists of (a) overall means, standard deviations, and reliability coefficient estimates of the major dependent variables; (b) the pretest analyses; (c) the final examination analyses; (d) temporal placement analyses; (e) total module performance score analyses; (f) state anxiety analyses; (g) attitude analyses; and (h) pacing data analyses.

As indicated, a second phase of the effort consists of assessment of the relationship of additional criterion item practice versus narrative review material to trait-state anxiety, with emphasis on implications of these findings for the review structure and format. Concurrently, consideration of the value of review in computer-managed instruction was investigated by study of advantages of (a) one review over none and (b) two reviews over one.

4. **Automated Testing Investigation.** Since the reliability and validity of automated testing procedures have been empirically established, present research and development efforts are centrally concerned with increasing, through revision, validity and with studying affective impact of such testing procedures. CAI research in automated testing encompasses both computer-based intelligence testing and computer-based personality evaluation.

In the area of personality evaluation, we have developed and are evaluating the validity of automation of the Minnesota Multiphasic Personality Inventory. Technological facets of this developmental effort include test administration, test scoring, and test interpretation. As a concurrent study, investigation was made of item response latencies of the computer-based MMPI, in comparison with other MMPI item characteristics. Separate stepwise regression analyses indicate that the number of characters in an item account for 47% to 58% of the latency variance. Such research findings indicate latency may not have the clinical significance often attributed to that variable. Further research areas on the computer-based MMPI encompass (a) affective aspects for subjects, in terms of anxiety and attitude; (b) continuing comparisons between computer-administered versus a traditional administration of the MMPI; and (c) examination of test-retest relationships.

Computer-based intelligence testing research efforts have centered largely around the Slosson Intelligence Test. Investigative results demonstrate the feasibility and validity of an interactive computer approach to the assessment of intelligence. Additionally, attitudinal and anxiety data were collected, indicating a complex interaction between the nature of the test and the quality of the computer programming procedures. This affective area is under further investigation. A second phase of this research concerns anxiety levels and test validity, as related to amelioration of present testing materials and methods. Studies being conducted vary computer-based learning games with computer-administered academic materials, prior to actual test time. Results of this experiential man-machine study should provide (a) implications for test mode procedures revision, (b) data base for decrease in anxiety level, and (c) increased validity for this approach.

5. **Dynamic Pictorial and Graphic Presentation via CAI.** As an investigative area, graphic and pictorial materials presentation in computer assisted instruction is chiefly concerned with memory processes as they relate to learner information processing. Research was initiated on short-term memory multiple match experiments, with pre-adult population as testing resource. Investigation was in dual areas, including (a) graphic stimulus variables of pictorial geometric and ideographic forms, and (b) single match versus multiple match retrieval processes of individuals. Results highlighted main effects of different pictorial and ideographic forms, and the effects of those forms on short-term memory performance. Extensive analysis of latencies was also carried out. This line of investigation was merged at the end of the year into the rule learning area.

A second phase of investigation into graphic and pictorial presentations concerned graphics oriented material on military history. Subjects were drawn from the university's ROTC unit. An extension of previous research, this effort replicated prior feedback findings. Data indicates the importance of graphics in organized CAI materials, to minimize training and learning variable effects. This area will be subsumed in the future into studies attempting to minimize learning difficulties.

6. **Individual Differences and Subjective Organization.** In the spring of 1971, we began an investigation into the nature of subjective organization. This variable was first observed in the context of free recall learning and is essentially an extension of the work done on associate and conceptual clustering. Subjective organization has been shown to be dependently related to performance in a variety of traditional laboratory tasks, but research on its relationship to meaningful school learning is lacking. Two lines of research are under way. We are currently analyzing correlative data from a variety of achievement measures and subjective organization obtained from ninth and twelfth grade black students in an effort to establish the construct validity of subjective organization. In the context of an experiment using college students, to be finished by June, we are investigating the relationships among subjective organization, verbal comprehension, associative (rote) memory, speed of closure, and verbal creativity, as well as the interactive effects of subjective organization in variously organized textual material. Basically, we are predicting performance differences between students high and low in subjective organization when textual material lacks organization. Furthermore, students differing in subjective organization ability, should select clustering strategies at different rates over learning trials. The methodology employed in this investigation, should provide much needed information about individual differences in a theoretical process variable and its relationship to learning from prose.

As a vehicle for research efforts, this health education course received three administrations in 1971. Applying a variety of instructional strategies, the three administrations were primarily concerned with treatment group comparisons on measures of performance, attitude, anxiety, and time. In the first field testing, the differential effects of four selected instructional strategies were compared; three strategies were CMI, while the fourth was traditional classroom instruction.

One of the CMI treatment groups, Remedial Prescription-Forced Mastery, represented the most typical CMI strategy. If students in this group failed to reach criterion on an objective, they were presented remedial prescriptions and were required to take another randomly chosen set of items until they reached criterion.

Students in the second treatment Remedial Prescription-Forced Progression group who failed to reach criterion on an objective were only presented the remedial prescriptions and were not permitted to repeat the failed posttest. In the forced progression group, students who failed to reach criterion on an objective were given neither remedial prescriptions nor were they permitted to repeat the failed posttest.

The results demonstrated a general superiority of the CMI groups over the CI groups on final examination performance. This superiority was attributed to (a) a greater degree of familiarity with the objectives and criteria for the CMI groups; (b) differential content emphasis; (c) the positive effects of frequent testing; (d) the composition of the final examination; and (e) possible differences in levels of achievement motivation on the final examination.

The second administration attempted in-depth extension of previous strategies research, and innovated the inclusion of state anxiety as a variable in CMI evaluation as well as the testing for efficacy of review and varied temporal placements as related to student self-pacing. Data from the first field test was utilized in ascertaining pacing techniques.

The overall objective of the study was to ascertain both cost-effective and optimally-instructive reviews within an individualized self-paced course. After completing study on one of eleven modules, each student underwent evaluation at the terminal. Those not reaching criterion were prescribed remedial activities; however, criterion mastery was not mandatory.

Random assignment was made to one of four review groups. (a) Distributed Review group: presented with two review sessions on each of the first five modules. These review units were distributed evenly over the length of the course, with five sessions in the first half of the course and five sessions in the last half. (b) Pseudo-Distributed group: presented with the same review materials as the DR group, but the sessions were arranged in such a manner that they were completed when students went through the sixth module. (c) Massed Late Review group: presented with the same review materials as the other two groups. However, the materials were presented in one comprehensive review session, before students went through the last module. And (d) Control group: did not receive any reviews. Results indicate that consistent pacing produces significantly better performance than does massed pacing. Further research is planned to investigate the validity of pacing as an affective variable on performance and as an index to student review needs. Additionally, lower state anxiety was found to result when reviews were similar in format to subsequent performance tests.

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.

1. **Computer Managed Instruction.** The distinctive characteristic of our CMI approach is the utilization of a student-terminal interaction capability. In general, these CMI courses are divided into learning modules which include objectives, references, and evaluation measures. A student usually chooses his own sequence and paces himself through the course, using learning materials available in the CAI Center. When a student feels he has sufficiently studied the references to enable him to reach an objective, he interacts with the computer for individual evaluation. The computer records and scores the test responses and can allow the student to progress to the next module, can require more evaluation, or can provide remedial prescriptions. Thus, it is the immediate computer decisions imparted to students in the form of feedback and/or remedial activities which constitute the major advantages of our CMI.

a. **Undergraduate Level CMI.** The most extensive of these CMI courses, in terms of students processed, is the undergraduate health education course. This ample subject pool provides excellent resources for investigations of optimal training strategies within CMI. As a comprehensive goal, research centers upon performance-enhancing learner strategies which optimize CMI instruction. Basically, investigative efforts comprise a series of programmatic studies in optimal course revision strategies and alternative prescriptive-remediation techniques within the CMI paradigm. Specifically, previous investigation has dealt with effects of selected instructional strategies on student confidence, study time, terminal time, studying strategies, attitudes, and performance, particularly in terms of remediation/success criteria.

In the third course administration, primary concern was with revision techniques in terms of identification of positively effective revision methods and of techniques which effect objectives mastery. In this study an 80/80 goal was reached by the students, thereby indicating the validity of revision techniques. The investigation provided needed empirical evidence that given a revision subsystem, instructional materials and course operational procedures can be developed which insure a high proportion of students reach a given level of mastery. The bipartite revision process effected in this administration was based upon data collected from student performance measures, attitudes, opinions; and judgements of content experts and educational technologists.

Additionally, the health education course was this year the focus for a pilot study of the role of curiosity. In two field tests applied to 192 students, curiosity trait and state measures were administered at appropriate sequential points for both high and low interest learning modules. The specific goal of the study was to ascertain the relationship of curiosity to performance, in terms of predictive variables. Data from these studies will be utilized in future research within the CMI course, and should prove invaluable in investigation of learner strategies.

b. **Graduate Level CMI.** A graduate-level computer-managed instruction course entitled, "Techniques of Programmed Instruction" has served as a valuable vehicle for investigating computer-managed instruction techniques and also for investigating instructional variables in an actual on-going setting. This course was utilized to investigate the effects of presenting objectives to students in a graduate CMI course. The students who registered for the course during the Spring 1971 quarter were randomly assigned to an objective group and a no-objective group. The hypotheses, based on previous laboratory studies, that objectives would decrease test-item response latency, increase study time, and facilitate performance on unit tests were not supported. Objectives did significantly reduce state anxiety; however, even that effect diminished as the course progressed. Apparently, graduate students are able to "psych out" a course very rapidly and objectives have little effect.

2. **Sequential Testing.** 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.

In developing the multivariate prediction model, previous computer-based sequential testing usage of right-wrong performance measures were rejected. The multivariate prediction model should increase classification accuracy beyond that achieved with binary-coded item response data. As such, our model is expected to contribute substantially to present sequential testing procedure. At present, the multivariate prediction model is in final stages of conceptualization, prior to initialization of implementation procedures. Additional consideration in this research effort is being given to the size of the unit for sequential testing items; i.e., whether decisions are made on the basis of single or grouped items.

The role of test item sequencing on test performance is also being investigated in a series of studies. The importance of extending research of this kind relates to the appropriateness of present practices of test construction wherein test items are arranged in order of increasing difficulty. As results obtained from these tests are used both to classify students and to evaluate the effectiveness of instruction, it is crucial that the effects of test-item sequencing be evaluated. The first study in this sequence is being conducted to examine the effects of test-item difficulty sequencing on the performance of students differing in levels of facilitating and debilitating anxiety. The hypothesis that item-difficulty sequences are differentially anxiety inducing is also being investigated. In a subsequent study the test items will be presented by a computer-assisted instruction system. This will facilitate the collection of data to investigate the effects of test-item sequencing on response latency. Future research will focus on the effects of assigning students to different item-difficulty sequences according to individual difference characteristics in an attempt to optimize test performance for each student.

3. **A Computer-Based Learning Information Retrieval System.** Planned and developed as an instructional tool, FOCUS (Florida State University On-line Coordinate Index Use Study) is centered around a decision-making model of index preparation and use. Prior to phase-out of this School of Library Science course from the CAI Center, Dr. Gerald Jahoda and Ferol A. Foos had completed four of five project stages. The projected phases were: (a) planning of indexing system, (b) preparation of the first index version and usage in teaching, (c) enlargement and refinement of the index and preparation of additional instructional material, (d) use of the enlarged and refined index in teaching, and (e) use of the index in research. (Steps one and two were completed here in 1970; steps three and four were completed as of July 1971.

In 1971 the data base for the index consisted of 1856 documents on library automation, systems studies in libraries, and indexing; as well as an on-line computer searched coordinate index, printed coordinated index, abstract bulletin, subject authority list, computer-aided instruction programs for index searching and preparation, and a programmed text for index preparation. The original Coursewriter II index searching exercise was completely revised; the new program, SEARCH, retains basic elements of the decision-making model but is a console exercise with consistent computer language and provides immediate feedback to the student. In early 1971, PREP, an index

preparation exercise comparable to SEARCH, was also developed. Revision and updating of concomitant tools were also performed in 1971. Future use of FOCUS will be with the University's CDC 6400 computer; techniques and programs developed in the CAI Center study will be used for the preparation of indexes to other university data bases.

C. Validation Strategies

CAI represents a major technological systems approach to training which has far reaching implication for the human-oriented training systems that presently exist in the military. The sociological issue seems 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 and CMI approaches. Cost factors for these roles and their possible shift remain one of the unexplored domains in the CAI and 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 and CMI models within existing military systems.

Project ENRICH. Established in November 1968, Project ENRICH (Experimental Naval Reserve Instruction with Computer Help) recognized the need to improve the moment-to-moment management of the training process and to enhance the feasibility and validity of a CMI model for Seaman recruits. Since the first feasibility and validity study of a CMI model, the value of the ENRICH concept and program has been reviewed and tested in several ways, primarily through activities in the area of educational technology. In its most extensive effort, the ENRICH team has developed a successful training procedure for the advancement of Naval Reserve Seaman Recruits.

Computer-supported management and instructional procedures were devised, using conventional curriculum content from several sources. They were applied to two samples of recruits, with appropriate modifications from the first to the second application. Final results reveal that the ENRICH SR curriculum produced superior achievement, large savings in training time, greater reliability of training management, and good morale effects.

On the basis of the analysis of the performance data, especially the results obtained for the trainees who participated in ENRICH II, it was tentatively concluded that the CMI approach to the training of Naval Reserve Seaman recruits is an effective method of instruction. In the operational phase of the program, trainees achieved a higher level of performance in a shorter period of time than did SRs of comparable ability trained during previous years using conventional training methods. The interview data provides evidence that the trainees developed positive attitudes towards their Navy work and enjoyed the CMI procedures. Given the small number of trainees available to us for the evaluation studies, it was not possible to do the type of evaluation that would permit a definitive statement regarding the advantages of CMI. Nevertheless, the results may be considered promising and suggest that it would be worthwhile to carry out more definitive studies to determine the range of applications of CMI procedures to Naval Reserve training.

D. Computer Systems Strategies: D-17 Minuteman I Computer

The release into the market of small general purpose computers with capabilities exceeding those of the D-17 and at prices below the concession cost of the D-17 led to the decision to abandon the project of converting the D-17 computers for CAI application.

E. Abstracts of Studies

In the year 1971, twenty-three publications were issued from the CAI Center, intended to communicate the research finding from studies and sponsored projects that have direct implication for the role of computers in education and training. CAI publications are classified primarily as systems memos, technical reports, or technical memos, depending upon the nature and extensiveness of subject treatment. Beyond that primary classification, each of the publications parallels in area of emphasis the four major component areas described in the preceding sections: learner strategies, training strategies, validation strategies, and computer systems strategies.

Abstracts of the twenty-three publications are presented here, categorized by component area. A complete listing of Center publications is presented in Appendix A.

Learner Strategies

"The Complete Automation of the Minnesota Multiphasic Personality Inventory and A Study of its Response Latency." Thomas G. Dunn, Robert E. Lushene, and Harold F. O'Neil, Jr. Technical Memo No. 28, The Florida State University, January 30, 1971.

The purpose of this research study was twofold: to test the feasibility of completely automating the Minnesota Multiphasic Personality Inventory (MMPI) and to compare item response latencies with other MMPI item characteristics. A total of 26 scales was successfully stored automatically for 165 students. The program also typed a Mayo Clinic interpretive report on a terminal, seconds after the student had completed the MMPI.

For the entire MMPI item pool, separate stepwise regression analyses for males and females indicated that the number of characters in an item accounted for 47% to 58% of the latency variance. The variables item ambiguity, social desirability and social desirability- dispersion, accounted for only 3% to 8% of the variance. However, when considering the 38 MMPI critical items, "deviant" response latencies were found to be longer than "non-deviant" response latencies. In a replication experiment the results were almost identical. Therefore, except for subsets of personality items like the critical items, latency may not have the psychological or clinical significance often attributed to that variable.

"Review of Automated Testing." Duncan N. Hansen, John J. Hedl, Jr., and Harold F. O'Neil, Jr. Technical Memo No. 30, The Florida State University, February 26, 1971.

The primary purpose of this study was to review the background literature on automated psychological testing. In this respect, research and development efforts were discussed within the traditional evaluation model involving test administration, test scoring, and test interpretation. A more inclusive model of the assessment process is discussed which reveals future possibilities for computer applications. Preliminary specifications and required developmental activities needed to operationalize this multi-test multi-professional assessment model are outlined within the framework of a psycho-educational information management system.

"The Effects of Trait Anxiety and Dogmatism on State Anxiety during Computer-Assisted Learning." Edward Rappaport. Technical Memo No. 33, The Florida State University, May 15, 1971.

This study was concerned with the effects of anxiety and dogmatism in computer-assisted learning. Several hypotheses based on Rokeach's conception of dogmatism and Spielberger's Trait-State Anxiety Theory were set forth. Female students were selected on the basis of extreme scores on the STAI A-Trait Scale and the Dogmatism Scale. The computer-assisted learning task consisted of difficult mathematical problems presented by an IBM 1500 CAI system.

The hypothesized relationship between dogmatism and A-State was not confirmed. When controlled for A-Trait, HD and LD students did not differ in the level of A-State displayed during the experiment. As hypothesized, HA-Trait students had significantly higher levels of A-State during the experiment than LA-Trait students.

Neither A-Trait nor dogmatism was related to errors on the CAI task. However, a significant interactive effect of math ability and A-State on performance was observed. HA-State resulted in more errors for low math ability students but had no effect on the performance of high math ability students. This finding was explained in terms of Drive Theory.

"The Development of a Measure of State Epistemic Curiosity," Barbara L. Leherissey. Technical Memo No. 34, The Florida State University, May 3, 1971.

The development of a theoretically-derived measure of state epistemic curiosity, the State Curiosity Scale (SCS), was described. Reliability and validity data was collected in two empirical studies with female undergraduate students. Alpha reliability coefficients of .87 in Study I and .89 in Study II were found. Concurrent validity findings included a significant positive correlation between the SCS and the Ontario Test of Intrinsic Motivation (OTIM), a trait measure of specific curiosity. That is, students high in trait curiosity were found to have higher levels of state curiosity than students low in trait curiosity. Indirect evidence of the construct validity of the SCS were the findings of a significant negative correlation between state epistemic curiosity and state anxiety, and a significant positive correlation between state epistemic curiosity and performance in a Computer-Assisted Instruction (CAI) learning task.

"Effect of Anxiety, Response Mode, and Subject Matter Familiarity on Achievement in Computer-Assisted Learning." Barbara L. Leherissey, Harold F. O'Neil, Jr., and Duncan N. Hansen. Technical Memo No. 41, The Florida State University, August 10, 1971.

Effects of trait and state anxiety levels (low, medium, high) and response modes (reading, covert, modified multiple choice, constructed response) on posttest achievement for familiar and technical materials dealing with heart disease were investigated. Learning materials were presented to 148 subjects via computer-assisted instruction. High trait anxiety was associated with high state anxiety for all groups. Constructed response and reading groups performed significantly better than covert and multiple choice groups on technical but not familiar materials. However, the constructed response group had higher levels of state anxiety and longer learning times than other response mode groups.

"Effect of Anxiety, Response Mode, Subject Matter Familiarity, and Learning Times on Achievement in Computer-Assisted Learning." Barbara L. Leherissey, Harold F. O'Neil, Jr., Darlene L. Heinrich, and Duncan N. Hansen. Technical Memo No. 42, The Florida State University, September 1, 1971.

Effects of trait and state anxiety (low, medium, high), response modes (reading, constructed response), and program length (long, short) on posttest achievement for familiar and technical materials dealing with heart disease were investigated. The hypothesis that shortening time spent on the CAI task would reduce state anxiety and improve technical posttest performance was not supported. On the familiar posttest, however, shortening program length was effective in improving performance for the constructed response group. In addition, the constructed response groups were found to have higher levels of state anxiety and hostility during the task than the reading groups.

"Temporal Position of Reviews and its Effect on the Retention of Mathematical Rules." Lorraine Rumbel Gay. Technical Report No. 18, The Florida State University, April 30, 1971.

The purpose of this study was to investigate the mathematical rule learning one variable, spaced review, which verbal learning studies have indicated is important for retention. The effect of temporal position of review was investigated in two experiments: experiment I involved one review; experiment II involved two reviews. The methodology for both experiments paralleled that employed in meaningful verbal learning research.

Experiment I compared the relative effectiveness of one review placed either one day (Group I), one week (Group II), or two weeks (Group III) after original learning. Learning consisted of four rules presented via computer-assisted instruction. Subjects utilized varying numbers of examples, all learning to a common criterion of two consecutive correct problem solutions. The four rules involved principles from algebra and geometry: raising an algebraic expression to an indicated power, determining the measure of the third angle of a triangle, determining the exponent of the product of factors, and finding the geometric mean.

Fifty-three eighth grade students were pretested, presented with the learning task and randomly assigned to one of four groups; the four groups were the three groups described above plus a control group which received no review. The review procedure was very similar to the learning procedure only in that it began with the presentation of two new problems. All subjects relearned to a criterion of two successful problem solutions for each rule.

Three weeks from the day of original learning, all subjects were administered a delayed retention measure on the four rules. While all review groups retained considerably more than the no review group, temporal position was not significant. These findings are consistent with previous research on meaningful verbal learning.

Experiment II compared the relative effectiveness of two reviews placed either one and two days (Group I), one and seven days (Group II), or six and seven days (Group III) after original learning. Sixty-seven seventh grade students were pretested, presented with the learning task, and randomly assigned to one of four groups; the four groups were the three groups just described plus a control group which received no review. The learning and review procedures were identical to those described for experiment I, all subjects learning to a common criterion.

Three weeks from the day of learning all subjects were administered a delayed retention measure on the four rules, the same one used in experiment I. All review groups retained significantly more than the no review group. Also the group with both

an early and a delayed review retained significantly more than the group with two early reviews. This suggests that while an early and a late review each make a unique contribution to retention, the contribution of the latter is greater.

It was also found that in general, subjects in all groups required the same number of examples to reach criterion at the time of review 1 as at the time of original learning. At the time of review 1, however, example latency was approximately 50 percent shorter than at the time of learning. In contrast, at the time of review 2, subjects required half as many examples to reach criterion as at the time of learning, with example latency being 75% shorter.

"The Effects of Various Review Paradigms on Performance in an Individualized Computer-Managed Undergraduate Course." Thomas G. Dunn. Technical Report No. 22, The Florida State University, August, 31, 1971.

The objective of this study was to investigate how to plan reviews within an individualized self-paced undergraduate course

The students who enrolled in Health Education 319 for the Spring Quarter, 1971, served as subjects in this experiment. This course was conducted utilizing the student interactive capability of Computer-Managed Instruction at the Florida State University Computer-Assisted Instruction Center. The following specific questions were investigated: (a) will reviews facilitate retention; (b) which review format will be more effective, objective questions or paragraph-like statements; (c) how will the placement of reviews affect retention; (d) what will be the effect of student pacing on performance, with or without reviews; and (e) how will students react (state anxiety and attitude) to the changes in course procedures which result from including reviews within the course.

The results for several dependent measures indicated that reviews did not significantly facilitate retention. In addition, the review treatments did not differ among themselves with respect to format and placement variables. It was concluded that the reviews should be more comprehensive and greater in number. In addition, since these improved reviews would take more time, they should be presented to those students who demonstrate a need for review. In this manner, Computer-Managed Instruction would remain cost-effective.

The results of the pacing analyses revealed that subjects who paced consistently performed significantly better than subjects who massed their coursework. In addition, for one performance measure (TPT1) a pacing by amount of review interaction was found indicating that the amount of review did not contribute to the performance of consistent pacers but did contribute to the performance of nonconsistent pacers. It was suggested that further research be conducted to determine if pacing does in fact affect performance and also, that pacing may provide information about those students who may have the greatest need for reviews.

With respect to affective measures, there was a significant main effect for the state anxiety data with subjects receiving question reviews having lower state anxiety scores than subjects receiving paragraph reviews. It was concluded from these results that planning reviews similar in format to a subsequent performance test may result in lower state anxiety while taking this test.

"The Effects of Stimulating State Epistemic Curiosity on State Anxiety and Performance in a Complex Computer-Assisted Learning Task." Barbara L. Leherissey.

Technical Report No. 23, The Florida State University, December 1, 1971.

The present study sought to: (a) investigate the hypothesis that stimulating state epistemic curiosity within a complex Computer-Assisted Instruction (CAI) task would reduce state anxiety and improve performance; (b) assess further the reliability and validity of the State Epistemic Curiosity Scale (SECS; Leherissey, 1971b); and (c) integrate the findings within the theoretical framework of the Optimal Degree of Arousal concept.

Subjects were 152 female undergraduates enrolled in psychology and education classes. Their trait curiosity and trait anxiety differences were ascertained by extreme scores on the Ontario Test of Intrinsic Motivation (OTIM; Day, 1968) and the State-Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, & Lushene, 1970), and these scores were the basis for equal assignment to Curiosity-Stimulating Instruction (CSI) or No Instruction (NI) conditions within a Reading (R) or Constructed Response (CR) program version. Curiosity-Stimulating Instructions presented prior to the learning materials were designed to increase desire to (a) know more about a learning task; (b) approach a novel or unfamiliar learning task; (c) approach a complex or ambiguous learning task; and (d) persist in information-seeking behavior in a learning task. Students in the NI condition were given a brief rest in place of these instructions.

The CAI learning program consisted of technical materials explicating myocardial infarction diagnosis. State epistemic curiosity, as measured by the SECS, and state anxiety, as measured by the STAI, were assessed periodically via CAI.

Hypotheses on relationships between curiosity, anxiety, and performance were derived from the Optimal Degree of Arousal concept which provides a theoretical model for these predictions. As predicted, (a) high state curious students had lower levels of state anxiety and performed better than low state curious students; and (b) high trait curious students had higher state curiosity scores than low trait curious students.

The hypothesis that students in the CSI condition would perform better than students in the NI condition was only partially supported in that (a) high state anxious students in the CSI condition performed better than high state anxious students in the NI condition, whereas there was little difference in the performance of low state anxious students in these conditions; (b) both low trait and low state curious students in the CSI condition performed better than low trait or low state curious students in the NI condition, whereas there was little difference in the performance of high trait or state curious students in these conditions; and (c) in the CSI condition, the CR group performed better than the R group, whereas there was little difference in the performance of either group in the NI condition.

Contrary to predictions, neither state anxiety nor state curiosity differed for students in the CSI and NI conditions. Regardless of instruction conditions, initially high curiosity declined throughout the CAI task. However, the CR groups had a greater decline in state curiosity and increase in state anxiety than the R groups. In addition, only high trait curious and low trait anxious students in the R groups maintained their initial high levels of state curiosity and low levels of state anxiety, respectively, throughout the CAI task.

With respect to the reliability and validity findings, the SECS was found to have high internal consistency and substantial concurrent and construct validity. The findings were generally supportive of the predictions derived from the Optimal Degree

of Arousal concept. On the basis of an integration of the data collected, however, extensions and refinements of the Optimal Degree of Arousal concept were offered via a new theoretical model, the Three Factor Model.

"An Evaluation of a Computer-Based Intelligence Test." John Joseph Hedl, Jr. Technical Report No. 21, The Florida State University, June 1, 1971.

The general purpose of the present study was to investigate a computer application to the area of individualized intelligence testing. Primary emphasis was placed on questions relating to the feasibility, reliability, and validity of a computer-based administration and scoring program for the Slosson Intelligence Test (Slosson, 1963). Specifically, the evaluation focused on concurrent validity relationships with the Wechsler Adult Intelligence Scale (Wechsler, 1955). In addition, predictive validity in terms of college grade point average was compared in terms of forecasting efficiency. Certain affective variables (student attitudes and anxiety) were studied to determine their relationship to the computer-based and traditional examiner test administration procedures. Examiner ratings of student testing behaviors were related to the attitudes and anxiety variables.

The computer-based Slosson Intelligence Test (CB-SIT) was designed to operate with an IBM 1500 Instructional System (IBM, 1967). The test items were individually presented on a cathode ray tube. Students entered their answers for immediate computer evaluation. The answer analysis algorithms were based upon a key word/phrase dictionary for each item which was developed from previous test item protocols. If the student was scored as either correct or incorrect, the program continued to the next item. If the answer was scored as partially correct, the student was instructed by the computer to more fully explain his response.

Forty-eight undergraduate students (24 males and 24 females) were individually tested with the WAIS, SIT, and CB-SIT. A latin square design was employed to counterbalance potential order and sequence effects of the three different intelligence test administrations. In addition, each testing session included an administration of an attitude scale and anxiety scale both before and after each testing period. A time period of approximately one week separated the different test administrations.

Within the context of the latin square design, the CB-SIT was shown to correlate .75 with a traditional examiner administration of the SIT. More importantly, equivalent concurrent validity relationships with the WAIS were shown as follows: the CB-SIT correlated .54 with the WAIS and the SIT correlated .52 with the WAIS with a college population. In terms of predictive validity, the best predictor of college grade point average in terms of R^2 was the CB-SIT.

In terms of the affective measures, the computer testing experience lead to higher levels of state anxiety in comparison to either of the two examiner testing sessions. The student attitude results were fairly consistent with the anxiety results. Generally, attitudes toward examiner testing increased for the pre to post measurement periods, whereas attitudes toward the computer testing procedures decreased over the same measurement periods.

Examiner ratings of test behavior were found to be significantly related to the performance of the subjects. In addition, these ratings were also shown to be positively related to the student attitude measures and negatively related to the state anxiety scores.

The results of the present investigation demonstrated the feasibility and validity of an interactive computer approach to the assessment of intelligence. In addition, the attitudinal and anxiety data indicated that there might be a complex interaction between the nature of the test and the quality of the computer programming procedures that in turn determines the affective nature of automated testing procedures.

Training Strategies

"Task Analysis--An Information Processing Approach." Paul F. Merrill. Technical Memo No. 27, The Florida State University, April 15, 1971.

Several concepts and techniques used to design computer simulation of human performance were used in developing an information processing approach to task analysis. This new approach was compared and contrasted with Gagne's hierarchical task analysis model. Neither hierarchical nor information processing analysis would be sufficient for all types of tasks. A hierarchical analysis would be appropriate where lower ordered skills generate positive transfer to higher level skills, while an information processing analysis would be utilized where the output of one task subskill or operation is required as input for a succeeding operation.

"Two Applications of Simulation in the Educational Environment." David B. Thomas. Technical Memo No. 31, The Florida State University, February 26, 1971.

Computer-based learning simulations are a relatively recent development within the educational process. This paper focuses on the simulation techniques that allow for interactive responding via a time-shared computer terminal. Two simulations which provide a laboratory-like means for student involvement with complex quantitative models are discussed in the context of an individualized learning environment. **STATSIM**, exercises in statistics, permits the student to explore simulated representations of descriptive and inferential statistics relating to sampling distributions, the concepts of Type I and Type II errors, and the sequential nature of hypothesis testing. The simulation of mathematical learning models provides a student laboratory for investigation of associative learning. The paper concludes with a discussion of an experimental investigation of student control of instructional sequence in which learning simulations were employed as learning materials. The results suggested that naive students may show increased performance when permitted learner control over instructional sequence.

"Systems Concepts and Computer-Managed Instruction: An Implementation and Validation Study." Walter Dick and Paul Gallagher. The Florida State University, Technical Memo No. 32, April 15, 1971.

This report describes the utilization of systems concepts in the development of a course which was presented to students via terminal-oriented, computer-managed instruction. In order to test this model of CMI, systems concepts were utilized to develop a course, Techniques of Programmed Instruction, a graduate-level course in the FSU College of Education. The model includes problem identification, task analysis, assessment of entry behaviors, behavioral objectives, criterion-referenced evaluation instruments, instructional sequence and strategy, media selection, implementation, and evaluation.

In the evaluation study, several experimental treatment variations were investigated. One variable was the comparison of the performance of students who selected their own instructional sequence as compared to those who were required to follow a set sequence. The other comparison was between the performance of students

who interacted with graduate assistants as they evaluated their progress in the development of a programmed instruction sequence. The other students interacted directly with the computer in order to assess their progress.

The analysis of the results indicated no significant differences among the experimental treatment groups. An accurate analysis of the time and effort required on the project indicated that the developmental costs were approximately \$9000, while the implementation cost for 59 students was approximately \$3500.

"An Investigation of the Effects of Two Types of Instructional Terminals in Computer-Managed Instruction." Bobby R. Brown, Wallace H. Hannum, and Walter Dick. The Florida State University, Technical Memo No. 36, May 15, 1971.

This paper reports the findings of an experiment in which 28 students taking a credit earning graduate level course in techniques of programmed instruction were randomly assigned to either cathode ray tube or teletype terminals.

Results from the analysis of the final concept test data revealed that students performed equally well regardless of terminal device. Apparently the information load in the CMI system is sufficiently low to allow acceptable performance without the necessity for some form of memory support. The difference in error rate is interpreted to reveal a diminished effect of memory support on reducing errors. This effect of memory support has been found in CRT's using CAI learning materials. The failure to find this effect in this study is probably due to the difference in CMI and CAI; i.e., CMI does not present instructional material that may require some form of memory aid for effective learning.

There was a significant difference in the performance of the CRT and teletype groups on the course product. A further analysis of the data revealed that as a whole, the CRT completed the units on the concepts at an earlier date than did the teletype group as well as spending less time interacting with the system. Apparently the students in the CRT group began work on their products earlier than the teletype group.

As was expected the CRT group spend significantly less time signed-on to the CMI system. This probably reflects the operating speeds of the terminal devices rather than any other factor.

"A Feasibility Study of Tutorial Type Computer-Assisted Instruction in Selected Topics in High School Chemistry." Lee Summerlin. Technical Memo No. 39, The Florida State University, July 26, 1971.

There are no adequately tested, tutorial-type CAI programs currently available at the high school level in chemical education. The problem selected for this study was to determine the effectiveness of short-term, tutorial-type computer-assisted instruction in selected topics in high school chemistry. To determine CAI effectiveness, posttests specifically designed for this study were administered at the completion of the study and 60 days later. Control group students generally performed 20% higher than did CAI students on both posttests. The CAI student group, however, showed approximately a 50% time savings over traditional instruction. Most CAI group students were able to complete the chemistry program in from one third to one half time required by classroom students. The increased learning rate called for self pacing and meaningful time usage not ordinarily encountered in traditional instruction; students in CAI felt challenged to productivity. Student interest in CAI was high; and student attitude toward CAI was generally favorable.

"Use of an On-Line Searched and Printed Coordinate Index in Teaching." G. Jahoda and Ferol A. Foos. Technical Memo No. 40, The Florida State University, July 30, 1971.

An indexing system to 1850 documents on library automation, systems studies in libraries, and indexing systems was developed for use in instruction and research. The indexing system consists of an on-line searched coordinate index, a printed coordinate index, a subject authority list, an abstract bulletin containing the 1850 documents in the index, computer-assisted instruction for index preparation and searching, and a programmed text for teaching index preparation. The system has been used for instruction of graduate library school students in index preparation, searching, and evaluation.

"An Investigation of Selected Instructional Strategies in an Undergraduate Computer-Managed Instruction Course." R. Michael Lawler. Technical Report No. 19, The Florida State University, April 30, 1971.

This study investigated the differential effects of selected instructional strategies in a computer-managed instruction (CMI) learning environment. The investigatory questions were primarily concerned with treatment group comparisons on measures of performance, attitude, and time. Questionnaires and other self-report measures were used to characterize student strategies.

The sample consisted of 167 undergraduates in a health education course at Florida State University. Forty-one of these students received traditional classroom instruction (CI group) and served as a control group. The remaining students were randomly assigned to one of three CMI treatments. For these latter students, the course was divided into 14 modules with a total of 32 objectives. Throughout the course, module posttests were administered which consisted of 5 items per objective which were randomly selected from a pool of 15 items. The criterion for passing a module test was set at 80%.

During the first week of classes, the pretest and other evaluative instruments were administered to all students. For the remainder of the quarter, the CMI students proceeded with their study of appropriate self-instructional materials. When a student felt prepared to be tested, he scheduled computer time and was administered the posttest on the module he had completed. Upon course completion, the evaluative instruments and final examination were administered to all students. Half of these items were used in the module posttests, the other half were used only on the pretest and final examination.

One of the CMI treatment groups, Remedial Prescription-Forced Mastery, represented the most typical CMI strategy. If students in this group failed to reach criterion on an objective, they were presented remedial prescriptions and were required to take another randomly chosen set of items until they reached criterion.

Students in the Remedial Prescription-Forced Progression group who failed to reach criterion on an objective were only presented the remedial prescriptions and were not permitted to repeat the failed posttest.

In the Forced Progression group, students who failed to reach criterion on an objective were given neither remedial prescriptions nor were they permitted to repeat the failed posttest.

The results demonstrated a general superiority of the CMI groups over the CI groups on final examination performance. This superiority was attributed to (a) a greater degree of familiarity with the objectives and criteria for the CMI groups; (b) differential content emphasis; (c) the positive effects of frequent testing; (d) the composition of the final examination; and (e) possible differences in levels of achievement motivation on the final examination.

The results of performance and attitude measures failed to demonstrate the efficacy of requiring forced mastery only or of providing remedial prescriptions only. However, the group required to reach mastery, which was also given remedial prescriptions, had significantly greater mean final examination scores than the group which was not required to reach mastery nor given prescriptions. These data supported the interpretation that with this initial field test of the course, the effects of content organization, presentation format, and frequent testing overshadowed the more subtle effects associated with the differential CMI treatment characteristics.

Comparisons of time indices among the CMI groups indicated no significant differences in study time or in the number of days required to complete half or all of the module posttests. Limited evidence suggested that the Remedial Prescription-Forced Progression group required significantly less computer time. Average time on the computer for all CMI students was approximately 3.5 hours, while CI students spent 30 hours in the classroom.

Finally, self-report measures and anecdotal remarks suggested that: (a) some students disliked the forced mastery requirement; (b) student "studying" strategies were influenced by the course content and instructional method; and (c) students of different strategy "types" performed differentially on the final examination.

"Information Processing Models for Reading Skill Acquisition." Duncan N. Hansen. Technical Report No. 20, The Florida State University, May 30, 1971.

Reading has a multivariate nature, requiring extensive model building in order to gain any generalizability across content, students, and situational variables; thus, explicit representation of information processing models via computer programs provides a framework for theorizing and hypothesis testing. This study highlights the simulation concepts which have been utilized to specify the purposive behaviors of reading/learning processes. Highly promising for understanding the reading/learning process, three generic types of IP models are considered: (a) the General Problem Solver, in terms of concepts of purposive behavior processes, hierarchies, means-end analysis, memory structures, and personality processes; (b) interactive natural language models as exemplified by the work of Weizenbaum, providing representation of the decomposition and semantic processing requirements necessary for reading comprehension skills; and (c) instructional models, contributing to a theoretical context within which optimal learning sequences can be identified for reading.

This study then turns to an analysis of component processes commonly found within information processing models: information structures, process components, and systems processes. A brief review of recent empirical research findings follows. Highlighted are some important aspects of reading comprehension previously overlooked, but which need to be developed in the near future in order to realize present potential promise. These include (a) increasing evidence for the requirement to have an internal self-inspection capability which represent the monitoring process found in skillful readers;

(b) considerable research efforts needs to be given to studying how people learn to debug their own problem solutions, or how the skills of error analysis are applied; (c) work on instructional quantitative models needs to be complemented by allowing readers to evolve strategies in long passages, thereby offering some prediction concerning self-determined reading rate and the organization of serial and parallel processing of the comprehended information.

Validation Strategies

"Project Enrich Report." Prepared by William Maloy, Charles Spielberger, Richard Dunahm, Mark Levin, and Donald Shontz. The Florida State University, May 1, 1971.

This report presents development efforts, findings and results in the Project ENRICH program and the ENRICH concept. Extant since November 1968, Project ENRICH is the joint effort of the Computer-Assisted Instruction Center with the Naval Reserve Training Command, NRSD, 6-37S, Naval Reserve Training Facility of Tallahassee. ENRICH personnel, involved in completion of FITS packages and a computer-supported cadre training strategy, were primarily concerned with development and evaluation of the ENRICH Seaman Recruit Curriculum. All recruits underwent the 9-lesson training sequence; the main measure of the performance was the Standard Navy Advancement Examination for SA. Each trainee was also personally interviewed as part of a systematic procedure to evaluate and upgrade the program. Instructional management and innovations included the ENRICH Drill Plan, focused instruction, monitored self study, CRT Training Sequence, standard training appraisal and standard dismissal sequences.

On the basis of the analysis of the performance data, the report concludes that the computer-managed instruction approach to the training of Naval Reserve Seamen recruits is an effective method of instruction. In the operational phase, trainees achieved a higher level of performance in a shorter period of time than did SRs of comparable ability trained during previous years using conventional training methods. The interview data provides evidence that the trainees developed positive attitudes towards their Navy work and enjoyed the CMI procedures. The report concludes with recommendations for further, more definitive studies to determine the range of applications of CMI procedures to Naval Reserve Training.

Computer Systems Strategies

"Measurement Techniques for Individualized Instruction in CAI." Duncan N. Hansen and Barbara F. Johnson. Technical Memo No. 35, The Florida State University, May 15, 1971.

Individualized instruction presents problems in measurement which challenge the conventional measurement paradigms. Taking into consideration the problems of item variance characteristics of CAI, idiosyncratic learning sequences, and lack of a model for effectiveness assessment, this paper reviews various measurement techniques used at the Florida State University CAI Center. The R and D strategies focus on two major goals: measurement providing information on priorities for revision within the CAI course materials, and measurement speaking directly to the effectiveness of the instructional process. Measurement techniques are related to three levels of course characteristics: (a) course materials; (b) concept segments within a CAI course; and (c) course effectiveness models. Foreseeable future trends are briefly discussed.

"Computer Terminal Selection: Some Instructional and Psychological Implications." Bobby R. Brown and Harold F. O'Neil. Technical Memo No. 37, The Florida State University, May 15, 1971.

Factors which have previously provided the basis for decisions as to the use of CRT or teletype terminals in computer-assisted instruction may be decreasing in importance. Specifically, differential cost factors and teleprocessing capability may no longer provide a basis for differentiating between CRTs and teletypes. In this paper, in which findings from several experiments have been reviewed, instructional and psychological implications of instructional terminals are discussed. The major terminal characteristics discussed are cost, teleprocessing capability, presentation rate, and display mode. The major instructional and psychological implications discussed are device memory load factors and instructional time and efficiency.

Student characteristics of intelligence and anxiety are discussed in relation to instructional terminal characteristics.

"CAI Myths That Need to be Destroyed and CAI Myths that We Ought to Create." Duncan N. Hansen and Barbara Johnson. Technical Memo No. 38, The Florida State University, June 30, 1971.

Five myths about computer-assisted instruction are persistent and confusing, especially to educational leaders attempting to understand computers and education. The five myths destroyed in this paper are: (a) the teacher is the total instructor; (b) the CAI computer is designed for instruction; (c) there is one best CAI language for computer usage; (d) the biggest cost of CAI implementation is machinery; and (e) a lack of learning materials exists in CAI. This paper offers a framework for understanding, conceptualizing, and integrating major educational functions via information management system (IMS). The proposed IMS has the following primary functions: (a) information retrieval of administrative and institutional data; (b) training requirements for personnel; and (c) computer support of instruction via computer-managed instruction, computer-assisted instruction, and learning simulations.

"APL/1500 File Access Subroutine Package." Thomas D. McMurchie and David B. Thomas. Systems Memo No. 10, The Florida State University, February 1, 1971.

The APL/1500 File-Access Subroutine package is a self-contained collection of related subroutines which provide users of APL/1500 FORTRAN and Assembly Language systems with the ability to manipulate the data in APL/1500 disk files. The subroutines permit off-line access to data generated through instructional and research applications of the system.

A description of the use of the File-Access Subroutines, and a listing and execution of a sample FORTRAN program which accesses existing APL/1500 files is included.

"Manual of APL/1500 Functions: System Functions." Thomas D. McMurchie and David B. Thomas. Systems Memo No. 11, The Florida State University, February 1, 1971.

The system functions which are reported in this document serve a potentially useful purpose for the system operator or other qualified privileged user of the APL/1500 system in the form of a punched workspace, permit the system operator to observe and modify the APL/1500 system operation. The system function described in this document replaces those described in previous document, McMurchie and Thomas, 1971.

"STATSIM: Exercises in Statistics." David B. Thomas, Paul F. Merrill, and Duncan N. Hansen. Systems Memo No. 12, The Florida State University, April 15, 1971.

STATSIM employs Monte Carlo procedures for the purpose of demonstrating descriptive and inferential statistics relating to the χ^2 , t, z, and F distributions, the concepts of Type I and Type II errors, and the sequential nature of hypothesis testing. STATSIM permits a student to explore the meaning of various statistical concepts by way of sample problems and exercises which may be worked as often as desired. The student is guided through the hypothesis testing procedure by actually inspecting the data and successively making appropriate inferential decisions as further hypothesis testing information is given him. The final inference may be evaluated by STATSIM to provide the student with feedback on the correctness of his inference.

"A Programming Language/1500 (APL/1500) Operator's Guide." Thomas D. McMurchie and Scott E. Krueger. Systems Memo No. 13, The Florida State University, August 1, 1971.

This document describes the procedures necessary for starting, running, and stopping the APL/1500 system. Additionally, it describes all system commands that are necessary for the administration of the APL/1500 system. Operation of the recording terminal feature which provides a System Log is also described.

This document is a revision of the original Operator's Guide supplied by SRA in 1968 with the first release of the APL System for the 1500. It incorporates a number of extensions to the implementation of APL including file handling capabilities, improved directory operations, and remote terminal execution controls. The features reported here are intended for use only by privileged users of the APL/1500 system. Only the system operator or other equally qualified persons should be permitted access to these features as misuse of the concepts employed may permanently damage the system.

"Manual of APL/1500 Functions: System Functions." Thomas D. McMurchie and David B. Thomas. Systems Memo No. 14, The Florida State University, September 18, 1971.

The system functions reported in this document serve a potentially useful purpose for the system operator or other qualified privileged users of the APL/1500 system. When used in conjunction with the privileged system commands, these system functions provide a powerful system management tool.

III. FEDERALLY FUNDED PROJECTS

A. The Wakulla County Computer-Related Instructional Technology Project. (US Department of Health, Education, and Welfare Title III Project)

The Wakulla County Title III project, completed in June 1971, focused on three primary goals: validation of the efficacy of CAI drill and practice mathematics materials as a means of improving the arithmetic performance of rural school children; validation of the efficacy of CAI reading materials as a means of improving academic performance of rural students; and development and implementation of oral language instruction in standard speech patterns.

Computerized drill and practice materials in arithmetic were designed to match existing textbooks concept by concept, and grade level by grade level. Daily

exercises in reading comprehension for a year's work for grades one through eight provided lessons graded on two parameters: readability, and question difficulty. These reading lessons included their own testing and ability level assignment strategies, contained in several types of prose. Questions demanded informational recall, contextual inferences, and evaluation.

Lessons were presented in Wakulla County via eight remote teletype terminals, interfaced to the IBM 1500 at the CAI Center by a Digital Equipment Corporation PDP-8 680 Communications System.

Results for the first two years of the project demonstrated the positive potential of the CAI approach - both in reading and mathematics. Results of the third year are largely unassessable, due to the massive reassignment of students throughout the county, which placed an almost equal number of CAI-experienced students in the experimental and control schools. Overall indications were that CAI has promising potential for the problems of disadvantaged populations.

The oral language program staff developed and implemented English language materials which would teach the essential characteristics of appropriate speech for classroom discussion, provide students with experiences in the cognitive uses of languages, and provide students with a learning situation designed to expand their lexicons and sets of concepts. In the process of this development and implementation, the staff compiled a comparison of standard and nonstandard language patterns. Conclusions were that the materials are more effective with a black population than with a rural white population, and are more effective with younger children.

The final report produced by the project staff presents a narrative of the three years of the project, statistics and implications, and the recommendation that many CAI projects be implemented, particularly in the realm of meeting the needs of the described population. A set of guideline recommendations for such future projects was drawn up by the staff, covering the areas of university-school district relations, learning materials development, technology, school operation, and project management.

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.)

In the third year of operation, this School of Social Welfare project purposes to improve social work education through the use of innovative as well as improved methods and of the latest educational technologies. Developed in this research prior to 1971 have been: (a) computer programs to test strengths and weaknesses of incoming social work graduate students; (b) computer-assisted instruction specifically related to areas of competence or need, as determined by the computer-managed testing; and (c) extension methodologies for a graduate and undergraduate continuum, with expectations of reduced degree-earning time. Additionally, prior project efforts have resulted in a programmed text on mental retardation, and a pool of items suitable for pre and posttests.

During 1971, development began on (a) simulation experiences which reflect real life situations, and (b) simulation of social work administrative situations. Emphasis was on computer-assisted programs containing problem-solving capability.

Specifically, these areas presently being tested are composed of the following elements: (a) a pool of questions; (b) student testing with immediate feedback component; (c) a programmed text (in social service administration); (d) problem-solving micro-simulations of individual modules of instruction; and (e) problem-solving macro-simulations which cover four or more modules and test a student's grasp of a number of elements rather than just one, his ability to integrate knowledge and finally his judgment, given a certain set of facts.

Pilot testing of this latter model has taken place during the winter quarter. Summative evaluation is expected to be completed during the summer of 1972.

C. Improving Youth Vocational Opportunity Through Parent Counseling. (United States Office of Education, Title 1 Project.)

The Parent Counseling Title I project primary goals are: (a) to provide competencies to each parent so that they may counsel their children and in so doing provide supportive assistance to their child's vocational maturation, and (b) to acquaint each parent to their career possibilities as a paraprofessional "occupational specialist." To realize these goals, personnel from the Department of Adult Education and Center for CAI are jointly developing computer-managed instructional materials.

Faced with a learner population with limited reading skills, emphasis has been placed on developing nonprint instructional materials. Current developmental activities include the production of a 20-minute color documentary film on local sources of career information; a videotaped panel discussion with personnel from the county supervisors' office on the subject of guidance services offered by the county school system; a three part slide/tape series on the structure and trends of the labor market; videotaped U.S. Department of Labor public service announcements on job discrimination and racial prejudice; a matrix describing available sources of low cost educational financial assistance; an overhead transparency sequence on job families, keyed to job classifications in the Dictionary of Occupational Titles; and online evaluation activities.

The first of three instructional phases will begin in January of 1972. During this prototypic phase, considerable emphasis will be placed on collecting formative input. Community liaisons will be established in an effort to locate the project in its area of need.

D. Development of Specifications for an Advanced Instructional System. (United States Air Force.)

The Advanced Instructional System (AIS) is a development within the Air Force Human Resources Laboratory (AFHRL) to implement the latest demonstrated state-of-the-art in training techniques, media usage, management procedures, and computer technology to Air Force Technical Training. The CAI Center was awarded a contract by AFHRL to develop functional design specifications for the individual multi-media computer-based training system which would provide significant cost-effective improvements in the operation of technical training courses at Lowry Air Force Base, Colorado.

In addition to the goal of providing individualized training, AIS will focus on the managerial processes which can be enhanced by the computer, cost-effective multi-media approaches which may provide time-savings, modular implementation which will provide both flexibility during development and revision of learning materials and additional cost savings during expansion throughout the Air Force.

AIS will be implemented within three technical training courses with a total enrollment of over 2000 students. The courses of Inventory Management (inventory and supply), Precision Measuring Equipment (precision electronics measurement and calibration), and Weapons Mechanic (tactical weapons loading) represent a broad range of technical training requirements.

The AIS consists of seven subsystems which reflect the scope and complexity of the effort: (a) instructional materials, (b) instructional strategies, (c) media hardware and software, (d) management components, (e) computer hardware, (f) personnel and training requirements, and (g) related requirements. These subsystems are designed to provide for all aspects of the instructional process from materials development and evaluation through student use and management to review and revision. Operational considerations, including computer systems design and maintenance, CAI languages, and the selection and training of AIS personnel, are also considered in the design.

The instructional materials subsystem includes components for task analysis, development of behavioral objectives, related test items and curricular plans, and instructional strategy specification. Formative, summative, and continuing evaluation processes operate within a computer implemented management process. Additionally, materials production and editing activities are specified and related to both the management process and computer capabilities. Substandard course modules are identified through computer analysis of the on-going instruction and through evaluation of field performance following course graduation.

Instructional strategies are implemented following assessment of student characteristics measured both prior to and during the administration of each course. The strategy approaches are related to the identification and management of incentives to learning and the implementation of a multi-faceted adaptive instructional model (the model itself is being developed by the CAI Center staff). The model will provide a means of contingently adapting alternative instructional sequences, remedial loops, and instructional media and methods to individual differences. The instructional strategies and decision rules are used to assign the appropriate instructional treatments on the basis of individual student characteristics.

The media subsystem which was specified includes provisions for media software, media devices, and carrels. The media which are to be utilized within instruction are designed, produced, and implemented within this component. Requirements for the selection and revision of media software, procurement and/or design of hardware devices and carrels, and monitoring of media usage were specified.

The management subsystem includes all software and operating environment specifications to provide management capability of the system. This includes management of materials development, tracking of media, scheduling algorithms, tracking of students and allowing course designers and instructors to designate to the computer subsystem the criteria and relationships between instruction, performance, strategies, and the prescriptive control of students.

The computer subsystem includes all computer hardware necessary to allow operation of the management subsystem. Hardware must allow for collection and storage of data during interactive, batch and retrieval operations. In addition, it must provide adequate man-machine interface in a user oriented environment to allow optimum training and training management.

Personnel and training requirements have included primarily the provision for instruction of all personnel in the major concepts, goals, and procedures of AIS. Additionally, the requirements and procedures for determining job descriptions and requirements have been specified.

E. First National Computer Art Symposium. (National Endowment for the Arts, Florida Fine Arts Council. Randolph Luttrell, Coordinator.)

With the support of the CAI Center, several other university departments (Art, Art Education, Theater), and Control Data Corporation, the First National Computer Art Symposium was held October 22 and 23, 1971. The symposium comprised a computer art show representative of works and artists across the country, lectures by five guest artists, and a joint panel discussion among artists, art historians, and technicians. In addition, films of Stan VanderBeek, Kenneth Knowlton, Lillian Schwartz, and Ron Resch were shown; each artist's presentation included technical explanations of the procedures involved in executing his art as well as his feelings about the aesthetic validity of his work.

Symposium guest speakers included Robert Mallery, Professor of Sculpture at the University of Massachusetts; Ronald Resch, Research Professor of Graphics and Architecture in the Computer Science Department at the University of Utah; Stan VanDerBeek, Artist Fellow in Computer Animated Films in The Center for Advanced Visual Studies; Kenneth Knowlton, Director of Software Animated Film Research at Bell Telephone Labs; and Jeffrey Raskin, Director of Visual Arts Department at University of California in San Diego. Also present as guest and as speaker was H. W. Jansen, noted art historian and president of the College Art Association.

Computer art, unlike many art forms, draws together people from many diverse fields; communicating at the symposium were not only artists but also physicists, artists, art education, microbiologists, computer programmers, and psychologists. Representatives came from the Japan Broadcasting Corporation, RCS Research Labs, and Control Data Corporation.

As anticipated, the symposium created and sustained interest in the capabilities of computers in art and art education. Resultant directions are tripartite: (a) dissemination of symposium informative and summative materials; (b) efforts by the symposium coordinator and his colleagues to locate funds for and to design a program for the university in computer art; and (c) present research by university members to combine computer art processes with extant art processes, thereby extending the state of the art.

F. FSU Elementary Teacher Training Model. (U.S. Department of Education).

In an attempt to further verify the effectiveness of the FSU model for teacher education, a special effort was made to develop, employ, and evaluate curriculum materials used in existing courses. The FSU model identifies the following generalized training goals: (a) The teacher will plan for instruction by formulating objectives in terms of behaviors which are observable and measurable; (b) 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; (c) The teacher will employ appropriate strategies for the attainment of desired behavioral objectives; (d) The teacher will evaluate instructional outcomes in terms of behavioral changes; (e) 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 carefully 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.

Based on data received from previous research conducted using the FSU model, in addition to adjustments made in the assessment of teachers' professional needs, a considerable effort was made in improving and developing materials used in an undergraduate health education course.

In keeping with the desire to provide relevant learning experiences that satisfy both individual and social health needs, a project was begun to introduce drug abuse education utilizing traditional and multimedia (including computer-based simulation) techniques.

Plans for the future include continuing the R & D bases of the FSU model including a field study of previous teacher trainees to determine the effectiveness and appropriateness of their learning experiences.

G. Public Service Careers Program. (United States Department of Labor. John J. Hedl, Jr., Project Director).

Directed toward the development of human potential in the university's work force, the Public Service Careers Program deals with entry and upgrade employees at FSU. The program stresses mutual benefit to employee and employer, with the University

especially benefiting from efficient and capable manpower; and the employee profiting from the training, equitable policies, and career planning. It is hoped that PSC will be a prototype for future university manpower resource management, both locally and statewide.

Computer-managed instruction is central to the multi-faceted training program. Basic reading and mathematics skills progression are taught via the teletype terminal, with materials designed and tested by project staff members. Also taught on the terminals are staff-written learning simulations, exploring decision-making processes in the world of work. CAI is supplemented by traditionally-administered instruction in job-related skills; these skills are determined on the basis of individual need, as ascertained by standardized testing and job task analysis. The individualized nature of the PSC training program provides the skills utilization necessary for effective entry and efficient upgrading, along with high trainee motivation. On-the-job supervision, guided by the PSC staff, rounds out the more technical aspects of job training.

Increased communication skills is the goal of a corollary program within the overall training management. Group and individual counseling guide the trainee to career realizations, realistic choices in the world of work, and continuing self-learning. This emphasis on human relations extends the usual scope of job training programs; and, as a cumulative evaluation process for both trainee and program, ensures instructional effectiveness.

Future plans for the PSC program, which will continue until March 1973, include (a) synthesization and improvement of training materials and methods, both staff administered and programmed; and (b) increased involvement of supervisory personnel in the employee training.

H. The Wakulla County Program for Curriculum Development Through the Use of Computer-Assisted Instruction, Programmed Materials and Reading. (U.S. Department of Health, Education and Welfare, Barbara Briggs, County Director.)

In a cooperative effort, the Wakulla County, Florida, School Board and the CAI Center began in 1971 to implement computer-assisted instruction in special classes for educable mentally retarded students. In a planned three-phase operation which concentrated on teaching rather than training the EDR student to read, instruction will begin with CAI data collection; then alter to CMI, with emphasis on curriculum design and a gradual phase-out of computer assistance. The program serves four EMR units in the county school system, three elementary and one high school level, with a total of about 67 students ranging in ages from 8 to 16.

Major objectives of the project are: (a) to implement existing CAI reading materials and procedures in four EMR classrooms in Wakulla County; (b) to evaluate the efficacy of using existing CAI reading materials, or teaching beginning reading skills to educable, mentally retarded learners; (c) to explore a new approach to intellectual evaluation of the mentally retarded learner, utilizing the continuous monitoring and performance assessment capabilities of CAI rather than conventional testing procedures; (d) to observe the learner's affective and psychomotor behavior while they interact with the CAI terminal; and (e) to develop individualized, non-computer supported reading materials based on learners' performance on existing CAI reading materials.

The latter objective (e) constitutes the most significant and widely generalizable outcome anticipated from this project. Through formative evaluation based

upon detailed student performance data collected during the CAI presentation of the material, along with a systematically planned phaseout of computer support of this instructional materials, it is anticipated that an individualized program of materials will be developed. The potential significance of this development lies in the fact that the reading materials will have been empirically derived and developed, based on the performance and students in the specific target population. The planned phaseout of computer support for these materials will provide an individualized reading program which will then be available for widespread use with EMR students.

IV. CURRENT GRADUATE PROGRAM

CAI Center graduate students are members of the Instructional Systems program of the Department of Educational Research at the Florida State University. The basis of the EDR-CAI graduate training program was developed from the Center's three-year experience with the Institute in Computer-Related Multimedia Instruction, and USOE-sponsored activity series. The Instructional Systems program of the University provides training in research, development, and evaluation of instructional systems for promoting effective learning. The program also provides for specialization in the use of operation analysis techniques for developing means for individualized instruction, multimedia 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 experience in developmental research activity is required of all graduate students. Each student, toward that aim, is assigned to a project as an integral part of the learning experience during his entire graduate program.

Five students entered the program during the fall quarter, 1971. Five students completed their doctorates during 1971; and five are in preliminary stages of dissertation preparation. The Center has for 1971 studies a total of twelve graduate students.

V. DIVISION OF INSTRUCTIONAL RESEARCH AND SERVICE SPONSORED ACTIVITIES

A. **Physics Review.** From the initial development of CAI test-review sessions for Physics 107 three years ago, use of the problem sets has succeedingly increased. The undergraduate students enrolled in the basic class come to the Center on a voluntary basis, interacting on the terminal with 55 problem sets. An average of two hours per student is utilized at PDP-8 TSS teletype terminals; questions for review cover a wide variety of representative course topics. In addition, the student may take the teletype printout for further study. At present, plans are underway to transfer this course review from the CAI Center to the University's 6400 system.

B. **SIBE: A Sequential In-Basket Exercise Technique.** (Martha Jane K. Zachert, Department of Library Science.) SIBE, an innovative technique for presenting a Sequential In-Basket-Exercise to graduate students in library science, was designed to meet the need for moment-to-moment realism in problem development, consequences, and solutions. A computer-assisted format was chosen in order to take advantage of two capabilities of the computer: interaction with a student and the collection of data generated by student responses.

The SIBE technique presents a three-layered problem in such a way that the student must make a series of related decisions and deal with the consequences of these decisions. In order to gather data, four seminal problems were designed, each typical to administrative areas of (a) personnel management, (b) coordination of activities, (c) public relations, and (d) direction of work. The problems were programmed in Coursewriter II for presentation in the CAI mode using teletype terminals for student input and to provide hard copy print-out. This print-out serves as a record for students of the problems and their individual responses, and for reference in the follow-up classroom discussion. The computer was also programmed to collect the desired data about student performance. Finally, an affective questionnaire was used to obtain student reaction to the CAI mode.

For each problem sequence, the student is presented with the initial in-basket item, designated a seminal problem, followed by four action choices and a "comment response" choice. The student, in the role of an administrator, makes his choice of the action he would take by entering the designation of that choice (A, B, C, or D) via the teletype keyboard. Alternately, the student can make the comment response choice (E) and enter a statement of his intended action via the keyboard. When the student makes his third action choice, he has completed the CAI part of the problem; classroom discussion takes over at that point.

The pilot study was planned to determine (a) to what extent library science students choose the same decision pathways in the resolution of an administration problem, (b) to what extent elapsed time varies among students in making these decisions, (c) whether such an in-basket exercise would stimulate class discussion, and (d) whether library science students would find the SIBE a useful learning mode. Among the 33 students in the pilot study, concurrence in pathway choice ranged from 1 to 6 students per problem with a mean of 1.88 students in agreement. The total time for completion of the four problem exercise ranged from 26 to 63 minutes with a mean of 42.9. Considerable classroom discussion was generated by the problems, and 96% of the students answering an affective questionnaire felt that they learned "some" or "a lot" from the SIBE.

C. Computer-based Learning System for Religion 210. Now averaging 250 to 300 students a quarter, the Religion 210 course (a University basic requirement offering) faces problems similar to most humanities large-section courses; that is, the need to provide an individualized interaction with each student in order to maximize his intellectual and appreciative competencies. As part of the effort to solve this problem, the CAI Center, with Dr. Charles Swain and another course instructor, Mary Glynn, developed computer-based materials. In addition, Dr. Swain prepared audio tapes and utilized self-grading of tests.

The purpose of the latter was to further move toward the major course goal: the development of sophisticated thinking patterns concerned with the assumptions, axioms, and postulates of religion study. Two developments were undertaken. First, a computer-managed instruction (CMI) set of units was prepared to accompany the five major unit texts currently used in the course. These CMI materials allow a student to test himself on material and receive a diagnosis of weak learning areas along with a prescription of correction. The materials have been well received by students and in practice are used as part of study resources and strategies resulting in much usage just before course examinations.

The second development concerns an attempt to use a natural language dialogue system to teach concepts. This system follows a Socratic dialogue scheme of asking students questions to show the student inconsistencies and incompleteness in information he may have. The tutorial technique has been implemented for one complete reading of the course and more are forthcoming. Reactions of students have been generally favorable.

D. Computer-Assisted Contingency Management in an Advanced Level Undergraduate course. During the academic year 1970-1971, a computer-assisted, contingency management technique involving self-pacing, unit criterion mastery, and undergraduate managers was adopted for an advanced level undergraduate course in animal learning (Psychology 311). Students in the course were assigned to a manager, informed of the course requirements, and given a study-guide and reading list for the first ten units covering the following topics:

1. The notion of contingency
2. Two types of conditioning
3. Pavlovian conditioning
4. Operant conditioning
5. Negative reinforcement and punishment
6. Stimulus control
7. Secondary reinforcement and chaining
8. Complex learning
9. Emotion
10. Theories of reinforcement

After studying, a student was administered a two-minute oral "attempt" by a manager. If the student comprehensively answered the question, he qualified for a written "attempt;" if not, he took additional oral "attempts" until he qualified. Each written "attempt" consisted of short essay, graph, true-false and multiple-choice questions randomly selected from pools of questions covering different aspects of the unit. The responses to the short essay and graph questions were administered, scored, and analyzed by the managers; whereas the true-false and multiple choice questions were administered, scored, and analyzed by a computer via a teletype machine. For half of the students during the fall quarter, 1971, each computerized "attempt" included one review question randomly selected without replacement from one of the preceding units. The remaining students received no review questions. When a student completed all ten units, seven laboratory exercises, and a retention test, he earned a grade of "A."

As was the case during the previous two quarters, 90% of the students during the fall quarter, 1971 earned a grade of "A" and responses to course evaluation questionnaires were extremely positive. The effect upon long-term memory of including review questions on the written "attempts" will be evaluated by giving all students another retention test during the spring quarter, 1972. As a result of developing this computer-assisted contingency-managed course in Psychology 311 over the past two years, plans are currently underway to extend the same on-line use of a computer (via teletype machines) to a high enrollment, lower division course (Introductory Psychology, Psych 201) that fulfills a Liberal Studies requirement.

E. **Individualized Course in Education and Computers.** A graduate level CMI course entitled, "Computers in Education" was developed and implemented during the 1971 academic year. This course provides a survey of computer applications for direct instructional support such as CAI, CMI, games and simulations; and also for indirect instructional support such as testing, guidance and counseling, information retrieval, and administrative applications. The course has undergone considerable revision based on the performance and feedback from students who were enrolled in EDR 536 during winter quarter, 1971. Many of the references were updated, test items were revised, and a module on Social Factors of Computers in Education was added. During the summer quarter, 1971, two types of feedback to incorrect responses were included in the on-line quizzes. The data from this study is currently being analyzed. As new articles relevant to the course content appear in the literature, they are considered for inclusion in the readings for the course. Due to the current interest in these topic areas, there are many new articles and consequently, the references for the course are constantly being updated.

VI. COMPUTER ASSISTED INSTRUCTION CENTER

A. Personnel

Center Director

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

Resident Research Faculty

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

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

Sigmund Tobias, Ph.D., 1960, Educational Psychology, Columbia University, Professor at City College, City University of New York; Visiting Professor at FSU.

FSU Research Investigators

Perrin S. Cohen, Ph.D., 1967, Psychology, Columbia University, Assistant Professor of Psychology, 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, Executive Secretary of the Citizen's Committee on Education, State Government, Tallahassee, Florida.

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

Graduate Students

Third Year

Tom James
Ora Kromhout
Ed Durall

Second Year

Phil Duchastel
Darlene Heinrich
Nelson Towle
Susan Taylor

First Year

Michael Steve
John Reale
Stan Kalisch
Paul Luyben
Lela Buis

CAI Research Support Staff

Bruce H. Freed, Director, Data Systems
David B. Thomas, Research Associate
Barbara Leherissey, Research Associate
Barbara Johnson, Research Associate
John Hedl, Research Associate
Paul Manning, Research Associate
Bill Moody, Research Associate
Dwayne Clark
Steve Manieri

Programmer

Dewey Kribs

Operators

Ray Frost
Jerry Wester
Dave Coe

Coders

Betty Wright
Edna Reynolds

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 diagramed in Figure 1, includes an IBM 1500 Instructional System consisting of an 1800 central processing unit, a 1502 station

controller, sixteen 1510 CRT displays, each with a keyboard and a light pen, one 1518 typewriter, and six 1810 disk drives with removable disk packs of 1.024 million bytes each. Additional peripherals include two 2401 tape units, one 1442 card read/punch, and one 1443 line-printer. Some pertinent technical specifications of the capacity and performance of the above data processing components are as follows:

- (1) The 1800 CPU has 32K 16-bit words and has a cycle time of two microseconds.
- (2) Each 1810 disk drive has a data transfer rate of approximately 36KB.
- (3) The 2401 tape units have a transfer rate of 30KB.
- (4) The 1442 card read/punch read cards at the rate of 400 cpm and punches cards at a rate from 98 cpm to 390 cpm, depending on the number of columns punched per card.
- (5) The 1443 lineprinter has a character set of 52 characters, a line width of 120 columns, and a printing speed of approximately 240 lpm.

The second computer in the CAI Center installation is a Digital Equipment Corporation PDP/8 680 Communication System which is interfaced to the IBM 1500. The purpose of this is to provide the 1500 with a capability of supporting a mix of 16 remote or local teletypes. The 680 CPU contains 4K 12-bit words and has a cycle time of 1.5 microseconds. The teletypes operate at a rate of 110 baud.

The third computer, installed in mid-1970, is a PDP/8 TSS/8 timesharing which on its own supports 16 teletypes. The TSS/8 system includes a high-speed paper tape reader (300 characters per second), a high-speed paper punch (50 characters per second), one 256K-word disk to support the time-sharing system, and a recently added DEC tape drive with a transfer rate of one word per 12.8 microseconds. The TSS/8 handles teletypes at the rate of 110 baud each. In addition, there is a 100,000 baud channel connection between the TSS/8 and the 680 to provide maximum flexibility of the system.

In October, 1971, a special interface was added to the TSS/8 to control output to 64 binary electronic digital processes and 12 inputs from binary processes. For example, the TSS/8 can turn on or off 64 devices and receive on/off, or yes/no, input from 12 devices.

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 created a batch mode disk monitor system, the heart of which is a relocating, linking loader, and has developed special analysis programs in FORTRAN IV.

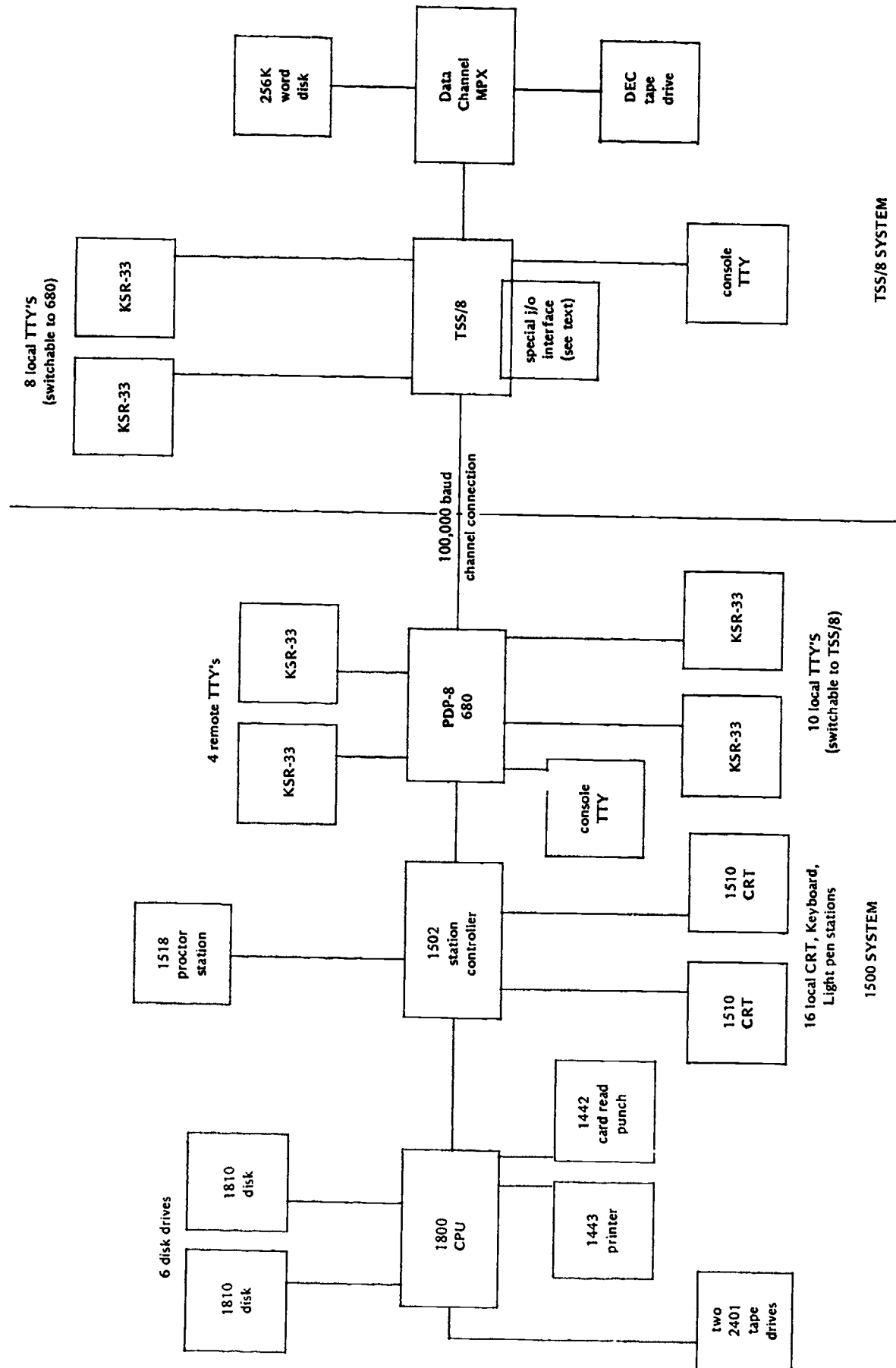


FIGURE 1. System Configuration

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, 1971, to December 31, 1971. In addition, prior publications are also listed. The Center will try to supply the articles to interested and qualified researchers.

JOURNAL ARTICLES PUBLISHED

Merrill, P.F. & Towle, N.J. Interaction of abilities and anxiety with availability of objectives and/or test items on computer-based task performance. *Proceedings of the 79th Annual Convention of the American Psychological Association, 1971*, 539-540.

JOURNAL ARTICLES ACCEPTED

Manning, P.C. & Gay, L.R. Establishment of Vocational Guidance Priorities, Counselor Education and Supervision. In press.

PRESENTATIONS

Merrill, P.F. & Towle, N.J. The effects of the availability of objectives on performance in a computer-managed graduate course. Paper accepted for presentation at the annual meeting of the American Educational Research Association, Chicago, April, 1972.

Towle, N.J. & Merrill, P.F. Effects of anxiety and item difficulty sequencing on mathematics aptitude test performance and posttest anxiety. Paper accepted for presentation at the annual meeting of the American Educational Research Association, Chicago, April, 1972.

Merrill, P.F. The effects of the availability of objectives and/or rules on the learning process. Paper presented at the annual meeting of the American Educational Research Association, New York, February, 1971.

Towle, N.J. & Merrill, P.F. Interaction of Abilities and Anxiety with Availability of Objectives and/or Test Items on Computer-Based Task Performance, APA, September 1971, Washington, D.C.

Hedl, J.J., O'Neil, H.F., & Hansen, D.N. The Affective Nature of Computer-Based Intelligence Testing Procedures. APA, September 1971, Washington, D.C.

Hedl, J.J., O'Neil, H.F., & Hansen, D.N. Computer-Based Intelligence Testing, AERA, February 1971, New York.

Hansen, D.N., Hedl, J.J., & O'Neil, H.F. Review of Automated Testing. AERA, February 1971, New York.

TECHNICAL REPORTS PUBLISHED

A Study of Computer-Assisted Multimedia Instruction Augmented by Recitation Sessions, Kenneth Majer, Technical Report 1, Florida State University, June, 1969.

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

Research and Implementation of Collegiate Instruction of Physics via Computer-Assisted Instruction, Duncan Hansen, Walter Dick, and Henry Lippert, Technical Report 3, Florida State University, November, 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, Technical Report 4, Florida State University, MNA 1969.

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

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

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

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

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

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

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APPENDIX B

DEMONSTRATION REPORT

Florida State University

School of Music Jack Taylor Class	2	30
Educational Administration John Strutko		
Elementary Education, Health Ed. Dr. Williams	1	6
Education 501 B. Woodson	1	10
Science Education Mr. Oliver	2	40
Elementary Education Dr. Davis	1	2
Physical Education Dr. Singer	1	25
Math Education Dr. Kalin	1	18
Educational Administration Dr. Rasmussen	1	20
Math Education Dr. Couvillon	1	2
Science Education Mr. Oliver	6	120

Other Demonstrations

Science Teachers, Gulf, Franklin, Calhoun and Liberty Counties	1	25
North Florida Junior College, Madison, Fla., Systems Design Class	1	13
Fairview Elementary School Eighth Grade Class	1	50
Medart High School, Wakulla, Fla. Algebra Class	1	40
University School, Tallahassee, Fla. Fifth Grade Class	1	12
W. T. Moore Elementary School, Tallahassee, Fla. Third Grade Class	1	28

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

Fulvia A. deBorrero, Republic of Panama
Niles deBorrero, Republic of Panama
John Manus, Redstone Arsenal, Alabama
S.R. Garner, Redstone Arsenal, Alabama
Donald H. McClain, University of Iowa
Ted Sjoerdsma, University of Iowa
Dr. Normal Dahl, Ford Foundation
Dorothy Sinclair, University of Houston
Students from University of Morrocco, Morrocco
Cabinet Officers from Morrocco
Dr. Frank Taylor, AID Mission, Brazil
American Friends of the Middle East, US Dept. of State (8)
Summer Institute for Science Teachers, ISCS (60)
Summer Science Institute participants (40)
Dr. Derek Sleeman, University of Leeds, England
Dr. John Annett, University of Leeds, England
Kjell Harnqvist, University of Goteborg, Goteborg, Sweden
Ake Anderson, Education Consultant, National Board of Education, Stockholm, Sweden
Leif Gouiedo, Head of Section, Planning Division, National Board of Education,
Stockholm, Sweden

Mr. Rothkropf, Bell Laboratories, New Jersey
Mr. Ed. Apple, Post Office, NMTC, Norman, Oklahoma
Mr. Joseph Yasutake, Lowry Air Force Base, Denver Colorado
Mr. Henry Taylor, Lowry Air Force Base, Denver, Colorado
W.H. Biggs, Jr. LCDR, NRTG, Gainesville, Fla.
Z.T. Wakefield, Capt. USNRR, Florence, Ala.
J.M. Wilkins, LCDR, USNR, Hdq., Sixth Naval District
H.J. Kosselor, RADM, USN, Commandant Sixth Naval District, Charleston, S.C.
E.M. Rosenberg, RADM, USN, Commander Naval Reserve Training, Omaha, Nebraska
H. Kiser, LCDR, USN, Aide to RAAM Kosselor
Stan VanDerBeek, Massachusetts Institute of Technology, Cambridge
Kenneth Knowlton, Bell Telephone Labs, New Jersey
Ron Resch, Computer Science, University of Utah
Jef Raskin, University of California at San Diego
Robert Mallery, University of Massachusetts, Department of Art.