THE DESIGN AND DEVELOPMENT OF A SYSTEM FOR THE COLLECTION AND ANALYSIS OF LEARNING STYLE DATA

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PREFACE

This study is concerned with creating and maintaining a data base which would support learning style research at Oklahoma State University. The main objective of the study is to develop and use a computer system which can aid learning style researchers in the collection and analysis of learning style data. The study describes the system designed and indicates the relationships between the learning style researcher and the data processing technician during the design and implementation of the system.

I wish to express my appreciation to my major adviser, Dr. Donald Phillips and to Dr. Richard Robl for their support and guidance throughout this study. I also wish to thank my third committee member, Dr. Cecil Dugger, for his observations and criticisms regarding the final manuscript.

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CHAPTER I

THE PROBLEM

Introduction

Educational research, like research in many other fields, has developed to a high degree of complexity. The volume of data and the difficulty of analysis of the data make the computer a likely tool for aiding research in education. The data handling capabilities of the computer are currently used in many areas of industry, government, and education to collect, manipulate, report, and analyze both numeric and non-numeric data.

A major problem in using the computer in educational research is the complexity of the computer itself. While an educational researcher may have basic knowledge of how the computer can be used to help solve his problems, he may need more advanced technical knowledge to effectively use the machine. The degree of technical computer knowledge required for larger and more complex educational studies may force the researcher to seek the aid of technicians who have experience in the application of the computer to data processing problems.

Educational researchers have placed much emphasis on the development and analysis of classroom methods for administering instruction. This is evidenced by the variety of instructional methods which have been developed and are used in today's educational institutions. Students may enroll in a variety of class modes including individually

programmed instruction, television, discussion, lecture, laboratory, or courses which are taped and may be listened to at the student's convenience. Many courses employ class trips, visual aids, or guest speakers.

There are, however, constants in every classroom situation. In every class there is an instructor as well as students. Despite the variety of methods used in a classroom, the instructor remains a key element in the student's success in a particular course. The instructor's method of communicating to his students, and his level of knowledge in the particular subject matter are important factors in a student's learning process. On top of this the instructor usually selects the class mode or method employed in his classroom. A student may have difficulty in a class where methods of instruction are employed that he does not like, understand, or to which he cannot adapt.

A learning style may be described as a learner's preference for the way in which he takes meaning from his surroundings. Each student has his own learning style. Some students learn best by example, others by actually doing what they are trying to learn. Some students prefer visual instruction, others prefer auditory instruction. An instructor also has a learning style which may govern his particular methods of teaching.

Individuals at Oklahoma State University are conducting research which seeks to identify learning styles in students and instructors. Once these learning styles are identified in students they will be matched with those of instructors. The hypothesis of the learning style research is that more effective learning will take place when a student and his instructor have similar learning styles. If the

hypothesis is correct, the learning styles in students might be used as an aid in counseling students in course and instructor selection.

Need

In order to identify learning styles, the researchers at Oklahoma State University needed to gather data relative to specific factors which are involved in the learning process, both in students and instructors. A wide variety of standardized tests were selected for use in measuring many different learning style factors. Data was also needed regarding student achievement. The learning factor data and the achievement data had to be subjected to a variety of statistical tests to determine the intra- and inter-relationships of student learning factors, instructor learning factors, and achievement.

The learning style research required collection of data on a large scale. Many students and instructors in several classes were included as subjects in the study. The learning style research was expected to continue over several semesters with essentially the same research process being employed each semester. A system or method was needed to collect and analyze learning style data and report the analysis results to the researcher.

Problem

The problem with which this study was concerned was the need for a data base which would support the learning style research being conducted at Oklahoma State University. This data base had to provide information which would allow the researchers to answer a variety of questions and test research hypotheses. The data base needed to be general enough to

provide information which would answer questions which arose after the data base had been established. Facilities were required for the editing, up-dating, and reporting of elements in the data base and subjecting the data elements to a variety of statistical tests.

Purpose

The purpose of this study was to design, develop, and test a system of computer programs which would aid in the collection, analysis, and reporting of learning style data.

Objectives

1. To identify those data elements which were viewed as necessary by learning style researchers.
2. To provide means for collection of data elements and establishment of a learning style data base.
3. To provide means for editing, correcting, or adding data elements to the learning style data base.
4. To provide means for selecting data elements from the data base for analysis and for reporting the analysis results.

Scope and Limitations

This study made no attempt to test hypotheses of the learning style research. The study was concerned only with providing data which learning style researchers could examine in order to draw conclusions about their research. Niec [1] gives an explanation of the learning style research which was supported by the system designed in this study.

Definition of Terms

Computer Program--A series of instructions which causes a computer to perform a task(s).

Data Base--A collection of data files.

Data Element--A basic unit of information.

Data File--An ordered collection of data records.

Data Record--A group of data elements common to something or someone.

Eta--The estimate of the curvilinear relationship between two variables.

Keypunch--The process of using a keypunch machine to place data on a machine readable card.

Learning Factor--Any measurable internal or external element which may affect the learning process.

Learning Style--A learner's preference for the way in which he takes meaning from his surroundings.

CHAPTER II

REVIEW OF LITERATURE AND RESOURCES

Information Systems

A plan of attack is needed to develop any information system. Alcorn [2] states that there are three phases in system development and maintenance in education; (1) educational specifications, (2) systems, and (3) field operation. He defines educational specifications as determining what data is to be collected and defining the output. He describes systems as having two divisions; (1) educational systems, which deal with the mechanics and timing of the school setting, and (2) machine systems, which are concerned with machine capabilities and production schedules. Field operation is defined as the operating or final stage. Alcorn indicates that educational specifications is the most important phase when he says "Educational specifications must generally control the situation, otherwise, the data collected will be relatively meaningless and useless" (p. 54).

In his book on the management and use of technical information, Dyke [3] reports that the basic steps in the successful design, installation, and operation of information systems are:

1. Definition of information needs of potential users of the system.
2. System design.
3. Selection of the equipment for mechanizing the system.

4. System installation and testing.

5. Operation, maintenance, and expansion of the system.

Dyke indicates that of the five steps, definition of user information needs is the most important. In order to achieve this step he suggests that the following questions be answered:

A. What types of information are being used now?

B. How is this information being obtained?

C. Is the information currently being used complete, accurate, and up-to-date?

D. What information is not currently available/used?

E. Where could this information be obtained?

F. Why isn't it being used now?

G. If the optimum system was designed what services would be expected from the system?

Learning Style Research

The literature contains several current studies which are representative of the type of research being conducted by learning style researchers at Oklahoma State University. Examination of these studies will yield insight into the data requirements and procedures employed in learning style research.

Gable and Roberts [4] conducted a study of the relationships of cognitive and affective variables with respect to student achievement in the classroom. The research design called for administering a battery of standardized tests to a group of students in a social studies class. These tests yielded measures of eight cognitive variables and three affective variables in the students. The study used final grades

in the class to measure achievement. After collecting the data the researchers subjected it to correlation and regression analysis to provide answers to their research questions.

Goldman and Warren [5] related study strategies of students in different major fields to college grade success. Their research design involved administering a study strategy questionnaire to students in four major fields. The students were asked to report their grade point average on the questionnaire. The responses to the questionnaire and the reported grade point averages were subjected to multivariate discriminant analysis in order to answer questions regarding the differences in student study strategies with respect to grade success in different major fields.

Goldman and Hudson [6] combined study strategy measures and ability measures to compare successful and unsuccessful students in different major fields. Here again, a battery of tests was administered to measure academic abilities and study strategies. Grade point average was used to measure grade success. Multivariate analysis was used to compare successful and unsuccessful students in different major fields.

Resources

The Oklahoma State University Computer Center operates an I.B.M. system 360 model 65 computer which is available for use by students, faculty, and administration [7]. This system has peripheral equipment including magnetic tapes and disk units, card readers, card punch, plotter, and printers. In order to use this equipment, an individual

must receive an account number associated with a fixed amount of funds which may be used to pay for computer usage.

In addition the computer center has statistical analysis programs available for use. The Statistical Analysis System (SAS) and the Statistical Package for Social Sciences (SPSS) are packages of statistical analysis routines which present, edit, transform, generate, describe, and analyze data on the computer [8, 9]. A user of SAS and SPSS routines is required to input his data in a prescribed format with several control cards and invoke the routine which contains the statistical procedure desired. The SAS and SPSS systems contain both descriptive and inferential statistical procedures.

Another resource available through the Oklahoma State University Computer Center is an optical mark-sense card reader and associated software [10]. Students may respond to questions on multiple choice tests by marking a specially designed tab card. This card is fed into the optical card reader and the software grades the test, giving individual scores and group summaries.

Summary

The literature reveals that a common method employed in current learning style research involves three main steps; (1) administering tests which measure selected learning variables, (2) collecting some sort of achievement data on the sample, and (3) analysis of the data collected to give a basis for the answers to research questions.

In order to establish a learning style data base special attention must be paid to determining the data elements required by the learning style researchers. The definition of data requirements will lay the foundation for the entire data base.

A computer system requires both hardware and software resources. Computer hardware is available which may be used in developing computer programs which will establish and maintain a data base. Statistical software packages are also available which may be used in the analysis of data elements in a data base.

CHAPTER III

METHODOLOGY

Introduction

The procedure for accomplishing the objectives of this study was divided into four main steps or phases; (1) definition of learning style data requirements and data uses, (2) design of data collection procedures and data base structure, (3) development of computer programs, and (4) testing of the system in a learning style research situation. Each step was accomplished through the cooperative efforts of a learning style researcher and a data processing technician. The learning style researcher provided data needs, both known and expected; the data processing technician provided methods for the collection, maintenance, and analysis of the data. The steps for accomplishing the objectives of this study were designed so that the completion of one step would lead to the next and so on until all objectives were achieved. Review of data needs was done at each step, however, to allow for the inclusion of data or processes that had been overlooked in preceding steps.

Definition of Data Requirements

The definition of learning style research data requirements and data uses was accomplished primarily by interviewing the learning style researcher. Based on the review of other learning style research,

it was expected that data for students would fall into the categories of (1) background data, such as name, sex, and university identification number, (2) learning style data measured by standardized tests, and (3) student achievement data in selected courses. The data needed for instructors was expected to be similar to that collected for students except that there would be no achievement data.

The method employed in interviewing the learning style researchers was simply to ask questions regarding the data requirements. Examples of these questions were:

1. What standardized test will be used for measuring learning style factors?
2. What and how many learning factors will be measured by standardized tests?
3. What scales would be used for recording these measured factors?
4. What kinds of background data will be required for the learning style research.
5. Would the research require associating a particular set of learning factors to an individual or would the subjects be anonymous?
6. What kinds of achievement data would be used in the study?
7. Would it be necessary to associate a set of student learning factors to a set of instructor learning factors?

The emphasis in the definition phase was to determine all data elements which might be required. It was felt that, because of uncertainties in the learning style research, it would be better to collect too many data elements than too few. Redefinition of data requirements and uses was actually repeated at each step of the procedure.

Data Collection Procedures

The design of data collection procedures and data base structure was concerned primarily with transmitting the data from the subjects to the data base. It was decided that background information would be collected from students and instructors by administering a questionnaire, learning factors would be collected using standardized tests, and student achievement would be collected from the instructor's records of grades in selected courses. The data flow for collecting the data was determined by the learning style research design (see Figure 1).

Data collection procedures involved the following basic functions:

1. Drafting of a background information questionnaire;
2. Determining the medium for recording testee responses;
3. Determining the method to be used for grading the tests;
4. Designing data record layouts for both instructors and students;
5. Determining the timing of data collection;
6. Determining data element formats;
7. Determining the specific statistical analysis to be performed on the data; and
8. Determining report formats.

After completing these functions, specifications for computer programs were determined so that the development of computer programs could begin.

Programming

The computer programs written were programs which would (1) establish files of records on individual students and instructors, (2) add

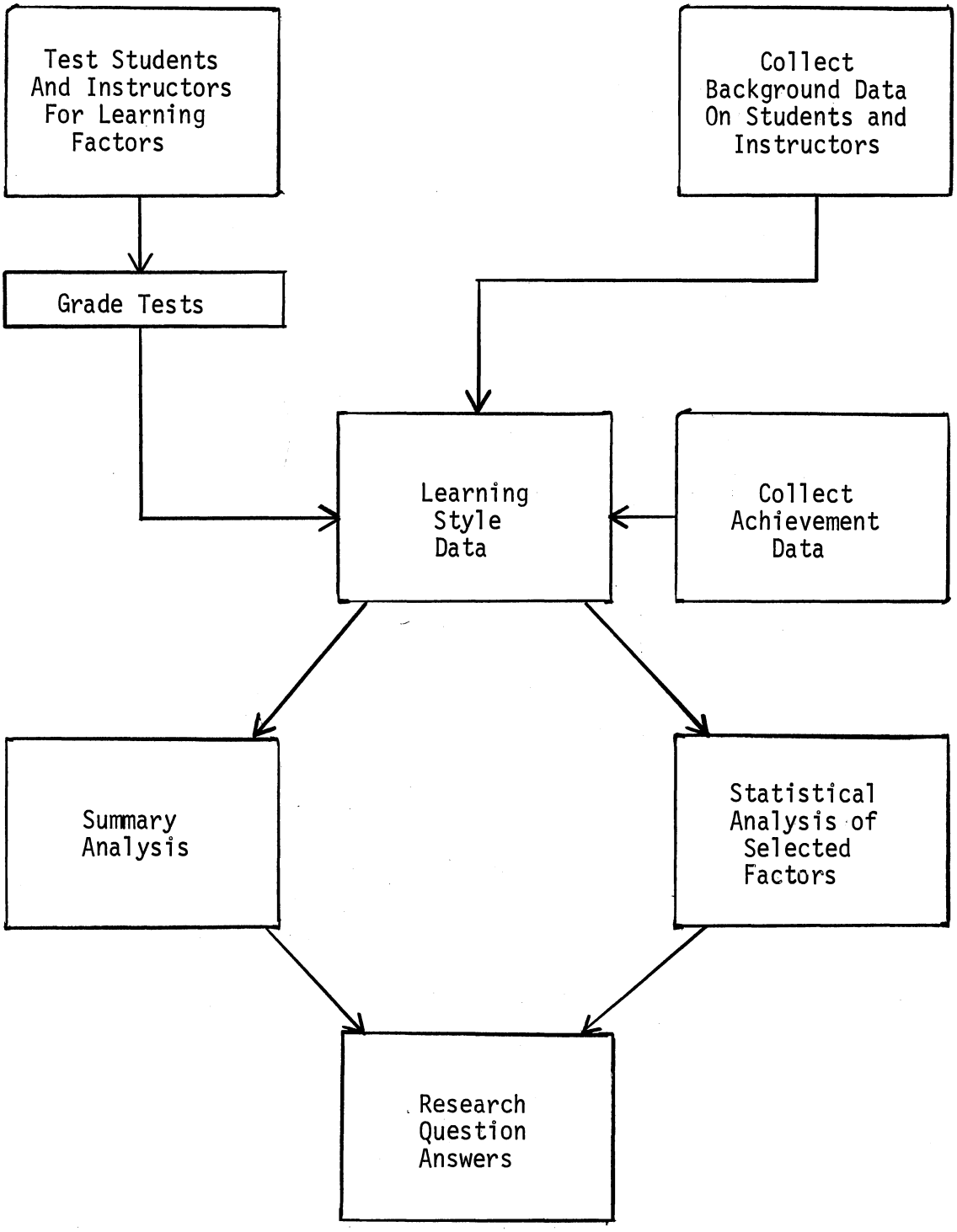


Figure 1. Learning Style Research Data Flow

additional data elements to the records of students and instructors, (3) change data elements on individual records, (4) format summary reports of data elements in the data base, and (5) format selected elements for input to statistical analysis routines. The programming languages selected for use were COBOL and PL/1 because of their file handling capabilities and flexibility in handling diverse types of data. As each program was written it was tested and errors in the program were corrected.

System Test

The system was tested on data collected from 11 instructors and a group of 940 students enrolled in the fall semester, 1974. A total of 19 sections of lower level courses from the disciplines of Economics, English, History, and Psychology were included in the system test. The background questionnaire and learning factor tests were administered by the learning style researcher in the first five weeks of the semester. The data base was created using the data obtained. The achievement data was collected at the end of the semester and added to the data base. All data was then edited for errors and corrected.

Once the data was edited, selected data was formatted for entry into the statistical analysis routines. The printouts from the statistical routines were given to the learning style researcher for review. Following the statistical analysis, summaries of individual scores on the tests were printed for distribution to the testees.

CHAPTER IV

PRESENTATION AND ANALYSIS OF THE SYSTEM

Introduction

The design and implementation of the learning style data collection system occurred over a period of 10 months. The design for accomplishing the objectives of this study called for four unique steps; definition of data requirements, definition of data collection procedures, programming, and system testing. The completion of each step was to lead to the beginning of the next step. There were, however, unknown parameters in the learning style research which forced deviation from this scheme. For example, the specific statistical tests to be used were not known until after the data was collected. This forced programming of routines for selection of data elements for statistical analysis to be delayed until after the system test was well under way.

This chapter concerns itself with a description of specific work done in the development and use of the learning style data collection system. The relationship between the data processing technician and the learning style researcher is described. Measures of cost for programming and processing of the learning style data as well as problems encountered in the work are also presented.

System Design and Implementation

The design of the learning style data collection system began in May, 1974, with a series of meetings between the data processing technician and the learning style researcher. The purposes of these meetings were to identify specific data requirements, identify sources for collecting the data, and discuss possible uses of the data. The specific tests [10] to be used by the learning style researcher were identified (Table I). Each of these tests generated one or more scores which were to be used for statistical analysis.

It was decided that background or biographical data such as sex, age, and high school grade average would be collected using a questionnaire administered to the testee (Appendix A). While much of this information was available in administrative files, it appeared that it would be less complicated and cheaper to collect this information directly from the subjects. Additional data needed were American College Test scores and grades in selected courses at the end of the semester.

A list of all data items required and their source was made and reviewed by the data processing technician and the learning style researcher. The list was examined with respect to the learning style research questions to determine if the data elements could be used to provide answers to the research questions. A final list of data elements was drafted and provided the information required for defining the data base (Table II).

The learning style data base was made up of three types of data files; (1) files containing raw data such as test responses, background information, and final grades, (2) a master file containing the refined

TABLE I

LEARNING STYLE TESTS ADMINISTERED

Name	Type	Number of Items/Scores
Verbal Analogies (VA)	Multiple Choice	20/2
Ordering I (ORD)	Multiple Choice	20/3
Hidden Figures (HF)	Multiple Choice	32/4
Alternate Additions (AA)	Completion	16/2
Tolerance for Ambiguity (TOA)	Rating Scale	16/1
Study Strategies (SS)	Rating Scale	43/21
Myers-Briggs Type Indicator (MB)	Multiple Choice	169/12

TABLE II

LEARNING STYLE DATA ITEMS AND SOURCE

Data Item	Source
Testee I.D.	Questionnaire
Course I.D.	Questionnaire
Age	Questionnaire
Name	Questionnaire
Major	Questionnaire
Sex	Questionnaire
Home Town Population	Questionnaire
High School GPA	Questionnaire
ACT Score	Registrar Files
Instructor or Student Identifier	Questionnaire
Test Date	Questionnaire
Home State	Questionnaire
Class	Questionnaire
VA Scores	Test
ORD Scores	Test
HF Scores	Test
AA Scores	Test
TOA Scores	Test
SS Scores	Test
MB Scores	Test
Final Grade	Instructor Grade Rolls

learning style data for each testee, and (3) files of data selected from the master file which were subjected to statistical analysis and used for formatting reports. The raw data was processed through computer programs which created and up-dated the master file. The master file was then used to format files of selected data appropriate for input to the statistical routines. Figure 2 shows the flow of data among these files.

After the basic parameters of the system were defined the work progressed to the more detailed job of defining data collection procedures. The battery of tests required approximately three hours to administer in each selected course. The learning style researcher was allowed only one hour in each class for testing. The tests were, therefore, divided into two sets, the first set to be administered in the allotted class time, the second set to be administered during special test sessions which the testees attended at their own discretion. The first set of tests consisted of Verbal Analogies, Ordering I, Hidden Figures, and Alternate Additions. The background questionnaire was also administered during the classroom testing. The remaining tests, Tolerance for Ambiguity, Study Strategies, and the Myers-Briggs Type Indicator were administered by the learning style researcher during the special testing sessions.

Testee responses to the tests Verbal Analogies, Ordering I, Hidden Figures, and Study Strategies were recorded by the testee on standard mark-sense tab cards (Appendix B). These tab cards were processed using the University Computer Center's optical mark-sense reader and associated software, which converted the marks on the cards to numeric values which could be interpreted by the test grading programs. Mark-sense tab cards

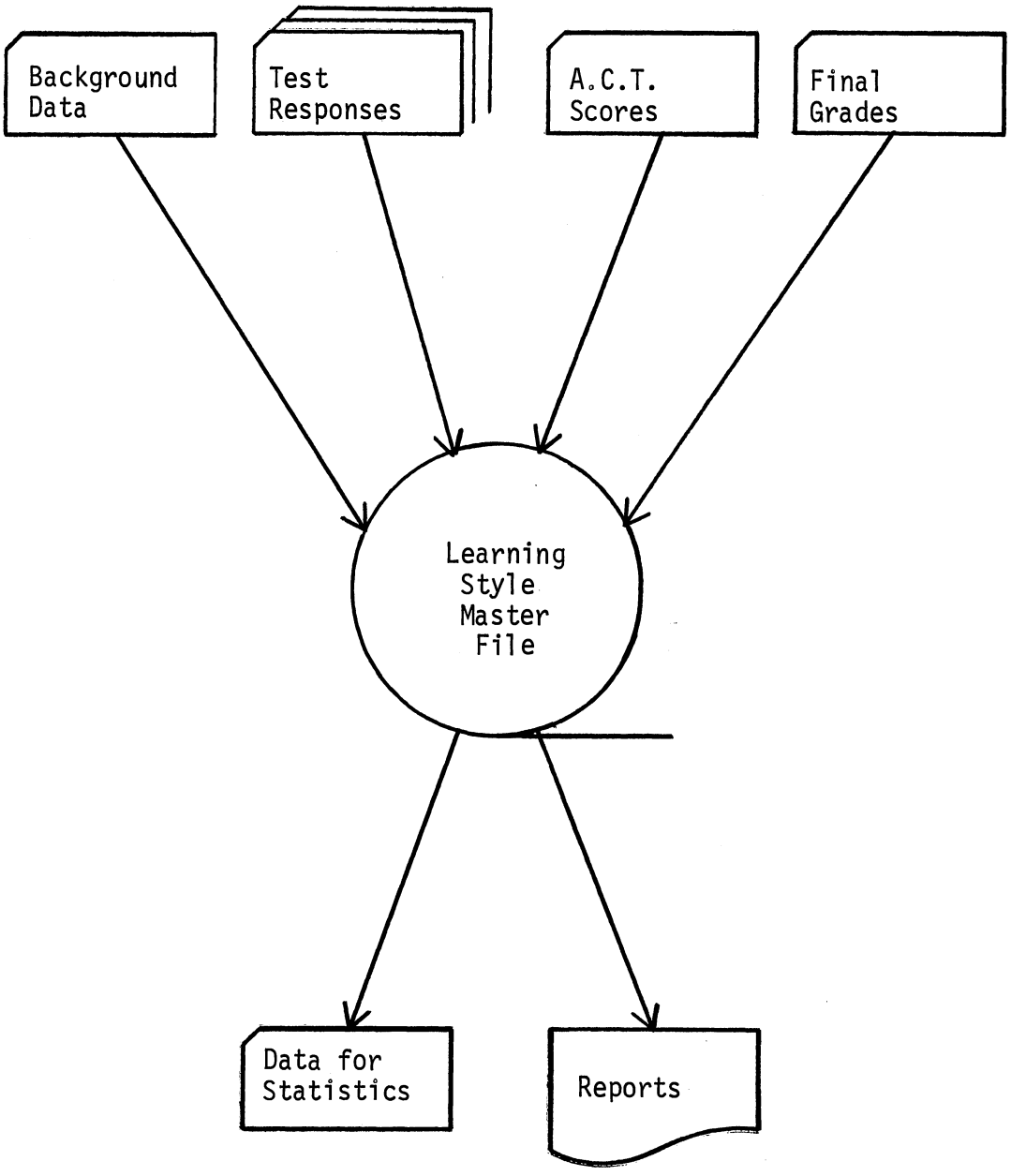


Figure 2. Data Flow Among Learning Style Data Base Files

were used for recording test responses because they were cheaper than having the test responses keypunched on standard computer cards. The OMR reader is sensitive, however, to poorly marked cards or marks made outside of the indicated spaces. Each mark-sense card was examined by the learning style researcher or the data processing technician before it was processed and poorly marked cards were corrected.

The tests, Alternate Additions and Tolerance for Ambiguity were hand scored by the learning style researcher and assistants. Neither of these tests could utilize the mark-sense card for recording responses. Alternate Additions was a completion test requiring the testee to fill in blanks while Tolerance for Ambiguity required that a specified answer sheet be used for testee responses. It appeared that scoring and recording of the scores on keypunch forms would be faster than recording each test item response on keypunch forms and scoring the test by machine. This is not the case, however, with the Myers-Briggs Type Indicator. This test required that a special form, designed by the author of the test, be used for recording responses. The test yielded eight raw scores, each raw score resulted from the addition of weighted values for correct responses to selected questions. The testee responses were punched on standard computer cards and scored by the computer.

The learning style researcher drafted directions for recording answers on the mark-sense cards for each test. The tests Verbal Analogies and Ordering I were combined as one test with two sections so that responses could be coded on only one mark-sense card. The test Hidden Figures was divided into two sections of 16 items each. The testees were asked to record both name and university identification

number on all answer forms. Special identification numbers were provided for instructors who had no six digit university identification number.

Following the definition of the format for the raw input data, the format for all data to be maintained on the learning style master file was defined (Appendix C). Student and instructor records were differentiated using a one position indicator, whose value was zero for students and one for instructors. Computer programs were then written to process the raw data (Appendix D). Background information was the first data to be entered on the master file. A master record was created for each completed questionnaire. The record created contained the testee university identification number, the background information requested, and blank positions in the record for test scores, American College Test scores, and final grades. Multiple master records were created for testees who were enrolled in more than one of the courses tested. Thus a student or instructor who occurred in two of the courses participating in the learning style research had two learning style master records. The master file was created and maintained in identification and course number order. The course number used was a 12 digit department-course-section identifier used by Oklahoma State University. A Background Information Report was produced by the program which listed the background information placed on the master file for each individual (Appendix E).

The programs were then written to grade the tests using grading methods and formulas for calculating scores provided by the learning style researcher. Each program accessed a testee response record, matched it to the learning style master file using the testee

identification number, graded the test responses using a test key, computed the test scores, up-dated the testee's master file record and formatted a test results report indicating the up-dates to the master file (Appendix E). Error listings were produced for those response records which contained invalid data or did not match the master file. A program was also written to produce the Learning Pattern Score Report (Appendix E). This report was used by the data processing technician and the learning style researcher to determine the completeness of the file after all test data was processed. Each program was tested using a small volume of data, and the results of each program test were verified by both the data processing technician and the learning style researcher.

The testing of students and instructors began the first week of the fall, 1974 semester and was finished by the end of the fifth week of the semester. The learning style researcher administered the tests to the selected courses, grouped the mark-sense test response cards by test, scored the Tolerance for Ambiguity and Alternate Additions tests, and submitted all data to the data processing technician. The data processing technician submitted the background information questionnaire, the Myers-Briggs Type Indicator response sheet, and scores from Tolerance for Ambiguity and Alternate Additions to the University's keypunch group for keypunching. Following the required keypunching, all data, both keypunched and mark-sense coded, were processed through the appropriate computer programs and placed on the learning style master file. Incorrectly coded testee identification numbers or poorly coded test responses were corrected after each computer run and reprocessed.

Permission was obtained from the registrar to access the university student files to obtain American College Test scores. This process involved formatting a card file of the student identification number from the learning style master file and submitting it to Administrative Systems Development, the administrative department responsible for maintaining student files. American College Test scores for selected students were returned and the learning style master file was up-dated.

At the end of the semester instructors in the selected courses provided copies of student grade rolls which contained student identification number and final grade received in the course. The student identification number and final grade were keypunched and inputted to a program which up-dated the learning style master file.

After all data was collected and placed on the learning style master file, programs were written to format, from the master file, three files of selected data on both students and instructors. These files of selected data contained keys for grouping of observations by course discipline, by instructor, and by sex as well as the data elements from the master file that the learning style researcher wished to examine. This selected data was punched on standard computer cards in a format which could be used as input to the statistical analysis packages SAS and SPSS. The data was punched on computer cards to allow sorting and grouping on an I.B.M. card sorter. Sorting the selected data externally before presenting it to the statistical routines was considered to be less expensive than forcing the statistical routines to do the sorting internally.

The statistical routines used were Pearson Product Moment Correlation and Multiple Regression Analysis from SAS and FAST TABS routine

from SPSS which computes a non-linear correlation coefficient called Eta. The selected data was divided into two groups; group one was students who had responded to all seven standardized tests and group two was students who had only responded to the tests offered during the classroom testing period. Observations in group one had a total of 19 independent variables and one dependent variable, while observations in group two had only five independent variables and one dependent variable. Both groups were analyzed at the group level, at the course level, and at the instructor level. The printed results of the statistical programs were returned to the learning style researcher.

The last step in the learning style data collection system was to format profiles to be returned to the testee which listed T-scores of selected scores from the tests administered. These profiles were returned to the learning style researcher for distribution to the testees.

The cost of computer processing time for the entire system design was approximately $400. This was funds allocated to the project for computer usage. Approximately half of this allocation was used for testing of computer programs that were written, the other half was used for processing the learning style data. Keypunching of data for the project cost $80. Additional resources required were two magnetic tape reels on which the learning style master file was stored and approximately 4000 mark-sense tab cards used for the recording of testee responses.

The largest source of problems in processing the learning style data was errors made by testees in recording their identification numbers on the test response forms. Transposition of numbers was

common. These errors were corrected using class listings provided by the instructors of the selected courses. Error correction, however, was very time consuming and reprocessing of the errors increased the cost of collecting the data.

While much work was required in designing the system and processing the data, an example of the time saved in using the computer can be seen by comparing estimates of the time required to grade the Myers-Briggs Type Indicator to the actual time required processing this test on the machine. The learning style researcher estimated that hand scoring of the test would require about 60 hours. Processing the test by machine required six hours for preparing the test responses for keypunching, eight hours for keypunching the responses, and about four hours for processing data through the grading program for a total of 18 hours.

Computer grading of the tests also reduced grading errors by reducing the human element in grading. Errors in keypunching test responses were reduced by having the keypunched data verified after it was keypunched. Errors made in grading mark-sense cards depended largely on how well the testees marked the cards. Responses which were marked too lightly could be interpreted by the machine as no response. All mark-sense cards used were scanned before they were graded and lightly marked responses were darkened. While this process could not eliminate all errors, small volume tests indicated that cards marked by the testees resulted in only small amount of error. Twenty-two mark-sense cards which were used by testees to record answers to the test, Hidden Figures, were checked for errors in converting the marks. Of the 704 possible responses of the group, only two errors were found, both errors on the same testee form.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary of the Study

The main objective of this study was to develop and use a computer system to aid learning style researchers in collection and analysis of learning style data. The design of this system began with the definition of learning style data needs. Procedures for collecting this data were designed and computer programs were written to create and maintain a data base of learning style information. Programs were written to format data from the data base for entry to statistical programs. The system was used to collect and maintain learning style data on 11 instructors and a group of 940 students who were enrolled in the fall semester, 1974. Results of statistical analysis of selected learning style factors were returned to the learning style researcher and testee profiles were formatted for distribution to the testees.

Conclusions

The primary conclusion of this study is that a computer system can be used for the collection and analysis of learning style data. The use of such a system can reduce the time required for grading of standardized tests and statistical analysis of the data. Machine grading of the

learning style tests can result in reliable, relatively error free data, providing response forms are properly marked by testees.

The establishment of a learning style data base provides data which can be used to answer learning style research questions which arise after the primary learning style research is completed. The learning style researcher can request additional statistical analysis on the data collected.

Changes in the test set used by the learning style researcher will require additional programming and some changes to the data base. The general design for data collection and analysis, however, may be used no matter what tests are administered in the learning style research.

The design and use of this system required close cooperation between the learning style researcher and the data processing technician. Changes or additions to the data base will require changes to existing computer programs or require that additional programs be written. This work will require lead time so that the work may be checked for errors. Any changes or additions to the data collection system will require continued cooperation and communication between the data processing technician and the learning style researcher.

Expansion of the present system can be done with considerably less effort than was expended during the initial design. The learning style master file contains extra space in each record for adding data elements. An addition to the learning style test set would require writing a program for grading and placing scores on the master file and changing programs which select data for entry to statistical analysis programs to include the additional scores.

The learning style collection system is designed to manipulate learning style data in a research situation. The system would require considerable modification if it were to be used for matching of student learning styles to instructor learning styles for student counseling. The nature and extent of these modifications will not be known until the learning style research is completed.

The system designed is by no means the only method possible for using the computer to aid learning style research. It represents only one approach which was successfully used in the collection and analysis of learning style data. The work on this study not only accomplished the study's objectives but also emphasized the need for the data processing technician to possess and use certain non-technical communications skills.

Recommendations

The system designed in this study serviced the data needs of only one learning style study. The system would be more beneficial to the learning style research effort if it serviced the data needs of all learning style studies being conducted at Oklahoma State University. The definition of data requirements for several studies would require extensive communication among all of the learning style reserachers and one or more data processing technicians. In short, the system could provide coordination among all researchers involved in the learning style research effort. The coordination of learning style research would help to eliminate unnecessary duplication of effort and would allow better communication among the researchers.

The data processing technician was required to be more than just a programmer in order to design and implement the learning style data collection system. Many two year post-secondary data processing programs offer skill training in computer operation and programming. The techniques of system analysis and design are usually given only a small amount of attention. Research should be conducted in order to determine if two year data processing programs need more emphasis in system analysis or if the data processing technician should continue to learn these skills on the job. The research should seek to determine if it is practical and beneficial to include the teaching of system analysis techniques in the programs and if so, determine how this instruction could be included. Research should also be conducted to determine what special communication skills are needed by the data processing technician when dealing with a user of his technical skills.

The Role of the Data Processing Technician

While this study was primarily descriptive in nature, the work on the system brought out information regarding the role of the data processing technician in system development. The design of the learning style data collection system required close cooperation between the data processing technician and the learning style researcher. The success of the system depended greatly upon the quality of communication between these two individuals.

It is clear that the data processing technician must have technical abilities and knowledge to effectively work on system development such as the learning style data collection system. The technician was also

required to have communication abilities which were as important as these technical abilities. The technician was required to learn and use a new set of terminology used by learning style researchers and develop a limited background in educational research techniques in order to communicate effectively with regard to data needs and system processes. Misinterpretation of what the learning style researcher was saying could lead to (1) mistakes which would require additional work on the part of both parties for correction or (2) errors in the data used to answer learning style research questions.

The data processing technician also acted as a critic of the learning style research. The definition of data elements needed for the establishment of the learning style data base required the technician to question the need for each element. This questioning resulted in elimination of some useless data and allowed the learning style researcher to re-examine research questions and methods for answering the questions.

The data processing technician was required to tolerate changes in the system at each step of the development. These changes were brought on by changes or additions to the learning style research. While changes usually required additional work, they were to be expected and had to be made in order to provide data which could be used effectively by the learning style researcher.

A long period of time was spent by the data processing technician in discussion of the system work with the learning style researcher. Points of misunderstanding on the part of either the data processing technician or the learning style researcher had to be discussed until both parties were satisfied. Agreement between both parties was

required before detailed decisions, regarding the collection and analysis of the data, could be made by either party.

The following guidelines are offered to the data processing technician who may undertake work similar to the task described in this study. These guidelines are general in nature and are meant as points to be considered when designing and implementing systems for specific educational research studies.

Guidelines

1. Obtain a general description of the research design from the researcher.
2. Review previously completed research which is similar in design in order to determine research terminology and develop background in the research techniques.
3. Become familiar with existing computer resources, both software and hardware.
4. Begin more detailed discussions with the researcher. Any unfamiliar words, phrases, or ideas used or referenced by either the technician or the researcher should be discussed.
5. Identify the specific data elements required and sources for collecting the elements. Indicate to the researcher the cost and difficulty of collecting each element so that he may decide how much he needs the element.
6. Determine how the researcher wishes to use each element and the form in which each element should be maintained on the data base.

7. Determine the statistical tests to be used and use, where possible, existing programs. If satisfactory statistical routines do not exist then programs must be written to do the tests. When using existing statistical programs check results of a small sample test, by hand if necessary, to insure that the programs are correct and that the results are appropriate for use by the researcher.
8. Make the programs which are written as simple and straight forward as possible. Changes to the system, input requirements, and formats are inevitable and require easily modified programs.
9. Tests of individual programs should be reviewed in detail with the researcher. Errors should be eliminated as soon as possible because errors which are discovered late in the system development will require more work for correction and may lessen the researcher's confidence in the validity of his data.
10. If possible allow more than the longest estimate of lead time needed for work on the system. Data processing systems tend to grow during development and time consuming problems will occur that are not expected.
11. Accommodate the needs and wishes of the researcher whenever reasonable and possible because the success of the system depends in part on the satisfaction of the researcher. If possible offer alternatives to requests for work that appear unreasonable or impossible to fulfill.
12. Try to maintain a sense of humor throughout the system work.

SELECTED BIBLIOGRAPHY

(1) Niec, Alphonsus. "A Study of the Learning Styles of College Students, Instructional Styles and Academic Fields Related to Achievement." (Unpub. Ph.D. dissertation, Oklahoma State University, July, 1975).

(2) Alcorn, Bruce K. "Educational Specifications Versus Systems - Does the Tail Wag the Dog." In Richard A. Karmann and Robert W. Marker. Educational Data Processing: New Dimensions and Prospects. Boston: Houghton Mifflin Company, 1967, pp. 51-54.

(3) Dyke, Freeman H. The Management and Use of Technical Information. Boston: Farnsworth Publishing Incorporated, 1968.

(4) Gable, Robert K. and Arther D. Roberts. Affective and Cognitive Correlates of Classroom Achievement: Research for the Counselor. Paper presented at the American Educational Research Association Convention, New Orleans, 1973.

(5) Goldman, Roy D. and Rebecca Warren. "Discriminant Analysis of Study Strategies Connected With College Grade Success in Different Major Fields." Journal of Educational Measurement, Vol. 10, No. 1 (Spring, 1973), pp. 39-47.

(6) Goldman, Roy D. and David J. Hudson. "A Multivariate Analysis of Academic Abilities and Strategies for Successful and Unsuccessful College Students in Different Major Fields." Journal of Educational Psychology, Vol. 65, No. 3 (1973), pp. 364-370.

(7) System/360 User's Manual. Oklahoma State University Computer Center. Stillwater: Oklahoma State University, September, 1972.

(8) Service, Jolayne. A User's Guide to the Statistical Analysis System. Raleigh, North Carolina: Student Supply Stores, North Carolina State University, 1972.

(9) Nie, Norman H., Dale H. Bent, and C. Hadlai Hull. Statistical Package for the Social Sciences. New York: McGraw-Hill Book Co., 1970.

(10) Accola, William V. and Dena B. Meenen. OMR Test Grading Program. Stillwater: University Computer Center, Oklahoma State University, January, 1972.

APPENDIX A

BACKGROUND DATA QUESTIONNAIRE

PLEASE PRINT REQUESTED INFORMATION

IN THE SPACES PROVIDED

1. STUDENT I.D. NUMBER [ ][ ][ ][ ][ ]

2. NAME [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]
LAST FIRST MIDDLE

3. AGE (years/months) _____

4. SEX (M or F) _____

5. HOME STATE _____

6. MAJOR _____

7. CLASS (circle one)

(a)Freshman (b)Sophomore (c)Junior (d)Senior (e)Other

8. HOME TOWN POPULATION (circle one)

(a) Below 10,000 (b) 10,000-50,000 (c) 50,000-100,000 (d) Over 100,000

9. APPROXIMATE HIGH SCHOOL GRADE AVERAGE (circle the number most representative)

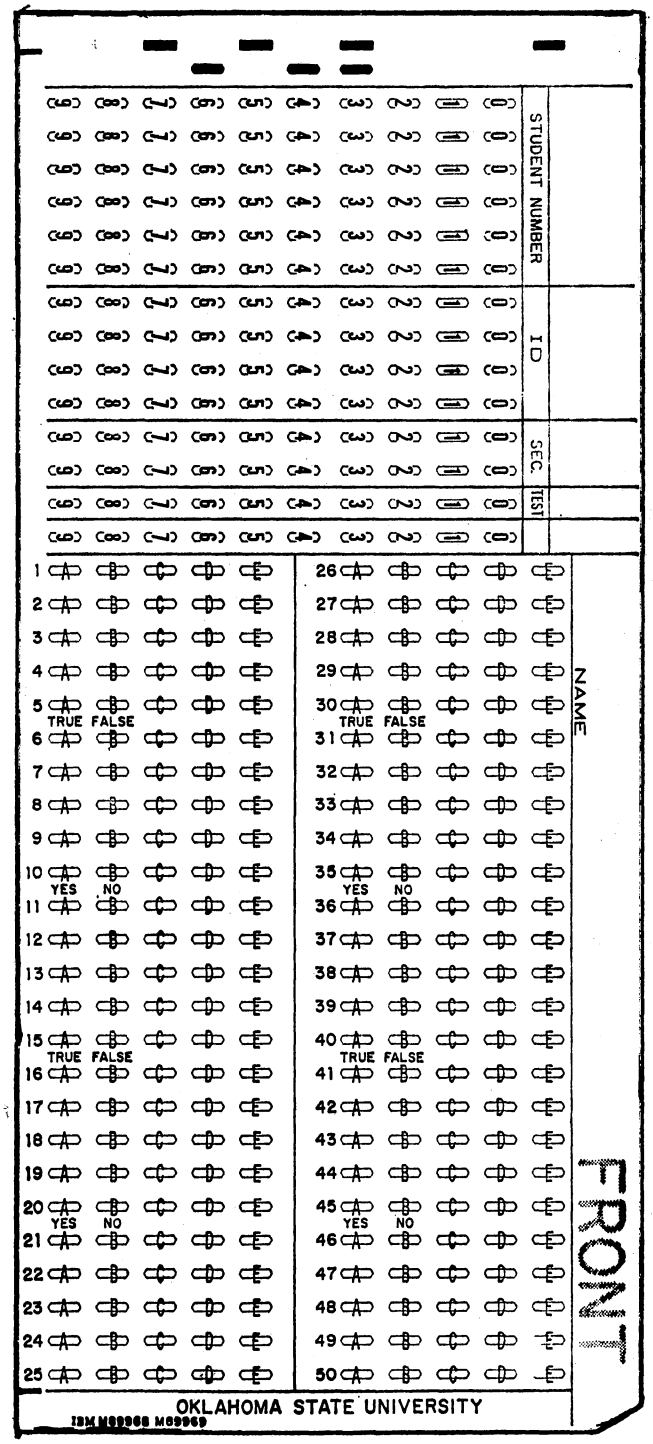
A B C D

1 2 3 4 5 6 7

10. COURSE _____ _____ _____

APPENDIX B

MARK SENSE CARD


STUDENT NUMBER
ID
SEC.
TEST
NAME
FRONT
TRUE FALSE
YES NO
OKLAHOMA STATE UNIVERSITY

APPENDIX C

LEARNING STYLE MASTER FILE DATA LAYOUT

Record Format Page 1 of 2

Record Name: Learning Style Master

POSITION		SIZE	TYPE	CONTENTS
From	Thru			
1	6	6	Numeric	ID
7	11	5	Numeric	DEPT
12	15	4	Numeric	COURSE
16	18	3	Numeric	SECTION
19	22	4	Numeric	AGE (YR/MO)
23	42	20	ALPHA	NAME
43	47	5	ALPHA	MAJOR
48	48	1	Numeric	SEX
49	49	1	Numeric	HOME TOWN POPULATION
50	50	1	Numeric	HIGH SCHOOL GPA
51	60	10	Numeric	A.C.T. SCORES
61	61	1	Numeric	INSTRUCTOR OR STUDENT CODE
62	67	6	Numeric	TESTING DATE
68	69	2	Numeric	STATE CODE
70	70	1	Numeric	CLASS
71	72	2	Numeric	HF 1 CORRECT
73	74	2	Numeric	HF 1 BLANK
75	76	2	Numeric	HF 2 CORRECT
77	78	2	Numeric	HF 2 BLANK
79	80	2	Numeric	VA CORRECT
81	82	2	Numeric	VA BLANK
83	84	2	Numeric	ORD CORRECT
85	86	2	Numeric	ORD BLANK
87	90	4	Numeric	ORD SCORE
91	92	2	Numeric	AA TOTAL
93	94	2	Numeric	AA CORRECT
95	97	3	Numeric	TOA SCORE
98	99	2	Numeric	MB - E SCORE
100	101	2	Numeric	MB - I SCORE
102	103	2	Numeric	MB - S SCORE
104	105	2	Numeric	MB - N SCORE
106	107	2	Numeric	MB - T SCORE
108	109	2	Numeric	MB - F SCORE
110	111	2	Numeric	MB - J SCORE
112	113	2	Numeric	MB - P SCORE
114	115	2	Numeric	MB - EI SCORE

Record Format Page 2 of 2

Record Name: Learning Style Master

POSITION		SIZE	TYPE	CONTENTS
From	Thru			
116	117	2	Numeric	MB - SN SCORE
118	119	2	Numeric	MB - TF SCORE
120	121	2	Numeric	MB - JP SCORE
122	123	2	Numeric	SS - CD TOTAL POINTS
124	126	3	Numeric	SS - CD AVERAGE SCORE
127	127	1	Numeric	SS - CD NUMBER RESPONSES
128	129	2	Numeric	SS - AS TOTAL POINTS
130	132	3	Numeric	SS - AS AVERAGE SCORE
133	133	1	Numeric	SS - AS NUMBER RESPONSES
134	135	2	Numeric	SS - MN TOTAL POINTS
136	138	3	Numeric	SS - MN AVERAGE SCORE
139	139	1	Numeric	SS - MN NUMBER RESPONSES
140	141	2	Numeric	SS - PL TOTAL POINTS
142	144	3	Numeric	SS - PL AVERAGE SCORE
145	145	1	Numeric	SS - PL NUMBER RESPONSES
146	147	2	Numeric	SS - FT TOTAL POINTS
148	150	3	Numeric	SS - FT AVERAGE SCORE
151	151	1	Numeric	SS - FT NUMBER RESPONSES
152	153	2	Numeric	SS - NT TOTAL POINTS
154	156	3	Numeric	SS - NT AVERAGE SCORE
157	157	1	Numeric	SS - NT NUMBER RESPONSES
158	159	2	Numeric	SS - TR TOTAL POINTS
160	162	3	Numeric	SS - TR AVERAGE SCORE
163	163	1	Numeric	SS - TR NUMBER RESPONSES
164	164	1	Alpha	FINAL COURSE GRADE
165	240	76	Blanks	FILLER

APPENDIX D

TABLE OF COMPUTER PROGRAMS

TABLE III

TABLE OF COMPUTER PROGRAMS

Program Name	Language	Function
BCKGRND	COBOL	Place background data on file
GDVAORHF	COBOL	Grade VA,ORD,HF, and place scores on file
GDAATOA	COBOL	Place AA and TOA scores on file
GDSS	COBOL	Grade SS and place scores on file
GDMYERS	COBOL	Grade MB and place scores on file
ACTADD	COBOL	Place A.C.T. scores on file
GRDEADD	COBOL	Place final grades on file
CVTNKSN	PL/1	Convert mark sense cards
SCRINVEN	COBOL	Format score inventory report
STAT1	PL/1	Format variables for statistics
STAT2	PL/1	Compute instructor/student distances for statistics
STAT3	PL/1	Compute variable intervals for statistics
PROFIL	PL/1	Format testee profile reports

APPENDIX E

SAMPLE REPORTS

LEARNING PATTERN BACKGROUND INFORMATION ADDED TO FILE 09/12/74

ID	NAME	AGE YR/MO	SEX	STATE	CLASS	POP	GRADE	COURSE	
999991	JOHN DOEA	XX/XX	M	OK	1	3	4	ECON	1234 001
999992	JANE DOEB	XX/XX	F	NY	2	1	3	ENGL	1234 005
999993	JOHN DOEC	XX/XX	M	TX	1	2	1	PSYCH	1234 011
999994	JOHN DOED	XX/XX	M	OK	4	2	0	ECON	1234 001
999995	JANE DOEE	XX/XX	F	KA	3	3	5	PSYCH	1234 012
999996	JOHN DOEF	XX/XX	M	OK	1	4	3	ECON	1255 003
999997	JOHN DOEG	XX/XX	M	OK	5	1	1	PSYCH	1234 012

SCORE INVENTORY
ECON 1234 004

ID	NAME	ACT	HF	VA	ORD	AA	TA	MYERS	SS	INSTR
999981	JOHN DOE		X	X	X	X	X	X	X	X
999982	JANE DOE	X	X	X	X	X	X	X	X	
999983	JOHN DOE	X		X	X	X				
999984	JOHN DOE	X		X	X	X				
999985	JANE DOE	X		X	X	X				
999986	JOHN DOE	X		X	X	X				
999987	JOHN DOE	X		X	X	X				

VERBAL ANALOGIES AND ORDERING 1 TEST RESULTS 01/11/75

ID NUMBER		VERBAL ANALOGIES CORRECT	VERBAL ANALOGIES BLANK	ORDERING 1 CORRECT	ORDERING 1 BLANK	SCORE
999991		10	0	5	8	3.25
999992		14	0	12	3	10.75
999993		12	1	5	8	3.25
999994		8	0	8	10	7.50
999995		9	0	9	5	7.50
999996		12	5	8	7	6.75
999997		12	0	9	3	7.00
NUM STUDENTS	7	11.00	0.86	8.00	6.29	6.57

LEARNING STYLE RESEARCH
STUDENT PROFILE

STUDENT NUMBER 999991

VARIABLE NAME	T-SCORE
VERBAL ANALOGIES	42.95
ORDERING	47.73
ALTERNATE ADDITIONS	65.77
WRONG	57.25
RI-1	43.66
HIDDEN FIGURES	49.91
RI-2	34.37
CLERICAL DILIGENCE	39.29
ACADEMIC SAVVY	51.04
MNEMONICS	65.14
PLANFULNESS	41.87
FORMAL THINKING	57.94
NOTE TAKING	44.33
TRANSFORMATION	39.12
EXTRAVERSION-INTROVERSION	37.26
SENSING-INTUITION	42.34
THINKING-FEELING	25.25
JUDGING-PERCEIVING	46.74
TOLERANCE OF AMBIGUITY	47.79

VITA 2

Ronald Wayne Kays

Candidate for the Degree

Master of Science

Thesis: THE DESIGN AND DEVELOPMENT OF A SYSTEM FOR THE COLLECTION AND ANALYSIS OF LEARNING STYLE DATA

Major Field: Technical Education

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Professional Experience: Computer operator, Oklahoma State University Computer Center, 1970-1972; computer programmer, Cities Service Oil Company, 1972; computer programmer, Oklahoma State University, 1973-1975.