73-26,403

OVERTON, Ruby Jean, 1941-
BUSINESS DATA PROCESSING CURRICULUM IN THE COMMUNITY COLLEGES AND TECHNICAL INSTITUTES AND DATA PROCESSING JOB CLASSIFICATIONS IN SELECTED BUSINESSES AND INDUSTRIES IN NORTH CAROLINA.

University of North Carolina at Greensboro, Ed.D., 1973
Computer Science

University Microfilms, A XEROX Company, Ann Arbor, Michigan

BUSINESS DATA PROCESSING CURRICULUM IN THE COMMUNITY COLLEGES AND TECHNICAL INSTITUTES AND DATA PROCESSING JOB CLASSIFICATIONS IN SELECTED BUSINESSES AND INDUSTRIES IN NORTH CAROLINA

by

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A Dissertation Submitted to
the Faculty of the Graduate School at
The University of North Carolina at Greensboro
in Partial Fulfillment
of the Requirements for the Degree
Doctor of Education

Greensboro
April, 1973

Approved by

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APPROVAL SHEET

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OVERTON, R. JEAN. Business Data Processing Curriculum in the Community Colleges and Technical Institutes and Data Processing Job Classifications in Selected Businesses and Industries in North Carolina. (1973) Directed by: Dr. Lois V. Edinger. pp. 295.

The purposes of this study were threefold:

1. To determine the business data processing job classifications of businesses and industries in North Carolina and the knowledges and technical skills needed for each job classification.

2. To survey the community colleges and technical institutes in North Carolina to determine the current curriculums in the business data processing education programs.

3. To determine the relation of the current curriculums to the job classifications and the knowledges and technical skills needed for each job classification.

Information for this study was obtained from questionnaires received from selected businesses and industries in North Carolina with computer installations and from personal interview sessions with data processing department heads in the North Carolina community colleges and technical institutes with data processing programs.

The following conclusions can be made concerning data processing job classifications and needs in North Carolina:

1. Graduates of the technical institutes and community colleges may enter the following data processing jobs: computer operator, computer programmer, data processor, cooperative computer programmer trainee, and data processing coordinator. For the job classifications of computer programming

manager, systems analyst, systems manager, and data processing manager more experience and education were desirable. The desirable education level for computer operators, data processors, key punch operators, data processing coordinators, and key punch supervisors was a high school degree.

2. Job opportunities were more numerous for the positions of computer operator, programmer, cooperative computer programmer trainee, key punch operator, and data technician.

3. Programmers, programming managers, and systems analysts need to be proficient in COBOL, RPG, and assembly programming languages.

4. Oral and written communication skills are desirable for all data processing classifications. These courses are general education course requirements in most of the community colleges and technical institutes. General mathematics, introduction to business and bookkeeping/accounting, and introductory courses in automated and electronic data processing were recommended by most data processing managers and were also included in the data processing programs in the community colleges and technical institutes.

5. Data processing managers indicated that little change would take place in their computer installation in the next three to five years, with the exception of a few changes in hardware and software. Managers did not feel that the present educational institutions would be able to fulfill the needs of data processing employees for future changes.

6. More job classifications were utilized in this study than in the study conducted by Bangs and Hillestad in 1967-68. The entire field of data processing seems to be growing and differentiating.

The following conclusions can be made about the data processing programs in the community colleges and technical institutes:

1. The primary objective of the community colleges and technical institutes has been to educate students for gainful employment as computer programmers.

2. Data processing advisory committees are prevalent in the community colleges and technical institutes. They provide useful assistance and information to data processing department heads concerning curriculum, equipment, and job opportunities.

3. Relatively few schools operate a cooperative part-time work experience program in data processing. Only five schools out of the twenty-one schools surveyed have such a program.

4. In-house computers, computer terminals, and computer services are becoming prevalent in businesses and industries. The community colleges and technical institutes maintain computer terminal connections with the Triangle Universities College Computation (TUCC) center, but continue to teach unit record equipment.

5. There does not seem to be any significant change in the data processing programs offered in the community colleges and technical institutes in North Carolina when compared with the earlier study by Bangs and Hillestad.

DEDICATION

To a special person without whose understanding and patience this study would not have been possible.

ACKNOWLEDGEMENTS

Many individuals have contributed to the completion of this study. Their assistance and encouragement were most helpful, and I extend to them my appreciation.

Appreciation is especially extended to Dr. Lois V. Edinger, chairman of my committee, for her patience and understanding and constructive evaluation and recommendations during the time span of this study. Full acknowledgement is also extended to other members of the committee for their continued interest, support, and guidance during the conduct of this study--Dr. Vance T. Littlejohn, Dr. Ernest W. Lee, and Dr. Dwight F. Clark, III.

Special appreciation and thanks are extended to the Data Processing Management Association, Piedmont Chapter, Greensboro, North Carolina, for their financial support and special interest, and especially to the members of the Educational Committee--Mrs. Vera S. Meyer, chairman; Mr. Dan U. Cregar, and Mr. Frank E. Fary, Jr.

Acknowledgement is made to the data processing department heads in the community colleges and technical institutes and to data processing managers in businesses and industries in North Carolina who assisted in the data collection process. Acknowledgement is also made to Dr. Ben E. Fountain, Jr., State President and staff members in the Department of Community Colleges for their contributions to this study. Appreciation and thanks are extended to the persons assisting in the preliminary stages of the study--Dr. Roscoe J. Allen, Mrs. Joretta K. Klepfer, Miss Sarah W. Jones, Dr. Dwight L. Gentry, and Mrs. Linda Hudson Fretwell.

A special thank you to Mrs. Marie E. Teague for her patience and understanding while typing this manuscript.

Finally, the writer expresses deep appreciation to professors, family, and friends for their patience, understanding, and support during the time span of this investigation.

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CHAPTER I

INTRODUCTION

Automation in the '70's

Automation has been defined as the process of doing work automatically with a minimum amount of human effort. The new technology involving the techniques and processes of automation is having as great an effect on the twentieth century as did the Industrial Revolution in the eighteenth century. The new revolution may be described as the "Computer Revolution."

Computers affect the lives of each of us. A man receives his pay check, pays his bills, watches space flights, watches election returns, hears of medical research, has his credit references checked, and listens to his children talk of the technological changes in the educational system--all processes in which the computer is utilized. No matter how large or small a business or industry, there is probably some type of modern technology being utilized. Dairies, department stores, manufacturers, medical research, and highway departments are only a few of the businesses and industries utilizing computer techniques to handle data, forecast inventories and style trends, register cars on toll roads, punch time cards and provide vital data on research projects in brain surgery, kidney transplants, and cancer.[1] Business data processing has become widespread in business, industry, education, medicine, and government. The processing of information must be handled efficiently and speedily in these organizations. The "Computer Revolution" has provided the means for faster and more efficient handling of vast amounts of information. The computer age has developed new jobs and changed old jobs, requiring extensive training and retraining. Instructional programs are being developed in some high schools, community colleges, and technical institutes to provide educational experiences in data processing.

In October, 1966, the Educational Research Service mailed questionnaires to the elementary and secondary schools in the United States with enrollments of six thousand or more to determine the extent that the "Computer Revolution" had actually affected the curriculum. Of the 1, 271 school systems surveyed, 986 (78 percent) responded.[2] Of the 986 (78 percent) schools replying, 266 (27 percent) indicated that data processing was taught in their systems. The earliest high school course taught in data processing was initiated in Fort Worth, Texas, in 1960. Prior to 1963, only a dozen or so school systems had introduced data processing on the elementary or secondary level.

The questionnaire asked for the number of students enrolled in

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[1]Carl Heyel, Computers, Office Machines, and the New Information Technology (London: The Macmillan Company, 1969), pp. 2-10.

[2]Educational Research Service, Teaching of Data Processing in Local School Systems, 1966-67 (Washington, D.C.: Educational Research Service, American Association of School Administrators and the Research Division, National Education Association, 1967), p. 2.

structured Electronic Data Processing courses in 1966-67. The 254 schools answering this question reported that the number of students taught in 1966-67 included a total of 32, 561 students who received some education in the theory and/or use of various types of data processing equipment.[3] This 1966 study, conducted in the elementary and secondary schools of the United States, indicated the extent to which the applications of computers and operation of computers was taught as well as the extent to which skills were necessary in preparing the output media to be taught in data processing education.

Goodlad and others have indicated that a knowledge of electronic data processing is a valuable supplement to a progressive high school and junior college education.[4] "No student ought to leave school without some understanding of automation and information processing, considering the important changes these are bringing to the adult world."[5]

Although a case may be made for educational programs in electronic data processing, it may not be feasible for a local community to develop such a program, as Carlberg of Wisconsin State University points out:

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[3]Ibid., pp. 3-4.

[4]John I. Goodlad and others, Computers and Information Systems in Education (New York: Harcourt, Brace & World, Inc., 1966), p. 81.

[5]Ibid.

However, establishing an instructional program in electronic data processing although ideal is not always practical for most communities. The size of the community and the high school, the degree of local need on the part of business and industry, and the school's financial resources must determine the type of program offered.[6]

Implications for Business Education

Today, one of the primary difficulties of business educators, as with all educators, is to "prepare students for life in a changing world in which it is impossible to predict with any great degree of accuracy what the world will be like when they are adults."[7] Most business educators will agree that data processing instruction should be included in the high school curriculum. The question becomes how extensive and how intensive should data processing instruction be at this level of the educational system. The same question can be asked in the community colleges and technical institutes of our nation. However, the extent to which data processing education should take place in the community colleges and technical institutes has not been researched and analyzed as thoroughly as high school data processing programs. Perhaps this is due to the newness of the community college and technical institute concept.

Normally, the first task for establishing curriculum in the business education department is to define what business and industry need in terms of employees and what pre-service training is needed in providing employees for

[6]Mona Carlberg, "Survey of Data Processing Instruction in Six High Schools," Journal of Business Education, XLI (March, 1966), 235.

[7]John C. Roman, "Automation's Challenge to Business Education," Business Education World, XLII (November, 1961), 21.

various jobs. Another consideration is: Will the present business education curriculum prepare the students for the available job opportunities in the community? To help business educators promote and develop programs in business data processing, in 1968, Congress approved Title VII of the National Defense Education Act which provided for the teaching of specialized courses for two-year preparatory curricula in business electronic data processing. Therefore, future trends in data processing should be toward improvement of the present data processing curricula and/or development of data processing programs in the secondary schools and the community colleges and technical institutes.

A Rochester, New York study revealed pertinent questions to be considered by both the high schools and the community colleges and technical institutes in preparing students for data processing occupations:

1. Are business students being properly prepared to take their places in business situations which daily are becoming more and more technological in approaches to the solution of problems?

2. To what extent are business education departments engaged in teaching data processing?

3. To what extent should they include data processing in their curriculum?

4. What considerations have they given to a unit of data processing?

5. What are the possible future trends in teaching data processing on the high school and community college levels?[8]

Results of the Rochester study indicated that business teachers considered data processing important and that data processing was being taught, but rarely with machines. The Rochester approach to help the student develop a working knowledge of what data processing is and how it is to be used in the business world provided a better understanding among business teachers in the training and education of high school students in data processing areas.[9]

Another study in data processing by Bangs and Hillestad indicated that many people needed to be trained and retrained to meet the personnel requirements of businesses and industries employing data processing personnel. From their study, the researchers developed recommended data processing curriculums and course outlines for high schools and for two-year post high schools. Findings of this study were classified into three categories: (1) Jobs and Job Opportunities in Data Processing, (2), Teachers of Data Processing, and (3) Data Processing Curriculums.[10] They found that entry jobs such as key punch operators, unit record operators, tape librarians, and computer operators were open to high school graduates. These same entry jobs as well as jobs as

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[8]Sister Mary Judith, RSM, and Clarence M. Williams, "Data Processing in the Business Curriculum," Journal of Business Education, XXXX, (November, 1964), 52-4.

[9]Ibid.

[10]F. Kendrick Bangs and Mildred Hillestad, Curricular Implications of Automated Data Processing for Educational Institutions (Boulder: University of Colorado, 1968), 14.

programmers, systems analysts, and supervisors of data processing were available to graduates of two-year post high schools. Yet, the schools did not seem to be able to fulfill the needs of business and industry in the field of data processing. One of the primary reasons for this situation was that teachers did not have the appropriate background or training to prepare programs in data processing education to meet business and industry needs.[11]

Bangs and Hillestad also found that because the need for data processing employees was so much greater than the number of people being trained in our educational institutions, business and industry often resorted to hiring data processing personnel having a specialized skill regardless of where they had received their education. As unit record equipment phases out with the installation of small computers, and key punch operators and verifiers are no longer in demand because of utilizations of discs, tapes, etc., the data processing personnel of business and industry will need retraining or training in new areas.[12] If our educational institutions are to participate in education for data processing personnel, they must be aware of the problems and needs of business and industry.

Data Processing Education in North Carolina

As technological changes have taken place throughout the United States, North Carolina has experienced changes in its new as well as its existing

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[11] Ibid., pp. 9-12.

[12] Ibid.

industries. In 1960, extensive business expansion and industrial growth were prevelant in the state. As this expansion and growth occurred, management in research and in production of electronic equipment expressed a concern for the acute shortage of trained personnel to fill the various levels of data processing jobs. Other expressions of concern were apparent in the following statements:

> Life Insurance Companies, Machine Tool Manufacturers, Textile Industries, Banks, as well as numerous State Agencies, began to reveal their interest in the matter. The American Society of Tool Engineers of North Carolina made several requests for formal training to be offered for technicians to operate and maintain tape-controlled production machines--a recognized vital operation in the rapidly expanding industrial states.[13]

These events called for the development of special programs to meet North Carolina data processing needs. In 1961, through the efforts of William A. McIntosch, presently Vice-President of Educational Planning and Evaluation at Central Piedmont Community College, Ivan Valentine, Director of the Burlington Industrial Education Center, and A. Wade Martin, State Supervisor of Trade and Industrial Education with the State Board of Education, Burlington Industrial Education Center accepted this challenge to train students in all levels of Electronic Data Processing ranging from key punch operation to computer programming.

In order to meet the data processing needs of the state and the objectives of the proposed data processing program, Burlington Industrial Education Center installed an IBM 1620, Model I Computer and began its two-year data processing

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[13]William A. McIntosch, "Data Processing Department. Burlington Industrial Education Center." 1962 (Mimeographed), p. 1.

program with an enrollment of seventeen students. With this program, Burlington became the "showplace" of all the industrial education centers in North Carolina. McIntosch stated that the program was successful, in fact, too successful. The program seemed to attract people; therefore, other industrial education centers in the state were anxious to participate in this new technology.[14] There quickly developed programs in other schools in the system--Central Piedmont Industrial Education Center in Charlotte in 1962, Asheville-Buncombe Technical Institute in Asheville in 1963, and W. W. Holding Technical Institute in Raleigh in 1964. In 1965, Rockingham Community College, Richmond Technical Institute, and Lenoir Community College began their data processing programs. In 1966 there were nine programs in operation in North Carolina with terminal connections to the Triangle Universities College Computation center. Today there are nine community colleges and twelve technical institutes with data processing programs, with other schools anticipating programs or offering at least one course in data processing.

Data processing curriculum. The early data processing curriculums in the industrial education centers and the technical institutes were designed for students with a scientific inclination (scientific data processing) and for students interested in computer applications related to the solution of problems pertaining to business (business data processing).

Courses common to both curriculums included speed reading, numbering

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[14]Statement by William A. McIntosch, personal interview, July 26, 1972.

systems and Boolean algebra, industrial psychology, and other courses designed to broaden a student's general knowledge. The primary difference in the scientific and business data processing programs was based on the type of background material required to enable a student to develop self-confidence in his chosen career. In addition to the common courses, the scientific program included mathematics, physics, chemistry, electronics, and scientific programming. The business program specifically included general accounting, industrial accounting, office management, and business programming. All of the courses were supported with extensive laboratory projects in the Electronic Data Processing Center on the computer and required support equipment.[15]

The curriculum, developed at Burlington Industrial Education Center, was the model for programs later developed at Central Piedmont, Asheville-Buncombe, and Holding with the exception of adjustments to fit the unique needs of their communities. By 1963, the curriculum had become more business oriented and included more courses related specifically to data processing such as functional wiring principles, introduction to data processing, fundamentals of computer programming, business programming, and linear programming. In order to maintain up-to-date data processing curriculums and to meet the data processing needs of the community served, the community colleges and technical institutes had to know what the needs were. Due to lack of time for surveys and investigations within the community service area, data processing instructors found it difficult to know what business and industry needed in data processing

[15]McIntosch, loc. cit.

areas. Rapid development of hardware and software in third and fourth generation computers made it difficult for the community colleges and technical institutes to define the specific occupational requirements of data processing personnel.

In order to find a solution to the data processing problems in North Carolina, it became necessary for a state-wide organization to assist the educational system. In 1964, the North Carolina State Board of Higher Education appointed an Advisory Committee on Computers to survey the four-year, state-supported institutions; private institutions; and the industrial education centers and technical institutes in North Carolina in order to determine a basis for making sound decisions about the short- and long-range future of data processing in the state. This committee emphasized the need for a special planning effort in the state and commented on the technical institutes and industrial centers:

> Our technical institutes and industrial centers are now proceeding separately to develop computer science and data-processing courses and curricula. These efforts need to be coordinated and standards need to be set.[16]

During the later part of 1965, the Community College System was beginning to realize that the utilization of the IBM 1620 and 1401 computers was becoming an expensive operation for only one program among many and with few students enrolling or staying in the program.

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[16] Advisory Computer Committee, Data Processing and Computer Education in North Carolina (Raleigh: State Board of Higher Education, 1965), p. 3.

<u>Data processing equipment</u>. In any discussion of data processing programs and curriculums, data processing equipment must be considered. The primary expense of a data processing program is the equipment that is needed to operate a successful program. The expense of the data processing programs in North Carolina has been of great concern even from the beginning of the first program. All of the early schools with data processing programs installed the second generation IBM 1620 computer, which was designed primarily for scientific and engineering applications. The computer was supported with unit record equipment consisting of card read punch, alphabetical printing card punch, alphabetical verifier, sorter, accounting machine, reproducing punch, and numerical collator. In the early days equipment was limited in some schools, again, because of the expense involved and the lack of an equipment budget for such an expensive program. Some schools began to install the IBM 1401 computer, but this computer did not completely serve the purposes of the data processing programs. The second generation, medium speed computers served as debugging devices and permitted students to write programs and process many problems. However, the stand-alone computer had limited language capabilities. Other problems with this computer were that the computer was too expensive in terms of the students being served, and the machine-oriented language, AUTOCODER, was too narrow a language to justify teaching. Some of the institutions were experimenting with FORTRAN AND SPS and teaching COBOL, PL/1, and other languages on a theoretical basis. These problems needed to be investigated and analyzed in more detail in order to determine the short- and

long-range future of data processing education in North Carolina.

Plans for data processing improvement. The Advisory Committee on Computers appointed by the North Carolina State Board of Higher Education in 1964 had provided some useful information about data processing education in North Carolina. This Committee was primarily concerned with the four-year institutions and only made general comments relating to the future of data processing in the industrial education centers and technical institutes. The Committee felt that there should be more coordination and some degree of standardization among these programs.

Dr. William A. McIntosch, who might be called the "father of data processing education in North Carolina," began to question the necessity of teaching specific languages for language sake and the use of a language for carrying programming concepts. His philosophy, which was supported by research and interviews with industry and data processing educators, indicated that educational programs in data processing should be machine independent and problem and procedure oriented.[17] With these thoughts in mind, McIntosch and others began to investigate other possibilities for the schools which would provide a satisfactory but less expensive system for the schools. In 1966, McIntosch recommended utilization of the Triangle Universities College Computation (TUCC) educational services. Shortly afterwards, terminals, some 1050 and

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[17] William A. McIntosch (Project Director), Data Processing Study for the North Carolina Department of Community Colleges (Raleigh: North Carolina State University, Department of Industrial and Technical Education, 1966), p. 7.

some 2780, were installed in the schools with computers. The use of these terminals provided the opportunity for other schools to become a part of the data processing program. The terminal concept also seemed to solve some of the equipment problems of the data processing program. Few changes had to be made in the curriculum and perhaps most importantly, the data processing instructors were able to utilize the terminal without extensive training or background information in data processing concepts and languages. Installation of a terminal expanded the language repertoire and provided economic parameters for controlling programming activities. In-core compilers were used to improve services and reduce cost. Therefore, the data processing programs were able to offer more extensive utilization of several languages--FORTRAN, PL/1, 360 Assembler, andCOBOL. In 1966, there were nine approved programs in operation through TUCC. As is true with any new revolution in education, the terminal concept needed to prove itself.

In 1966, McIntosch and others developed a study for the North Carolina Department of Community Colleges to determine whether TUCC was a feasible system. At this time there was also a rising concern about the use of computer-assisted instruction and a standardized computer administrative system. The primary concern of the schools with data processing programs was the feasibility of TUCC. Computer-assisted instruction was being used successfully in Charlotte at Central Piedmont as were the administrative uses involving accounting procedures, payrolls, and student registration in Charlotte and other schools. From this study, the feasibility of the data processing programs and

TUCC were summarized by the following comments of McIntosch:

> The terminal concept can be considered extremely successful. Operations are of such nature that constant vigilance is required and continuous communications with TUCC and subscribing institutions is absolutely essential to effective and economic operations.[18]
>
> Also, . . . the terminal concept is educationally and economically superior to the stand-alone systems when comparisons are relative. Options are available to the Terminal user which require institutional decisions related to economic ability. Instructor responsibility for establishing supervision of laboratory activities is essential. It is expected that operating changes contemplated at TUCC will be of such nature as to continue to offer increased services at decreased costs.[19]

With the apparent success of the terminal concept, data processing educators began to question the data processing curriculums. In December, 1968, a study was initiated under contract between the North Carolina Board of Education and the Department of Industrial and Technical Education at North Carolina State University to examine the data processing technical curriculums offered in the North Carolina Community College System.

The study was developed in three phases:

1. Phase I: Definition of the employment market in North Carolina for data processing personnel and the role of the Community College System in training employees for this market.

2. Phase II: Development of a curriculum in accord with Step 1, to meet student and industrial needs.

[18]Ibid., p. 2. [19]Ibid., p. 8.

3. Phase III: Determine equipment and other instructional requirements to compliment findings from Steps 1 and 2.[20]

This study is discussed in more detail in Chapter II. The proposed curriculum developed as a result of this study is in Appendix A.

During this time the technical institutes and community colleges were orienting their curriculum and their objectives toward developing computer programmers with an option leading to unit record operations. As stated earlier, the rapid development and changes in the third and fourth generation hardware and software made it difficult for the community colleges and technical institutes to define the specific occupational requirements of data processing personnel. Willis M. Parker, Dean of Occupational Education, at Holding Technical Institute, became concerned with this problem and began to investigate the curriculum offered at Holding to determine if their data processing curriculum was providing an adequate framework to prepare computer programmers for successful entry into the occupation.[21] Parker determined that there were at least four components needed in the data processing framework:

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[20]North Carolina State Board of Education and Department of Industrial and Technical Education at North Carolina State University, "Final Report on Study of the Data Processing Technical Curriculum Offered in the North Carolina Community College System," (Raleigh: North Carolina State University at Raleigh, School of Education, 1969), (Mimeographed), p. 2.

[21]Willis M. Parker, A Position Paper on Electronic Data Processing Curriculum Philosophy and a Suggested Curriculum Guide for Business Data Processing (Raleigh: W. W. Holding Technical Institute, Dean of Occupational Education, 1969), p. 1.

1. A need for a solid foundation in business mathematics and general mathematics with a working knowledge of statistics.

2. A need for accounting principles and practices.

3. A need for oral and written communications.

4. A need for computer programming efficiency.

As a result of his investigation, Parker developed a curriculum for Holding with the primary purpose of developing the desired proficiencies necessary at each level of study regardless of the time required--the individualized approach.[22] This program was published and was made available to other community colleges and technical institutes interested in improving their data processing programs.

Studies have been utilized to some extent in studying the data processing programs. As stated previously, the primary concern in the North Carolina Community College System's data processing programs has been in terms of the cost per student in relation to other programs. Today, this same concern persists. Student enrollment in some schools has decreased in the last few years and the cost of maintenance and the cost of equipment is greater in proportion to other programs in the schools. In order to understand the situation and the problems persisting in the data processing program, Mr. Robert Paap, President of the Catawba Valley Technical Institute, and others in the Community College System throughout the state have formed a committee to study solutions for the problems of finance, the use of hands-on experience versus hands-off experience, the possibility of installing stand-alone computers in the schools, the influence of

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[22]Ibid., pp. 1-4.

data processing on other instructional areas, and the administrative capabilities of the computer for the schools.[23]

Some of the problems in financing a data processing program relate specifically to the data processing curriculum to be offered. If the schools are to provide a data processing curriculum to educate students for employment in data processing occupations in business and industry, there will definitely be questions relating to the financing of such a program. Some of the questions to be answered in terms of finance will consist of determining the present and future needs of data processing equipment that will meet the preparatory needs of students in obtaining data processing jobs. Other questions are as follows:

1. How should the data processing program be financed in relation to other programs in the school?

2. In terms of business needs, is the student more flexible and more easily placed in a job situation if he has had hands-on-experience?

3. Should the Community College System consider a consolidated stand-alone computer for some schools with other schools maintaining their own computer?

4. How can the administrative use of the computer reduce the expense of the data processing program?

5. Since the needs of the data processing program are different, should the funding method be based on the size of the school and/or the program or some other criteria?

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[23]Statements by Robert Paap, personal interview, July 27, 1972.

Presently, this state-wide study is in progress with completion planned for July, 1973.[24] Perhaps the study will solve the problems of finance and administrative use, but the Community College System must also be concerned with the data processing curriculums and how they meet the needs of the community. The primary criteria for data processing education should be in terms of meeting the needs of the student, the community, and most importantly the needs of business and industry. The question becomes: Are the data processing programs in the community colleges and technical institutes doing sufficiently the job they purport to be doing?

The purpose of this chapter has been an attempt to bring together very briefly some of the facts from the beginning of the development of data processing education in North Carolina to data processing education as it exists today. Justification for continuing data processing education as it exists today in the Community College System is needed. Data processing education presents problems, not only in North Carolina but in other states as well. Because of technology and rapid changes taking place in our nation, business, industry, and education must be concerned with automation and computer technology in terms of preparing students to fulfill data processing employment needs. The questions raised by the Rochester study are still prevelant in the 1970's. Business and industry need data processing personnel who are prepared to meet and cope with the problems in business operations and with the changing job opportunities brought about by technology. The Community College System in North Carolina

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[24]Ibid.

should be aware of the changes constantly taking place in the business world and be willing to adjust curriculums to meet the changes. As changes emerge, business and industry will need to obtain personnel from training areas conforming to their demands. Business and industry must clarify their job classifications and their job requirements so that the Community College System will be able to design data processing programs that will prepare employees for their data processing installations. Therefore, the community colleges and technical institutes will need to evaluate their data processing programs periodically, in cooperation with business and industry, to determine whether their programs are indeed fulfilling the business and industry demands for data processing personnel. Surveys of job classifications in data processing and evaluation of data processing programs are needed today in North Carolina. Since there is such a great need for surveys and evaluations of existing data processing needs and programs, the present study was initiated to examine the programs within the North Carolina Community College System and to investigate the job classifications in businesses and industries in North Carolina to see if the community colleges and technical institutes are presently meeting the data processing demands of business and industry.

STATEMENT OF THE PROBLEM

The purposes of this study were threefold:

1. To determine the business data processing job classifications of businesses and industries in North Carolina and the knowledges and technical

skills needed for each job classification.

2. To survey the community colleges and technical institutes in North Carolina to determine the current curriculums in the business data processing education programs.

3. To determine how the current curriculums related to the job classifications and the knowledges and technical skills needed for each job classification.

The study will answer two questions:

1. What are the data processing job needs in North Carolina?

2. Does the present data processing curriculum in the community colleges and technical institutes respond to these needs?

The study included two phases:

Phase I: A survey of businesses and industries in North Carolina to identify job descriptions and classifications in data processing. Other factors considered were the job categories in data processing, the number of jobs available in these categories, and how personnel were distributed among these jobs. Knowledges and technical skills required of data processing personnel were described.

Phase II: A survey of business data processing education programs in the community colleges and technical institutes to determine the job categories for which students in the North Carolina community colleges and technical institutes are being prepared and to analyze and evaluate the curricula. Knowledges and technical skills required of data processing personnel were described in relation to course offerings in these institutions.

No type of quantitative analysis or evaluation of the North Carolina businesses and industries or community colleges and technical institutes surveyed was made.

This study was designed from and related to the national study sponsored by the Office of Education, United States Department of Health, Education, and Welfare in 1967-68 conducted by F. Kendrick Bangs, principal investigator, and Mildred C. Hillestad entitled Curricular Implications of Automated Data Processing for Educational Institutions.

SIGNIFICANCE OF THE PROBLEM

This study will provide current data on the status of jobs in business data processing in business and industry which can become the basis for future curriculum planning in the community colleges and technical institutes. It will also provide valuable information on job opportunities for data processing graduates. The study will be of value to business and industry in terms of future planning since it will describe the status of business data processing education in North Carolina community colleges and technical institutes.

Data collected will reveal businesses and industries' reactions to the type of training employees will receive in the community colleges and technical institutes. Community colleges and technical institutes will be aware of businesses and industries' evaluations of the data processing programs offered in these schools. In short, this study will prove beneficial to both the business community and to the community colleges and technical institutes.

LIMITATIONS

The study was limited to state-supported community colleges and technical institutes in North Carolina offering courses in business data processing and purporting to educate persons for business data processing jobs.

The study was limited to selected North Carolina businesses and industries utilizing data processing personnel.

The study was limited to the job-preparatory business data processing education programs in each institution and did not include computer-assisted instruction.

No effort was made to determine the extent to which data processing was being taught in the four-year educational institutions, public secondary schools, private business training institutions, or commercial training institutions.

DEFINITION OF TERMS

For the purpose of clarifying the meanings of specific terms used in this study, the following words are defined:

Acquaintanceship skills refer to familiarity with the operations of unit record equipment, computer terminal, computer and/or programming languages. Students are given firsthand experience or knowledge related to business data processing.

Automated data processing is the process in which original information is handled with a minimum of human effort. The process includes recording, classifying, calculating, and summarizing of information by use of unit record equipment--key punch, sorter, collator, accounting machine.

Business data processing refers to information handling in typical modern business offices in which operations are performed to convert crude information into usable or storable form.

Business data processing curriculum consists of those courses offered by an educational institution dealing with electronic data processing subject matter.

Cognitive understanding consists of acquaintance with a course(s) through general knowledge and/or understanding. Cognitive understanding would be primarily concept emphasis with student awareness of terminology related to business data processing.

Computer programming involves the science of logically coding instructions into a sequence and form that is machine readable by a digital computer for the purpose of processing data. Specific computer languages include: COBOL, FORTRAN, ALGOL, RPG, PL1, and 360 Assembler Language.

Computer terminal refers to the 1050 or 2780 terminals provided for the Community College System by the Triangle Universities College Computation (TUCC). These terminals provide accessibility for teaching many languages in the business data processing programs.

Community College is an educational institution dedicated primarily to the educational needs of the particular area for which established, and (a) which offers the freshman and sophomore courses of a college of arts and sciences, (b) which may offer organized curricula for the training of technicians, (c) which may offer vocational, trade, and technical specialty courses and programs, and (d) which may offer courses in general adult education.[25]

Electronic data processing is the process of handling original information with a minimum of human effort. Data processing is largely by electronic equipment, specifically electronic digital computers.

Hands-on-experience provides an opportunity for the student to manipulate the computer, the computer terminal, unit record equipment, and/or programming languages through participation in one of more of these areas.

Industrial Education Center was the forerunner of the technical institute and community college. "Its primary objective was the provision of that phase of education which deals with the skill and intellectual development of individuals for entrance into, or make progress in, trade, industrial and technical jobs."[26] It was an area school offering technical and skill training to selected high school youth and adults.

Production skills and understanding consist of the student's performance

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[25] Public School Laws of North Carolina: Community Colleges, Technical Institutes, and Industrial Education Centers, Chapter 115-2, General Statutes (1969), p. 2.

[26] North Carolina Department of Community Colleges, Progress Report: The Comprehensive Community College System, North Carolina, First Five Years: 1963-1968 (Raleigh: Department of Community Colleges, State Board of Education, 1969), pp. 1-2.

ability in utilizing the skills and understandings developed in the business data processing program. He is able to perform as a technical expert, i.e., performing competently.

Secondary school refers to the public high schools, grades 10 through 12, supported and governed by local, state, and federal funds.

Technical content refers to the knowledges and skills that personnel in the area of business data processing must possess in order to obtain a data processing job in business or industry in North Carolina.

Technical Institute is an educational institution dedicated primarily to the educational needs of the particular area for which established, and (a) which offers organized curricula for the training of technicians, (b) which may offer vocation, trade, and technical specialty courses and programs, and (c) which may offer courses in general adult education.[27]

ORGANIZATION OF THE THESIS

A review of the literature as it relates to the field of data processing in the secondary schools and the two-year post-secondary schools is presented in Chapter II.

In Chapter III the research design is explained and the specific methods and procedures used in the study are discussed.

Analysis and interpretation of data is presented in two chapters in order to discuss effectively the amount of data collected. Chapter IV is devoted to the

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[27] Public School Laws, loc. cit.

analysis and interpretation of the data processing job classifications in businesses and industries in North Carolina. Chapter V is devoted to the analysis and interpretation of the data processing programs in the North Carolina community colleges and technical institutes.

Chapter VI provides a summary of the study, conclusions, and recommendations for future study.

The study is concluded with a selected bibliography and appendixes.

CHAPTER II

RELATED RESEARCH

In conducting this study, a careful analysis of the related research to date was made. From the available literature, studies were selected which related to the status of data processing education and curriculums in the high schools and the community colleges and technical institutes, the job skills and knowledges required for data processing job classifications, and the employment opportunities in data processing available for high school and community college and technical institute graduates.

The majority of studies in the data processing area have been conducted at the high school level, but there is a relationship of the data processing areas in the high schools with those in the community colleges and technical institutes. Therefore, high school studies were selected for this study because of the relevant information they could contribute.

Many data processing studies have been conducted in the areas of computer-related instruction, computer simulation, and computer-assisted instruction for specific disciplines; but the results of these studies have not provided information that would be useful in analyzing or exploring the problems related to the purposes of this research. As a whole, the literature in data processing has produced little information for establishing business data processing instruction and programs in our educational institutions. Studies on the feasibility of a business data processing program and what courses to offer if it were to be part of the business education program have not produced guidelines or conclusive information that would be beneficial in establishing business data processing. The type of courses to offer in a business data processing curriculum have not been examined to the extent that an "ideal" program in data processing curricula could be established that would meet data processing personnel requirements of business and industry. Perhaps this is due to business and industry assuming the responsibility of training and educating their own data processing personnel. Recent indications are that business and industry would hire data processing personnel trained and educated in our educational system, but there is a lack of agreement among educational institutions and business and industry concerning data processing job classifications and job requirements for these classifications and where this education should occur.

Efforts have been made to determine the effect of automation and the installation of computers on business offices and to determine the educational implications of data processing on the business curriculums in both high schools and colleges. As a whole, the studies in the area of data processing curriculum have been conducted at the high school level. These studies explored such areas as:

1. The knowledges and skills needed by clerical workers.
2. Development of units of study in the principles of data processing.
3. Role of the school in preparing students for employment.

4. Salaries paid in jobs at different data processing levels.

5. Types of data processing equipment being used in business and industry.

6. Business applications for which computers are used.

7. Specialized programs provided by business and industry.

8. Integration of data processing with other subject areas of the business education curriculum.

As stated earlier, the results of these studies have produced limited information that would aid in curriculum development at the high school or two-year post high school levels. Bangs and Hillestad comment on the only conclusion that these studies have presented:

> On only one point, however, do the studies agree somewhat; namely, that people in the management positions in data processing departments need at least four years of college work. However, for the lower echelons of management (supervisory levels) the findings are inconclusive.[1]

The research reviewed in this chapter will be presented in six categories:

1. Effect of automation on business education and data processing curriculum and occupations in business and industry.

2. Need for data processing education at the high school or college level.

3. Status of data processing education.

4. Introductory courses in data processing.

5. Data processing opportunities for graduates.

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[1]Bangs and Hillestad, op. cit., p. 87.

6. Requirements for data processing occupations.

EFFECT OF AUTOMATION ON CURRICULUM AND OCCUPATIONS

In 1960, Frisbie conducted a comprehensive study to determine the technological changes in electronic data processing equipment introduced during the period from 1950 to 1958 and to identify progressive trends in employment in office occupations due to installation of electronic data processing equipment. She found that the expansion of electronic systems from 1950 to 1958 was 2, 107 installations. Also, the average capital investment in electronic data processing per clerical worker was increased by 6, 700 percent. She indicated that the jobs affected were junior skilled and unskilled levels. Four methods were generally employed to handle displacement of employees: (1) attrition, (2) layoffs, (3) transfers, and (4) retraining.[2]

The results of Kamper's study conducted in 1963 to determine the effect of automation on offices and on educational programs revealed interesting facts. She found that those entering the field of data processing and employees in business offices wanting to advance in data processing should have a bachelor's degree. A master's degree was often required for programmers and systems analysts, but a bachelor's degree was acceptable. Results indicated that high school graduates entering data processing should have a superior academic

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[2]M. Adele Frisbie, "Emerging Electronic Data Processing and its Relation to Office Employment and Costs, 1930-1957, and Implications for Business Training" (unpublished Doctor's dissertation, New York University, 1960), National Business Education Quarterly, XXX (Fall, 1961), 18-9.

record (B average or better). A high degree of mechanical and mathematical ability was significant for persons entering data processing occupations. Kamper found that three qualities were necessary for advancement in data processing occupations--responsibility, accuracy, and ability to think for oneself.[3]

In 1967, Richman identified the effect of automated data processing on office occupations in the area of Eau Claire, Wisconsin. He found that key punch machines, sorters, accounting machines, reproducers, verifiers, and collators were being used. Of the sixteen firms surveyed, the supervisory and management positions associated with data processing were held by men, with the exception of two cases. Women held positions in tab and key punch areas. Richman found that a large majority of the respondents had not trained their data processing employees on the job.[4]

NEED FOR DATA PROCESSING EDUCATION

Through surveys and interviews, LaSalle, Hallman, Cook, Bunch, Brightman, and Frazier attempted to identify the role of schools in preparing graduates for data processing occupations.

LaSalle investigated the role of the secondary school business education

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[3]Sister M. Catherine Kamper, OSF, "Effect on Educational Programs of Automated Machines in Business Offices" (unpublished Master's thesis, University of Wisconsin, 1963), National Business Education Quarterly, XXXIII (Fall, 1964), 51-2.

[4]John C. Richman, "The Affect of Automatic Data Processing on Office Occupations in the Greater Eau Claire, Wisconsin Area" (unpublished Doctor's dissertation, Wisconsin State University, 1967), National Business Education Quarterly, XXXVII (Fall, 1968), 39.

department in preparing students for automated data processing employment. Through questionnaires and personal interviews, he surveyed business educators, secondary school business education department chairmen, producers and users of automated data processing equipment throughout the United States. He found that most business educators and businessmen agree that data processing should be taught in the secondary schools and that data processing programs should emphasize problem-solving and logical-thinking skills, communications, and business relations. Data processing should be offered as a separate course at the twelfth-grade level and should include the following units of study: (1) types of automated equipment available, (2) employment opportunities in the field of automation, (3) an orientation to data processing, and (4) automated equipment operation. LaSalle found that work experience programs were emphasized.[5]

In 1967, Hallam surveyed the Illinois Corn Belt in an effort to determine the need for teaching data processing in the high school. The survey included an analysis of five data processing occupations--systems analyst, programmer, computer operator, auxiliary equipment operator, and data control and maintenance workers. Data control and maintenance workers (key punch operators, verifier operators, punched-card file clerks, tape librarians) represented over 40 percent of the 474 data processing workers surveyed. A high school education was sufficient for employment in these areas. Educational

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[5]James F. LaSalle, "The Role of the Secondary School Business Education Department in Preparing Students for Employment in Business Offices Using Data Processing Equipment" (unpublished Doctor's dissertation, Pennsylvania State University, 1964), National Business Education Quarterly, XXXIII (Fall, 1964), 40-1.

requirements for auxiliary equipment operators, representing 12 percent of the total workers, were similar to those of data control and maintenance personnel. The employees recommended, but did not require, for programmers, representing 16 percent of the population, a two-year computer programming and general business curriculum at the junior college level. For the systems analyst, representing nearly 14 percent of the employees surveyed by Hallam, a college degree was strongly desirable; but experience was considered the most valuable asset in this data processing position. They were promoted from within the firm, based on education acquired on-the-job and aptitude for systems work. Employers in this study agreed that the high school could offer a valuable service by teaching the basic terms and concepts of electronic data processing. Some employers thought that key punching and other clerical skills could be taught at the high school level; whereas, others felt that this was the responsibility of firms, not high schools. Other firms suggested including data processing in cooperative office education, thus giving students an opportunity for data processing work experience, eliminating the school's cost for data processing equipment.[6]

Hallam concluded that there was a need for a well-developed program of education in data processing at the high school level, junior college, and college and university levels. In the high school, emphasis was toward providing a basic understanding of computer technology, application, and operation.

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[6]Stephen F. Hallam, "Businessmen Talk About Data Processing Education," The Balance Sheet, XLIX (September, 1967) 15-7.

Junior colleges should train programmers and provide them with a general business background. A work-experience program was also recommended for the college and university level.[7]

In 1967, Cook determined the current and projected status of employment in data processing installations and the need for in-school business data programs. His study was a continuation of Brown's unpublished master's thesis, "A Status Study of Detroit, Michigan, Automatic Data Processing Installations With Implications for Business Education." Findings in Cook's study were primarily related to the implications for business education at the high school level. He found that 60 percent of all data processing personnel were found in two job classifications--key punch operator and machine operator--and that a high school education was sufficient for employment in data processing installations and would continue to be sufficient for all classifications except for systems analysts and supervisors. However, 40 percent of the companies surveyed had and would employ persons with high school data processing experience even for these classifications.[8]

In 1968, the Charlotte-Mecklenburg School System conducted a study among selected businesses in the Charlotte-Mecklenburg area to determine what the public schools should be offering in the instructional field of data processing. Since 1964, the Charlotte-Mecklenburg System has been offering data processing

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[7]Ibid.

[8]Fred S. Cook, "The Need for In-School Business Data Programs," National Business Education Quarterly, XXXVI (Fall, 1967), 15-6.

instruction utilizing primarily unit record equipment. In the fall of 1968, there were 800 students enrolled in the two types of data processing programs in the eight high schools. Each of the eight schools had a one-semester course in key punch training and a one-year course in computer technology. Many people in educational data processing began to express concern for upgrading the programs to the computer level. Questionnaires were mailed to 800 business firms in the area providing an opportunity for their opinions on data processing instruction in the high schools and for their recommendations on the type of instruction needed to prepare students for data processing occupations. The returns indicated that in the Charlotte-Mecklenburg area there were 101 companies with data processing equipment and 219 without data processing equipment. Of the companies without equipment, 19 percent planned to acquire services of a data processing organization and 16 percent planned to install data processing equipment within the next five years. Of the firms with data processing equipment, 37 percent did not have unit record installations and 50 percent planned to update their data processing installation within the next two years. The survey results indicated that there were 678 key punch positions and 1,077 programming staff members in the business firms, with 55 percent of the companies training their own key punch operators and 95 percent indicating that they believed it was the public school's responsibility to train these operators. In addition, 76 percent indicated that the schools should train computer operators, and 68 percent believed that the schools should teach unit record board wiring. Teaching the basic concepts of programming for vocational purposes was recommended by

91 percent of the businesses.[9]

Other findings of the survey indicated that there was a shortage of programmers, key punch operators, and machine operators. The teaching of COBOL and FORTRAN was recommended. Eighty-two percent of the business firms were willing to interview a well-informed high school graduate for possible employment in data processing, and 64 percent indicated that they would be willing to interview a selected data processing senior for part-time on-the-job training. From the results of this survey, indications were that the business community and its public schools should work together to provide vocational curriculum for high school students. Today, Charlotte-Mecklenburg offers instruction in data processing in all ten of its high schools. The objectives of their programs are to provide:

1. Basic information about data processing.
2. Skill training on the key punch.
3. Current programming languages.
4. Appropriate operating systems.[10]

In 1970, Brightman and others developed a publication to provide guidance and rationale for the continued development of computer curriculums in the junior college, and to offer help in the revision of current data processing programs in the colleges. This publication entitled, The Computer and the Junior

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[9]John M. Bunch, Charlotte-Mecklenburg Schools: Report of Data Processing Market Survey (Charlotte: Charlotte-Mecklenburg Schools, Business Education Department, 1968), pp. 1-4.

[10]Ibid.

College Curriculum, suggested that the schools offer more specialized courses and programs for students planning to work as professional data processors. Literacy data processing courses and computer programming skill courses were recommended also for non-data processing majors.[11] An interesting quotation from this publication is: "Data processing is today one of the few areas in occupational training in which each faculty member is called upon to learn more new things than are his students."[12]

The study group emphasized that if the junior college was to do its job properly, it must provide students with an up-to-date, career-oriented curriculum and that it must not hinder the graduates' potential growth by merely providing educational experiences to meet employers' needs. A summary statement relating to the curriculum indicated that "The college must accept the responsibility for providing learning experiences that are timely, that provide for the professional growth of graduates, and draw on particular strengths and attitudes of the teaching staff."[13] This survey identified three types of data processing professions which the junior college could teach and best prepare students on an entry-level basis: (1) business applications programmer, (2) computer operator, (3) unit record operator.[14]

In 1970, Frazier studied the programming function in specified electronic data processing installations. He attempted to provide a comprehensive body of

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[11]Richard W. Brightman and others, The Computer and the Junior College Curriculum (Washington, D. C.: American Association of Junior Colleges, 1970), p. 1.

[12]Ibid., p. 5. [13]Ibid. [14]Ibid., p. 14.

knowledge about the programming function in order to assist businesses in starting and operating the function and to assist educators in developing educational programs in electronic data processing and office administration. Frazier found that a majority of the firms had three levels of programming activity, definite rules for program testing, and programming personnel working directly with operating departments. In most instances the programmers were working alone in these installations. Three-fourths of the firms used the Programmer Aptitutde Test in selecting prospective programmers. In these business firms class instruction and programmed instruction were used to train prospective programmers.[15]

STATUS OF DATA PROCESSING EDUCATION

Since 1965, researchers have investigated data processing occupations in business and industry to determine what skills were needed for prospective data processing employees; and data processing curriculums in the schools to determine the status of data processing education.

In January and February of 1965, Carlberg surveyed data processing instruction in six high schools--Des Moines, Iowa; Fort Worth, Texas; Cedar Rapids, Iowa; Memphis, Tennessee; Monroeville, Pennsylvania; and Omaha, Nebraska--to gather data concerning teaching staff, equipment, and programs. With the exception of Omaha, the schools were technical high schools. The programs were established from 1960-65 and were initiated by school

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[15]Olin R. Frazier, "The Programming Function in Specified Electronic Data Processing Installations" (unpublished Doctor's dissertation, Indiana University, 1970), Business Education Forum, XXVI (October, 1971), 35.

administrators, teachers, and local industry. Carlberg found that teacher qualifications varied and included such requirements as a master's degree, data processing experience in business and industry, data processing training, recommendations, and willingness to advance their education in data processing. There were also various entrance requirements for students including aptitude tests (card punch, wiring) overall grade average (B), knowledge of bookkeeping, and typewriting skill (40 NWAM). The schools in the survey used IBM reference manuals and materials and teacher-prepared materials. With the exception of Des Moines, the schools purchased their own data processing equipment. Cost of the equipment varied from \$100,000 to \$600,000 depending upon the quantity and type of equipment purchased. Costs to schools with computers ranged from \$300,000 to \$500,000. Cedar Rapids, Memphis, Des Moines, and Monroeville had computers, with Memphis housing two computers. Most of these six schools used their equipment for administrative tasks also.[16]

Nixon was interested in determining the extent to which five New Jersey high schools were utilizing electro-mechanical and electronic data processing equipment. The four major areas of computer utilization studied by Nixon included: (1) scheduling, (2) retrieval of pupil personnel data, (3) business administration applications, and (4) use of equipment as a teaching tool. He concluded that a great amount of thinking and rethinking should go into the design of an automated

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[16]Carlberg, op. cit., pp. 235-36.

data processing system for a public secondary school.[17] The important aspect of his study in terms of this study is revealed in the following statement: "The more able student, who wishes to pursue advanced data processing training on electronic or computer equipment, should be encouraged to continue his education in a technical institute, a junior college, or a four-year college."[18] Nixon's comment indicated that high school education was not enough for the higher echelon data processing positions.

In 1967, Giles found that the majority of Illinois public secondary schools (94 percent) did not offer a course in data processing. At the eleventh and twelfth grade levels, 65 percent of the schools offered a unit on data processing in office practice, utilizing IBM simulators, calculators, and key punch machines. Giles found that 50 percent of the teachers teaching data processing had only three to six semester hours of training in data processing. In addition, there were no standard prerequisites for student admission to a data processing course.[19]

In 1968, Hallstrom investigated the status of data processing courses and/or units of instruction in data processing in the business education

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[17]Joseph Elton Nixon, "The Utilization of Electro-Mechanical and Electronic Data Processing Equipment in Selected Public Secondary Schools" (unpublished Doctor's dissertation, Temple University, 1966), p. 179.

[18]Ibid., p. 188.

[19]Wayne E. Giles, "The Status of Data Processing Instruction in the Illinois Public Secondary Schools" (unpublished Master's thesis, Southern Illinois University, 1967), National Business Education Quarterly, XXXVII (Fall, 1968), 17.

curriculums of public high schools of the northern twenty-one counties of Illinois, excluding Chicago. The results of her study are similar to those of Giles in that the data processing courses were offered primarily at the eleventh and twelfth grade levels, using simulated machines and key punch machines. Other findings were that 15.58 percent of the schools offered data processing courses, 68.34 percent of the schools offered at least one unit of data processing instruction, and approximately 40 percent of all business teachers had received some formal education in data processing.[20]

The most recent data processing study in Illinois was conducted by Rudolph to determine the use of data processing and computers in instruction in the Illinois public secondary schools. The results of her study indicated that unit record equipment was seldom used by secondary schools and that one-third of the schools used computers in some way--41 percent in administrative functions only, 5 percent in instruction only, 54 percent in a combination of administrative and instructional functions. These data disclose that the secondary schools used the computer to a greater extent for administrative than for instructional use. When used for instruction in mathematics and science, computer applications were problem solving, while in business education emphasis was on electronic data processing skills. The data reveals little or no emphasis on computer-assisted instruction, computer-managed instruction,

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[20]Elva Gustafson Hallstrom, "A Study to Determine the Status of Data Processing Courses and/or Units of Instruction in the Business Education Curricula of Public High Schools of the Northern 21 Counties of Illinois (unpublished Master's thesis, Northern Illinois University, 1968), National Business Education Quarterly, XXXVIII (Fall, 1969), 15.

computer-mediated instructions, game, and simulation. Rudolph recommended educational changes that would make computers for instructional use available to any state secondary school and expansion of instructional computer applications to other disciplines. Other recommendations included funding from the state for financing of computer instructional programs, cooperation between state universities and secondary schools to plan new instructional programs, teacher education programs, and in-service training programs in computer use.[21]

Recent studies on the status of data processing on the junior college level by Dostal and Reynolds indicate that emphasis at this level should be on programming and on the revision of data processing curriculums.

In 1970, Dostal surveyed thirty-five public junior colleges in the state of Illinois to determine the status of data processing instruction. In the junior colleges surveyed, data processing instruction was offered primarily in a separate course or courses. Dostal found that practically all the schools provided data processing on an introductory level, three-fourths on a unit-record operation, and almost all taught programming and system analysis and design. High level languages and symbolic or assembler languages were also emphasized extensively. Results indicated that the primary concentration for

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[21]Eleanore L. Rudolph, "A Survey of Data Processing and Computer Use in Instruction in Illinois Secondary Schools" (unpublished Doctor's dissertation, Northern Illinois University, 1972), Dissertation Abstracts, XXIII (August, 1972), 505-A-06-A.

preparation in data processing positions was in programming.[22]

A study conducted in Illinois by Reynolds in 1971 provided information on the data processing programs being utilized in junior colleges in that state. Even though this study was an analysis of business data processing programs and faculties in order to suggest curricular changes for teacher-education institutions, it does reveal pertinent facts related to this study. For example, all of the 55 Illinois junior colleges were operating a one- or two-year business data processing program or both programs. Reynolds found that the emphasis in these colleges for the next five years would be on curriculum maintenance and revision rather than on establishing new data processing programs. Within the next five years the curriculum changes would most likely be in the areas of programming languages, teleprocessing, systems courses, cooperative training, and related business courses. Other findings showed that the business data processing curriculums of the Illinois junior colleges met or exceeded the suggested curriculum recommendations as set forth by the Bangs-Hillestad study and the National Advisory Committee on Data Processing of the American Association of Junior Colleges in all respects except in the areas of programming systems and cooperative work experience. As for computer usage in the Illinois junior colleges, 91.7 percent utilized the computer for instructional purposes, with over 70 percent using the IBM 360 computer. Computers and teleprocessing systems were

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[22]June B. Dostal, "The Status of Data Processing Instruction in the Public Junior Colleges of the State of Illinois" (unpublished Master's thesis, Northern Illinois University, 1970), Business Education Forum, XXVI (October, 1971), 33.

listed as the equipment the schools were most likely to purchase in the next five years. Reynolds also found that it was desirable for teachers to have a graduate degree, data processing work experience, and course work in accounting. Specialized data processing background for teaching had been obtained from manufacturer's schools, work experience, on-job-training, and programmed instruction.[23]

INTRODUCTORY COURSE IN DATA PROCESSING

In the early days of data processing education, many researchers became interested in the type of courses to be offered in the curriculum and the lack of adequate and appropriate teaching materials and guidelines for data processing education.

MacDonald was concerned with the lack of teaching materials and the time lag between data processing education and the student's first data processing job. From his study, conducted in 1964, he developed a unit of study in the principles of data processing to be used in the secondary schools.[24] He emphasized the importance of the secondary school's data processing curriculum

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[23]Robert John Reynolds, "An Analysis of the Business Data Processing Programs and Faculties of the Illinois Junior Colleges with Curricular Implications for Teacher-Education Institutions" (unpublished Doctor's dissertation, Southern Illinois University, 1971), Dissertation Abstracts, XXXII (March, 1972), 5123-A.

[24]Robert David MacDonald, "The Development of a Unit of Study in the Principles of Data Processing for Use in Business Education Curriculum of Secondary Schools" (unpublished Doctor's dissertation, Northern Illinois University, 1964), p. 25.

with the following statement: "Education must make great strides to reduce the time lag between the training being offered and the demands of business."[25] He gave the reasons for this time lag as being:

1. The lack of clarity as to the training to be offered in data processing at the secondary level.

2. The lack of available data processing equipment.

3. The shortage of competent data processing teachers.

4. The absence of suitable teaching materials for data processing instruction.[26]

MacDonald found that high school teachers had no data on

1. The training the high school should offer in data processing.

2. The amount of ability needed to master data processing skills.

3. The level of competence to be sought for data processing students.

4. The courses that should be offered in data processing.

5. The students who should receive data processing training.[27]

He also found that business was looking toward the secondary schools for trained data processing personnel, that data processing had changed the nature of office jobs, that there was a decreasing demand for unskilled office workers, and that a reasonable, intelligent high school graduate could be successful in data processing.[28]

In 1965, Ledger found that business data processing machines should

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[25]Ibid., p. 26. [26]Ibid., p. 27 [27]Ibid.

[28]Ibid.

not be taught in the high school level, except where there was a great demand and where financial support was available to provide the equipment. The introductory data processing course at the high school level should consist of fundamentals only, such as terminology, the machines and their functions, and the relationship between data processing and other business subjects. He also found that the data processing course should be taught no earlier than the junior year.[29]

Wenner developed in Iowa a course outline for teaching a one-semester introductory data processing course at the high school level based on twelve data processing classifications and requirements. He determined the minimum employment requirements for the positions in electronic and mechanical data processing in selected businesses and designed a high school introductory course based on his findings. Wenner found that the minimum requirements were concerned with age, sex, education, training, and experience. Of the twelve positions studied, five were applicable to high school graduates with no electronic data processing experience. These included: (1) key punch and verifier operator, (2) tab equipment operator, (3) console operator, (4) auxiliary equipment operator, and (5) equipment operator. Four positions were open for high school graduates with extensive training and experience: (1) punch card methods analyst, (2) programmer, (3) coder, and (4) maintenance technician. Three

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[29]Gerald W. Ledger, "Data Processing: Its Effects on the Teaching of Bookkeeping at the High School Level" (unpublished Master's thesis, University of Wisconsin, 1965), National Business Education Quarterly, XXXV (Fall, 1966), 36-7.

positions--electronic data processing analyst, systems analyst, and tab equipment supervisor--were not open to high school graduates because of age and educational requirements. Wenner recommended that secondary school administrators seriously consider the implementation of a data processing course at the high school level. He also recommended that teacher education institutions take the lead in preparing teachers for data processing instruction.[30]

Wood developed a check list for the establishment of data processing instruction which would be useful in the secondary schools. He cautioned educators: "Our motive for setting up data processing courses must be to develop needed quality education and not simply to promote our field."[31] He also cautioned that the institution of data processing programs required careful and serious research, particularly in the areas of students available and/or qualified for the program and provision of adequacy in financing equipment.[32]

Business educators and businessmen interviewed in Chicago and the metropolitan area by Manning in 1968, indicated that an introductory course in data processing should be offered at the secondary school level. Businessmen were willing to hire high school students if they had a basic understanding of the punched card and the capabilities of operating the key punch, sorter, and collator.

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[30]James F. Wenner, A High School Orientation Course in Data Processing, Monograph Number 114 (Ohio: South-Western Publishing Company, 1966), pp. 69-72.

[31]Merle W. Wood, The Teaching of Automated Data Processing in the High School, Monograph Number 116 (Ohio: South-Western Publishing Company, 1966), p. 1.

[32]Ibid., pp. 1-2.

Hands-on-experience was considered desirable in the high school course. COBOL and AUTOCODER were the languages recommended for the secondary schools.[33]

DATA PROCESSING JOB OPPORTUNITIES

In order to provide data processing employees for business and industry, educators must be aware of the data processing job opportunities for their graduates. Research in this area has been done by Andersen and Robinson in the Minnesota area, Sister Angela in the Ohio area, Lovach in St. Louis, and two studies in North Carolina by the Greensboro Chamber of Commerce and the Employment Security Commission.

Andersen's study, conducted in Minnesota in 1965, was an effort to determine the future job opportunities for clerical employment in view of the increased use of electronic data processing equipment and the qualifications needed for these occupations. She found that high school clerical students could secure positions as key punch and verifier operators, tabulator-equipment operators, programmers, console operators, card method analysts, and computer operators if they had additional training in data processing.[34]

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[33]Marvin Dale Manning, "A Survey of the Opinions of Businessmen and Business Educators in the Chicago and Metropolitan Area Concerning the Content of an Introductory Data Processing Course in the Secondary School with a Resultant Course Outline" (unpublished Master's thesis, Northern Illinois University, 1968), National Business Education Quarterly, XXXVIII (Fall, 1969), 26-7.

[34]Mary Jane Andersen, "Integrating Office Automation Knowledge into High School Business Education" (unpublished Master's thesis, Mankato State College, 1965), National Business Education Quarterly, XXXV (Fall, 1966), 5.

In 1965, in Minneapolis and Madison, Robinson found that the business firms interviewed required a college education, or in some instances, a two-year post-high school degree, for managerial or supervisory data processing jobs. The shortage of trained data processing employees at this time required business firms to employ college graduates with management potential and with training in accounting, business administration, and mathematics. If they were interested in programming positions, on-the-job training was provided. Desirable traits for the higher echelon positions included the ability to think things through, the ability to be creative, and the ability to use logic.[35]

In 1966, Sister Angela surveyed selected business offices in Columbus, Ohio, to determine the job opportunities available and the requirements in electronic data processing for high school graduates. She found that 66 percent of the employees in the electronic data processing departments included key punch operators, computer operators, coding clerks, and programmers. She found that there was a high demand for persons with skills in all phases of electronic data processing, but those persons with education beyond the high school would obtain the better data processing positions.[36]

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[35]John S. Robinson, "A Guide to Electronic Data Processing and the Related Career Opportunities Written for the Business Education Teacher" (unpublished Master's thesis, University of Wisconsin, 1965), National Business Education Quarterly, XXXV (Fall, 1966), 48.

[36]Sister Angela of the Sacred Heart Franks, SND deN, "Occupational Opportunities for High School Graduates in Electronic Data Processing in Selected Business Offices, Columbus, Ohio, 1966: An Appraisal" (unpublished Master's thesis, The Catholic University of America, 1967), National Business Education Quarterly, XXXVII (Fall, 1968), 44.

Kovach surveyed firms in the St. Louis area in 1968 to determine the data processing opportunities for high school graduates. She found that the highest educational level required for key punch operators, tabulating machine operators, tape librarians, and other clerical workers was high school completion. The majority of the respondents required only a high school education for console and computer operators, programmers, and control clerks, while in systems and management, more than 50 percent required education beyond high school completion. In all jobs other than tape librarian, control clerk, and miscellaneous clerical positions data processing knowledge and training were required before employment was secured. For the high schools employers recommended courses in data processing concepts and theory, mathematics, communication skills, general business, bookkeeping, machine operations, and personal traits of dependability, logic, honesty, initiative, and flexibility. Kovach also found that promotion within the company was the general policy and that it was possible for an employee to advance from entry-level jobs into management and supervisory positions in data processing.[37]

In 1970, a Data Processing Committee of the Research Division of the Greensboro Chamber of Commerce conducted a study of local firms believed to have in-house computers. The Committee found a minimum of 41 firms with computers--2 were retailing firms, 19 service firms, 3 wholesalers, and 17

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[37]Sharron Dale Kovach, "Opportunities for High School Graduates in Data Processing Positions in Selected Business Firms in the St. Louis Area" (unpublished Master's thesis, Southern Illinois University, 1968), National Business Education Quarterly, XXXVIII (Fall, 1969), 22.

manufacturers. These 41 companies employed 1,222 individuals in their data processing departments. These employees included 296 programmers, 134 systems analysts, and 792 employed as computer operators, supervisory personnel and clerical workers. Since 1969 the number of data processing employees had increased by at least 23 percent. Other data indicated that 56 computers were located in Greensboro ranging in core size from 2K to 1536K. Of this total, 2 were in retailing firms, 24 in manufacturing firms, 3 in wholesale firms, and 27 in service firms. The Committee located 15 colleges, universities, business schools, and technical schools offering courses in data processing within a 25-mile radius of Greensboro. Other data included listings of the schools offering data processing with detailed information about the courses and the costs of the courses, office salary trends in data processing job classifications, computer manufacturers, and business firms in the area. This study revealed interesting facts about data processing in the Greensboro area and demonstrated that there is a need for educating and upgrading data processing employees in the Greensboro area.[38]

The North Carolina State Board of Education and the Employment Security Commission conducted a study to determine the overall industry employment patterns, and the needs for selected occupations from 1968 through 1973 and to identify existing employment problems. Data processing job classifications surveyed in this study revealed interesting facts: (1) anticipated employment by

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[38]Data Processing Committee of the Research Division, Greensboro Chamber of Commerce, Computer Centers: Greensboro's Growing Industry (Greensboro: Greensboro Chamber of Commerce, 1971), Summary.

1973 for business programmers was 1,220; (2) for key punch operators, 5,040; (3) for computer operator supervisors, 960; and (4) for digital-computer operators, 720. Among the top ten occupations in all occupational areas designated by the Employment Security Commission, only the key punch operator qualified as the data processing classification anticipating the greatest worker needs by the summers of 1970 and 1973. Anticipated key punch operators by 1970 was estimated to be 960; by 1973, 1,790. The survey indicated that the majority of employers required post-high school training for the following job classifications: digital-computer operator, business programmer, engineering and scientific programmer, detail programmer, and computer operator supervisor. Manufacturing and finance industries indicated the greatest need for key punch operators (manufacturing, 2,340; finance, 1,030) and business programmers (manufacturing, 570; finance, 210). In fact, manufacturing and finance industries demanded more employees in all data processing classifications than did construction, transportation, trade, and service industries. Another interesting outcome of this study was the data on the number of students enrolled in business data processing education in the two-year community college program in North Carolina during the fiscal year of 1968: first-year students, 450; second-year students, 150.[39]

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[39]Employment Security Commission of North Carolina, Manpower Requirements for Selected Clerical, Professional, and Sales Occupations 1966-1973 (Raleigh: Employment Security Commission of North Carolina, Bureau of Employment Security Research, 1969), Summary.

DATA PROCESSING JOB REQUIREMENTS

Once educational institutions have determined the specific data processing job opportunities for their graduates, they must then be able to identify the requirements that employers expect for these occupations. Studies by Jones, Hanke, Eirich, Walden, and Hurst reveal the differences that are occurring in the requirements for personnel in the various data processing occupations.

In 1964, Jones conducted "A Survey to Determine the Knowledges and Skills Needed by Clerical Workers in First-Level Entry Occupations in Digital Computer Installations." She surveyed 69 computer installations in Ohio to determine what these installations required of prospective high school graduates for first-level entry occupations in data processing. As a basis for her study, she used 54 data processing and clerical occupations and job descriptions recommended by Business and Automation. Of the 54 occupations used, she found that there were 27 first-level entry occupations for which a high school graduate with no work experience might qualify. These occupations included the following:

1. One level of Procedures Analyists.
2. Three levels of Programmers.
3. Four levels of Computer Operators.
4. Magnetic Tape Librarian.
5. Data Examination Clerk.
6. EDP Control Clerk.
7. Four levels of Tabulating Machine Operators.

8. Four levels of Keypunch Operators.

9. Three levels of Tabulating Record Control Clerks.

10. EAM Coder.

11. Data Converting Machine Operator.

12. Office-Boy Messenger.

13. Stenographic occupations.

14. IBM Department Clerk.

Some of the educational needs for employment in these occupations included getting along with people; performing work according to a schedule and a sequence; typewriting; clerical record-keeping; bookkeeping; handling source documents; preparation of flow charts and block diagrams; familiarization with tabulating and computer equipment; principles of programming and coding; filing, including punched cards, magnetic tape, and paper tape; and in some cases introduction to equipment operation. Jones also found that because of the characteristics of the rapidly developing computer technology, the type of education or training program needed in the high school at that time was one that would provide the student with flexibility. The high school student should also be informed of the data processing occupations that existed and the education and work experience needed to obtain these occupations.[40]

Hanke conducted a study in selected businesses in Northern Illinois to

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[40]Adaline Dorothy Seitz Jones, "A Survey to Determine the Knowledges and Skills Needed by Clerical Workers in the First-Level Entry Occupations in Digital Computer Installations" (unpublished Doctor's dissertation, Ohio State University, 1964), National Business Education Quarterly, XXXIV (Fall, 1965), 30-1.

determine the educational and training requirements for computer programmers. His study was primarily related to the training for programmers on the collegiate level (Department of Business). His findings indicated that 80 percent of the responding programmers had some college education. This finding did not correspond with the fact that one-half of the employers indicated that no college education was necessary. Most firms indicated that programming experience or college education was desirable, but they did not require this of prospective programmers. In 1964, these employers indicated that the best sources for preparing business programmers were on-the-job-in-service company training, colleges, and equipment manufacturers, respectively. Courses suggested for business programmers were accounting, general business, English, logic, communication skills, mathematics. Hanke found that aptitude tests were being used extensively in businesses (77 percent).[41]

In 1965, Eirich conducted a survey in St. Louis to determine the mathematical knowledges required of high school graduates for automated data processing occupations. Eirich found that a high school education was minimum for employment in automated data processing. He found that programmers should have a high degree of mathematical knowledge. Businesses indicated that students interested in automated data processing occupations should have mathematical knowledge in the following areas: general mathematics, beginning algebra,

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[41]John Edward Hanke, "A Study of the Education and Training of Business Computer Programmers in Selected Businesses in Northern Illinois" (unpublished Master's thesis, Northern Illinois University, 1964), National Business Education Quarterly, XXXIV (Fall, 1965), 23-4.

advanced algebra, and plane geometry.[42]

In 1968, Walden used the jury method to determine the competencies needed by data processing workers to enter specific job areas in data processing. This study was conducted in the Wichita, Kansas area using data processing supervisors, college teachers, and data processing workers. A jury of five people was used in each group to determine the needed competencies and to rank each competency. An average rating was obtained and three correlation coefficients were computed between the averages of supervisors-teachers, supervisors-workers, and teacher-workers. By use of chi-square at the .05 level Walden determined that for all respondents in the population represented by the samples, the ranking of the importance of that competency was independent of whether it was rated by supervisors, teachers, or workers. Among the supervisors there was strong agreement that their employees should be able to communicate and think logically. On the other hand, teachers and workers agreed that the most important competency for data processing workers was leadership ability.[43]

In order to maintain an up-to-date curriculum in business data processing counselors and business educators must be aware of the jobs available in data processing and the educational requirements, knowledges, and skills

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[42]Wayne M. Eirich, "A Survey of Mathematical Abilities and Knowledges Required of High School Business Graduates in Automated Data Processing" (unpublished Master's thesis, Southern Illinois University, 1965) . National Business Education Quarterly, XXXV (Fall, 1966), 20-1.

[43]J. B. Walden, "Identification of Content for Data Processing Curriculum by the Jury Method" (unpublished Doctor's dissertation, Colorado State University, 1968), Dissertation Abstracts, XXIX-A (1968-69), 3512-A.

needed in these jobs.

One of the more recent studies in business electronic data processing conducted by Hurst identified the knowledges and skills necessary for preparing high school students for clerical and professional jobs in business electronic data processing. Hurst classified clerical jobs as card-tape-converter operator, control clerk, computer-peripheral-equipment operator, high-speed printer operator, key punch operator, tape librarian, and verifier-operator. Professional data processors were classified as programmers and systems analysts.[44]

Hurst found that the initial knowledges and skills needed for data processing clerical employees consisted of operating the keypunch, keying tape, operating the computer, balancing reports, scheduling jobs for the computer, handling tape, filing, operating the verifier, and typewriting. He also found that clerical employees used the adding machine extensively when balancing reports for computer input. After processing by the computer, they were required to check the printed report against the original to verify accuracy of computer input. Hurst found that the various clerical employees seldom used the same knowledges and skills; therefore, he recommended that clerical employees train for as many of the positions within this category as possible so that their job opportunities would not be limited. Hurst indicated that professional employees spend most of their time writing programs, revising programs, debugging

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[44]Delbert B. Hurst, "Knowledges and Skills Necessary for a Career in Business Electronic Data Processing" (unpublished Doctor's dissertation, Georgia State University, 1970), Dissertation Abstracts, XXXII (July, 1971), 161-A, The Balance Sheet, LIII (November, 1971), 114-16, 118.

programs, analyzing business problems, designing systems, and preparing flow charts. The division of labor in the professional jobs was not as great as that in the clerical positions. The difference here related to the percentage of time devoted to a particular function.[45]

In order for clerical employees to advance to professional positions, Hurst found that these employees must have training in the same knowledges and skills as professional workers. For clerical positions, 53.6 percent of the businesses surveyed recommended proficiency in office machines and 48.7 percent recommended a one-year course in typewriting. Approximately one-third recommended a one-semester course in business mathematics and filing. Twenty-five percent recommended one year of accounting. On the other hand, for the professional positions 60 to 70 percent recommended one-year of algebra, a semester of administrative communications, first-year accounting, analysis of business problems and a semester of business mathematics. Fifty to 60 percent recommended a course in accounting systems and a course in information systems; 47.4 to 49.1 percent recommended second-year accounting and a one-semester course in statistics. Approximately one-third suggested auditing and cost accounting; with one-fourth recommending economics, principles of finance, money and banking, and office machines. Programming languages used most frequently in computer installations were COBOL, RPG, and BAL. Computer operators were encouraged to have at least a general understanding of computer languages, and professional employees were encouraged to have knowledge of at

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[45]Ibid.

least two languages, with COBOL being one of these two. Areas for curriculum improvement recommended by Hurst included oral and written communications, work experience, accuracy, logical thinking, business problem-solving, loyalty to employers, and job responsibility. Hurst indicated that clerical positions could be filled by graduates from the secondary school or the two-year post secondary school. Professional job training was offered in vocational programs at the two-year post secondary level or in regular data processing curriculums at the four-year college level.[46]

COMPREHENSIVE DATA PROCESSING RESEARCH

The first nationwide data processing study was conducted by Bangs and Hillestad in 1968 and had a great effect on data processing education throughout the United States. A more recent study on data processing curriculums in North Carolina was conducted by McIntosch and others in 1969 and provided the North Carolina Community College System with a curriculum guideline for data processing programs.

The most comprehensive data processing study was conducted in the years 1966-68 by Bangs and Hillestad entitled Curricular Implications of Automated Data Processing for Educational Institutions, sponsored by the Office of Education, United States Department of Health, Education, and Welfare. This study supplied information about the needs of business in terms of qualified personnel and evaluated the current data processing programs being offered in public

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[46]Ibid.

secondary and public two-year post secondary institutions at that time. The purpose of the study was to provide guidance for these schools in evaluating their existing programs in data processing and for establishing new programs in integrated data processing.[47]

Bangs and Hillestad found that, in 1966, from a total of 9,484 high schools and junior colleges and vocational schools surveyed that about 19 percent of the high schools and 61 percent of the junior colleges and vocational schools were offering or planning to offer courses in data processing.[48]

This study revealed that most of the high school data processing programs were found in the New England, Middle Atlantic, and Pacific regions of the United States. On the other hand, junior college and vocational school programs were located predominantly in the Pacific, Middle Atlantic, and East North Central regions.[49]

Bangs and Hillestad received information about the data processing jobs being performed in business from managers of data processing departments in 353 businesses and over 2,000 data processing employees in businesses. Responses showed that approximately four-fifths of key punch operators had no previous experience in data processing, approximately 35 percent of the programmers held no other data processing positions prior to their present jobs, and over one-fourth of the systems analysts held no other data processing positions prior to their present jobs. Approximately 70 percent of the data processing managers had held other jobs in data processing, but only 40 percent

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[47]Bangs and Hillestad, op. cit., p. 1. [48]Ibid., p. 21. [49]Ibid.

worked as unit record equipment operators before becoming supervisors.[50] The companies surveyed by Bangs and Hillestad varied greatly in terms of data processing personnel employed, with 14 companies reporting between 1 and 4 data processing employees and 7 companies with over 290 employees working in their data processing departments. The median number of employees in data processing departments in this study was 19. Of the total employees in data processing departments in the companies surveyed, there were 4,312 key punch operators; 205 tape librarians; 1,618 unit record equipment operators, 1,347 computer operators; 2,114 programmers; 531 data processing supervisors; and 544 systems analysts.[51] Bangs and Hillestad found that students in a few high schools were allowed to enter data processing courses as early as the tenth grade; however, the larger concentration of students was in the eleventh and twelfth grades. More than 50 percent of the schools surveyed offered adult evening classes in data processing.[52]

In 1969, McIntosch and others conducted a curriculum survey of the North Carolina Community Colleges and developed a suggested curriculum guide. The objectives of the study involved a three-step procedure:

1. To determine the current and projected employment market in North Carolina for data processing personnel.

2. To determine the relationship between present curriculum offerings and employment requirements.

3. To determine the facility and instructional requirements deemed

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[50]Ibid., pp. 21-3. [51]Ibid., pp. 95-7. [52]Ibid., pp. 203-05.

necessary to compliment the findings from Steps 1 and 2.[53]

Analysis of the McIntosch data collected for this study placed North Carolina in an average to slightly above average category among states in per capita data processing activity. The survey sample indicated that in 1969 there were approximately 5,000 data processing employees active in North Carolina jobs. If the same rate of growth from 1966 to 1969 continued from 1967 to 1972, there would be approximately 3,500 new data processing jobs created. The data collected indicated that the community colleges offering data processing programs would produce only 680 graduates during this same period. In this survey, business and industry commented that community college and technical graduates of the data processing programs were good employees. Usually, the institutions were able to place an excess of 95 percent of all data processing graduates in data processing jobs. Results of this study indicated that the data processing job market was and would continue to be open for data processing graduates in North Carolina and other sections of the country. McIntosch found that the data processing programs in the secondary schools and four-year colleges did not compete with the two-year programs in the Community College System. Each institution appeared to serve the data processing employment at different entry levels. Recommendations were made to offer an introductory course in computers for students enrolled in all technical programs and to retain the current problem and

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[53] William A. McIntosch and others, "Study of the Data Processing Technical Curriculum Offered in the North Carolina Community College System" (Raleigh: North Carolina State University, Department of Industrial and Technical Education, 1969), Summary.

procedure-orientation in the two-year data processing curriculum, but with changes to include more third generation concepts and languages and less functional wiring experience.[54] Another recommendation was for the development of a continuing process of evaluation which would provide the Community College System with data processing programs that would offer a maximum of realistic opportunities for its students and a direction for new and future programs in data processing.[55]

SUMMARY AND CONCLUSION

A review of literature in the field of data processing revealed that much effort has been expended to explore the effect of automated and electronic data processing on office occupations and data processing curriculums, efforts have been made to identify the data processing jobs available and the requirements for these jobs, and units of study and curriculum guidelines have been suggested for teaching data processing. In spite of these efforts, findings in data processing research cannot be generalized because the studies are extremely localized geographically. The survey of data processing research showed that more is known about data processing education in the secondary schools than in the two-year post secondary schools or the colleges and universities. Consequently, business educators have not been able to utilize the findings of data processing research effectively in data processing programs. They still seem to disagree on data processing issues involving who to teach, what to teach, the scope and

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[54]Ibid.

[55]Ibid.

sequence of the data processing curriculum, and the knowledges and skills needed for employment in data processing occupations.

In view of these studies, the present study was designed to answer some of the questions that have been unanswered pertaining to job classifications, job opportunities, and job requirements in data processing in North Carolina.

CHAPTER III

PROCEDURES

This study was designed as an attempt to determine the business data processing job classifications of businesses and industries in North Carolina and the knowledges and technical skills needed for each job classification and to evaluate the current business data processing curriculums in the community colleges and technical institutes in North Carolina to determine how the current curriculums related to the job classifications and the knowledges and technical skills needed for each job classification. Data were gathered about business data processing job classifications and needs through mail questionnaires and interviews with data processing managers in selected businesses and industries in North Carolina. Further data about the status of data processing instruction in the community colleges and technical institutes were gathered from interviews with heads of data processing departments in these schools.

The sample survey design utilizing questionnaires and interview schedules was used because of the information needed and because of the data needed at the state level to serve as a basis for curriculum development in data processing education programs in community colleges and technical institutes. The interview schedule, rather than the mail questionnaire was used to collect data in the community colleges and technical institutes because of the probability of a higher rate of response and because it was believed that interviews with these schools would probably provide more information on the status of data processing education.

A prepared schedule of questions was used to gather information from data processing department heads in the community colleges and technical institutes regarding the early development of data processing programs, the objectives of the program, the number of students enrolled, placement procedures for data processing graduates, data processing teachers, cooperative programs in data processing, and precise information regarding curriculum and program coverage.

The mail questionnaire to data processing managers in selected businesses and industries served to gather information regarding the educational and skill requirements of data processing personnel. Data were gathered from management personnel about equipment used; languages used; data processing, general education, and business courses recommended for data processing personnel; tests given; promotion patterns; and future plans and trends in the data processing field, especially in his own firm.

Material in this chapter is divided into six major areas: (1) preparation of questionnaires, (2) preliminary study, (3) selection of subjects, (4) collection of data, (5) data coding and classifying, and (6) analysis of data.

PREPARATION OF QUESTIONNAIRES

Preliminary forms of the questionnaire and interview schedule were prepared and were tried out in the state of Virginia, as described under the preliminary study on page 69.

The questionnaire for business and industry was refined by rewording questions that did not convey proper meaning, raised bias, contained more than one element, were leading questions, or did not obtain factual information.

The same type of procedure was used to refine the interview schedule utilized in the community colleges and technical institutes. In order to further standardize the interviewing techniques, a tape recording was made of each interview conducted in the preliminary study. (See Appendix B-2, Management Questionnaire and Appendix B-3, School Questionnaire.)

A taxonomy of job classifications was developed in order to provide the subjects with a standardized list of job classifications being surveyed. The taxonomy was compiled from data processing job descriptions used by the North Carolina State Personnel Department. The taxonomy was mailed with management questionnaires and utilized in the school interviews. (See Appendix E-1, Taxonomy of Job Classifications.)

Definitions of industries studied was prepared from the Standard Industrial Classification Manual for classification of the types of businesses and industries that should be included in the survey. This information was mailed with management questionnaires as a reference for classification of the particular business or industry surveyed. (See Appendix E-2, Definitions of

Industries Studied.)

An introductory letter was mailed with each management questionnaire to acquaint the business or industry with the study and to ask for their assistance in obtaining needed information. (See Appendix B-1, Introductory Letter.)

PRELIMINARY STUDY

Prior to the initiation of the basic study, a pilot study was run in selected community colleges in Virginia and in selected businesses and industries in Virginia in order to validate the instruments. Through correspondence with the Department of Community Colleges in Richmond, Virginia and with the Department of Labor, Research and Statistics Section, Division of Commerce and Industry, a listing of the community colleges in Virginia offering a data processing program and a listing of businesses and industries in Virginia having data processing installations was obtained.

Five community colleges were selected for an interview session, with only two responding and confirming the interview session. Five businesses and industries were asked for interview sessions, with three being interviewed. Five mail questionnaires were mailed to business and industry, with four responding to the questionnaire.

In the two selected community colleges, the person in charge of the data processing education program was interviewed. Information was obtained relating to the scope and sequence of the data processing curriculum, the students in the data processing program, the teachers of data processing, and the type of equipment being utilized. In order to standardize the interview schedule and procedure, a tape recording was made of each interview session. After data were gathered from the interview schedule, the interviewees were asked to evaluate the wording of the questions, the length of time to conduct the interview, and for any omissions of data that would be useful for the survey. Information from the interviewees was used to refine the wording and change the format of the questionnaire. The tape recordings were evaluated to assure that each interview was being conducted in an identical manner.

Three data processing managers in business and industry were interviewed, and preliminary questionnaire forms were mailed to data processing managers in other businesses and industries. Basically, the same procedure was followed for refining the management questionnaire as was used in refining the interview schedule of the community colleges. Data processing managers supplied useful criticism and suggestions for the survey procedures. The questionnaire and interview schedule were revised several times before mailings and interviews were made in North Carolina. (See Appendix D-1, Pilot Study Subjects in Virginia.)

SELECTION OF SUBJECTS

Two different populations were studied in this investigation: community colleges and technical institutes and businesses and industries using either automated or electronic data processing.

Selecting the Schools

The entire population of fifty-six community colleges and technical institutes in North Carolina was written requesting a school catalogue. From a review of the school catalogues, it was determined that nine community colleges and twelve technical institutes in the Community College System had business data processing education programs. (See Appendix C-2, Name and Location of Institutions Within the North Carolina Community College System and Appendix C-3, Institutions With Data Processing Programs Within the North Carolina Community College System.) Interview sessions were scheduled with the person in charge of business data processing education in each of these schools.

In the interview sessions, the data processing head provided information about the scope and sequence of units in the data processing curriculum and the purpose of and courses included in the program. The head was asked to discuss the students in the data processing program in terms of selection processes, characteristics, and the knowledges and technical skills needed for completing the program. Information on the equipment used, such as key punch, verifier, reproducer, interpreter, collator, accounting machine, and computer was collected. (See Appendix B-3, School Questionnaire, for detailed information that was collected.)

Selecting the Businesses and Industries

The North Carolina Department of Labor publishes the North Carolina Directory of Manufacturing Firms. From this listing of businesses and industries and from other data, a listing based on employment is made of North Carolina's largest manufacturing and nonmanufacturing establishments. The list used for this study included the top 300 establishments based on March, 1971 employment. The North Carolina Department of Administration supplied a listing of state agencies including local school boards of education and colleges and universities with data processing installations. The General Services Division of the Federal Government provided a listing of federal agencies with data processing installations. The North Carolina State Board of Health supplied a listing of the 218 hospitals in North Carolina. Hospital administrators in each hospital on the list were written requesting answers to three questions concerning the data processing status in their hospitals. Hospitals having data processing installations were later included in the survey sample. (See Appendix D-2 for questions asked of each administrator.)

From these four listings, classifications were made based on the Standard Industrial Classification. After placing manufacturing, nonmanufacturing, state agencies, federal agencies, and hospitals with data processing installations in their proper classification, the businesses and industries were selected randomly based on the Table of Random Numbers.

Since data collected in this study was not subject to sophisticated statistical analysis, a purposive sample was utilized and a small sample of thirty companies was used. The sample of businesses and industries was based on the largest manufacturing and nonmanufacturing establishments because data processing equipment represents a large capital investment and large firms generally have computer installations. After surveying the total sample of state agencies, federal agencies, and hospitals, this assumption proved to be true.

Table 1 on page 74 shows how the businesses and industries in the sample were distributed according to the Standard Industrial Classification categories. Since the samples selected from federal and state government, hospitals, and secondary schools and universities and colleges consisted of the total population, the data collected from these areas were assumed to have significant differences and were to be treated separately. A preliminary study of the data collected from this sample revealed no significant difference; therefore, the sample of all businesses and industries was combined. (For a description of each Standard Industrial Classification category, refer to Appendix E-2. For a listing of the companies surveyed in this study, refer to Appendix C-1).

The survey of the selected businesses and industries in North Carolina was conducted by mail questionnaire. Follow-up study was later done by interviews with selected Charlotte businesses and industries. Charlotte was selected because it is considered the distribution center of the Carolinas and the leading sales and marketing center of the nation's textile industry. Therefore, Charlotte's response to the management questionnaire would provide valuable information for the North Carolina Community College System.

Data processing managers in the selected businesses and industries were asked to supply information related to job classifications, and knowledges and technical skills needed in these jobs, job opportunities available in data processing, and the criteria for selecting data processing employees. (See Appendix B-2 for detailed information that was collected on the Management Questionnaire.)

Table 1

Businesses and Industries Surveyed and Management Questionnaires Returned

Type of Business or Industry	Questionnaires Mailed		Usable Questionnaires Returned	
	N	%	N	%
Manufacturing	26	41.9	8	26.7
Construction	1	1.6	1	3.3
Transportation, Communication, Public Utilities	8	12.9	4	13.3
Trade	6	9.7	2	6.7
Finance, Insurance, Real Estate	6	9.7	4	13.3
Federal Government	2	3.2	2	6.7
State Government	3	4.8	2	6.7
Hospitals	5	8.1	3	10.0
Secondary Schools, Universities	5	8.1	4	13.3
Total	62	100.0	30	100.0

SOURCES OF DATA

School Data Collection

Before visiting the schools, appointments were made with persons in charge of data processing departments in the nine community colleges and twelve technical institutes of North Carolina with data processing education programs. A structured interview session was held with the data processing head to gather factual data about the data processing education program as well as an evaluation of the education program and the department's plans for the future.

Business and Industry Data Collection

The selected businesses and industries were mailed the survey package including an introductory letter, a taxonomy of job classifications, a definition of industries, the management questionnaire, and a pre-addressed return envelope. After two weeks a second request was mailed to nonrespondents. After another two-week period, a handwritten and illustrated post card was mailed to non-respondents. Additional follow-up was made after one more week. This follow-up included the scheduling of five interview sessions in the Charlotte area. (Copies of the enclosures are in the Appendix.)

The 48.4 percent of management questionnaires returned represented a total of thirty respondents which was predetermined to meet the small sample criteria. (Table 1, page 74) An up-to-date questionnaire return listing was maintained in order to assure immediate responses and immediate follow-up of non-returns.

DATA CODING AND CLASSIFICATION

As the interview schedules were completed and the survey forms were returned, each was reviewed and edited. After editing, the data were coded, classified, and tabulated on preliminary table forms for further analysis.

ANALYSIS OF DATA

Much of the information on the data processing programs in the community colleges and technical institutes was descriptive and did not lend itself to statistical analysis. The same was true for the information on the data processing job classifications in business and industry. Since this was a survey study, no statistical comparisons or generalizations were made on the data collected from the community colleges and technical institutes or from the businesses and industries. Where appropriate, the data were summarized with descriptive statistics (means, percentages, and ranges). Normative data were developed about qualifications, education, and training for data processing jobs.

Basically, the data were summarized and arranged in table form giving totals and percentages, percentages based on the total responses to questions, frequency of mention by the subjects, or rankings from high to low. Tables were used to show data such as:

1. Number of students enrolled in data processing programs in community colleges and technical institutes.

2. Number of data processing personnel in companies with computer installations.

3. Amount of data processing experience required by data processing managers for data processing employees.

4. Number of data processing skills required for data processing job classifications.

5. Amount of education desired by data processing managers for each data processing job classification.

6. General and business education courses required by data processing managers and in data processing programs.

7. Data processing courses and course content offered in data processing programs in community colleges and technical institutes.

8. Types of equipment being used in community colleges and technical institutes and in businesses and industries.

Certain information is presented in narrative form. A discussion is made of data processing managers' opinions of the future trends for data processing in their companies and in the community colleges and technical institutes. Other data discussed are patterns of in-service training programs for data processing employees and opinions of management personnel regarding the quality of preparation of employees obtained from community colleges and technical institutes.

CHAPTER IV

ANALYSIS OF DATA PROCESSING JOB CLASSIFICATIONS

Description of the Sample

Questionnaires were mailed to managers of data processing departments in sixty-two companies in North Carolina (Table 1, page 74) asking for information about the data processing jobs in their companies. Twenty-two companies did not respond to the questionnaire. Of the forty data processing managers responding, thirty reported having computer installations and responded to the questionnaire; six reported having no data processing manager; one data processing manager indicated limited time and no opportunity to respond; and one data processing manager omitted questions twenty through twenty-eight.[1] Two companies, one utilizing a real-time system and the other purchasing computer services, were not able to apply their installations to the questionnaire.

Information obtained about the data processing job classifications in business and industry included such things as the tests used in selecting employees in each classification, the skills performed by data processing employees in each classification, the courses needed by employees in each classification, and the promotional patterns for each classification. Information

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[1]Responses to questions one through nineteen were included in the analysis.

collected from the managers concerning employees in the various data processing classifications included such items as previous data processing experience required and amount of education desired. Type of equipment used in the computer installation, opinions on hiring selected students for cooperative work experience, and languages utilized were provided by data processing managers. Data processing managers were also asked to project the future needs and anticipated changes in data processing for the next three to five years. Data concerning the aspects of data processing jobs and needs of data processing personnel are presented and analyzed in the following divisions of this chapter.

Size of the Businesses and Industries

Data processing managers were asked to indicate the number of office personnel in their business or industry. Managers responded to this question in two ways: (1) The total number of office personnel employed throughout the business or industry was given. (2) The total number of office personnel employed only in the data processing department was given. With these responses, the data collected were not valid for a uniform interpretation and were not included in the analysis.

Data processing departments varied in size, with eighteen data processing managers reporting between one to twenty data processing employees; three reporting between twenty-one to thirty employees; three reporting between forty-one to fifty employees, and seven managers reporting more than fifty employees in their department. (Table 2) The mean number of employees in the data processing departments in this study was 41.0, and the median was 14.1.

Table 2

Data Processing Employees in Businesses and Industries with Computer Installations

Classification of Businesses and Industries as to Number of Data Processing Employees	Number of Businesses and Industries and Total Number of Data Processing Employees with Percentages			
	Businesses and Industries		D. P. Employees	
	N	%	N	%
1 - 10	9	29.0	57	4.5
11 - 20	9	29.0	152	11.9
21 - 30	3	9.7	80	6.3
31 - 40				
41 - 50	3	9.7	140	11.0
More than 50	7	22.6	843	66.3
Total	31	100.0	1272	100.0

Data Processing Equipment

The companies surveyed used a variety of equipment, with most companies operating at least one in-house computer. (Table 3) This study revealed that some unit record equipment is being utilized in computer installations in North Carolina. From data included on the table it is apparent that the following types of equipment are not being used extensively in business and industry: (1) reproducer, (2) interpreter, (3) collator, (4) accounting machine/tabulator, (5) paper-tape machine, (6) tape-card machines, (7) card-to-tape converter, (8) magnetic tape typewriter, and (9) optical scanner. Key punch machines, key punch-interpreters, and verifiers are being used extensively in business and industry because computer installations continue to maintain punched card files; as well as magnetic tape files. Video display terminal/scopes are being utilized by many data processing installations, particularly in those installations purchasing computer services or having real-time systems. Some equipment is unique to a particular installation, i.e., ticket converter and tape-to-card converter in department stores, MICR encoder and reader in banks.

Data Processing Job Classifications

The majority of data processing job classifications in computer installations is in the range of six to ten as shown in Table 4. Only two companies (6.5 percent) indicated that they had more than twenty data processing job classifications within their company.

Table 3

Items of Data Processing Equipment and Quantity Used by the 31 Businesses and Industries Reporting

Item of Equipment	Number
Computer, Terminal	568
Disc Drive	211
Teletype	179
Key Punch	143
Verifier	81
Printer	68
Card Reader	54
Computer, In-House	52
Key Punch-Interpreter	48
Card Sorter	30
Reproducer	26
Magnetic Tape Typewriter	22
Interpreter	18
Collator	12
Accounting Machine/Tabulator	7
Paper-Tape Machine	6
Optical Scanner	4
Tape-Card Machine	2
Card-to-Tape Converter	1

Table 3 (continued)

Item of Equipment	Number
Other	
Video Display Terminals/Scopes	113
Tape Drive	46
Key Tapes (Magnetic Tape)	11
Data Recorders	10
Key Punch/Verifier/Interpreter	10
MICR Encoder	10
Key Punch/Verifier	9
Inforex Key Endsy	8
1419 MICR Reader/Sorter	8
Key Tape/Verifier/Transmitter	6
1050 Communications	5
Paper Tape Reader	4
Teletype Terminal	3
Card Punch	2
Audio-Response Unit	1
Computer Output Microfilm/Com	1
Dimension Ticket Convertor	1
MICR Reader	1
NOVA Mini-Computer	1
Tape-to-Card Converter	1

Table 4

Number of Data Processing Job Classifications in 31 Businesses and Industries with Computer Installations*

Category of Businesses and Industries as to Data Processing Job Classifications	Businesses and Industries	
	N	%
1 - 5	8	25.8
6 - 10	16	51.6
11 - 15	5	16.1
16 - 20		
More than 20	2	6.5
Total	31	100.0

*In responding to the question, data processing managers indicated more job classifications than there were positions in their company.

Data Processing Employees Presently Employed

The number of data processing employees presently employed in each job classification of the twenty-seven companies who responded to this question is shown in Table 5. Key punch operator (296) and computer operator (201) positions require more employees than any other positions. According to the figures collected, programmers make up a large portion of the employees in computer installations. (Totals in Table 2 on page 80 and Table 5 are not equal since only twenty-seven out of the thirty-one companies responded to the question relating to the number of data processing employees presently employed

Table 5

Number of Data Processing Employees Presently Employed in Each Job Classification as Reported by 27 Data Processing Managers

Job Classification	Number of Employees
Key Punch Operator	296
Computer Operator	201
Programmer	176.5
Systems Analyst	90
Data Processing Coordinator	78
Data Processor	30
Data Processing Manager	23.5
Key Punch Supervisor	23
Cooperative Computer Programmer Trainee	16
Systems Manager	13
Programming Manager	12
Other	
Data Processor Technician	150
Inscriber	17
Data Control Clerk	8
Project Coordinator	6
Management Science	5
Project Manager	5
Control Supervisor	2
Input/Output Quality Control Clerk	2
Inscriber Supervisor	2
Programming Analyst	2
Systems and Programming Manager	2
Assistant Data Processing Manager	1
Data Processing Director	1
Operations Supervisor	1
Systems Development	1
Total	1164

in each classification.

Anticipated Increase in Employees for Data Processing Jobs

The number of potential data processing positions open for the next year in twenty-nine of the thirty-one companies responding to the question is given in Table 6. More positions in data processing next year will be open to key punch operators and data processing technicians. Computer operator and programmer classifications will also provide job opportunities for persons interested in data processing. Data processing managers indicated that there is a large turnover in the classifications of key punch operator and data processing technicians.

Qualified Data Processing Personnel

According to data processing managers, qualified computer operators and programmers were the most difficult positions of the data processing job classifications to fill. (Table 7) A small portion of the managers indicated that qualified systems analysts and key punch operators were sometimes difficult to find. Since data processing promotion is done within a company, this may account for the lack of difficulty in finding qualified personnel for the other job classifications.

Community College and Technical Institute Graduates

When asked about experience with employees educated in a community college or technical institute, some data processing managers did not respond or

Table 6

Anticipated Increase in Number of Data Processing Employees in Each Job Classification Within the Next Year (1973) Reported by 29 Data Processing Managers

Job Classification	Number of Anticipated Increase
Key Punch Operator	38
Computer Operator	29
Programmer	28
Systems Manager	
Cooperating Computer Programmer Trainee	19
Data Processing Coordinator	6
Systems Analyst	6
Data Processing Manager	3
Data Processor	1
Key Punch Supervisor	1
Programming Manager	1
Other	
Data Processor Technician	38
Data Control Clerk	2
Input/Output Quality Control Clerk	1
Management Science	1
Project Manager	1
Total	175

Table 7

Difficulty in Finding Qualified Data Processing Personnel in Specific Job Classifications as Reported by Businesses and Industries

Job Classification	Number
Computer Operator	10
Programmer	10
Systems Analyst	8
Key Punch Operator	8
Systems Manager	5
Data Processing Manager	5
Programming Manager	5
Key Punch Supervisor	4
Cooperative Computer Programmer Trainee	2
Data Processor	2
Data Processing Coordinator	2
Other	
Data Processing Technician	1
Inscriber	1
Inscriber Supervisor	1
Input/Output Quality Control Clerk	1
Project Manager	1
Management Science	1
Systems Development	1
Data Control Clerk	1
Total	69

reported that they had no experience with these institutions. Overall, data processing managers responding indicated that their experience was good, particularly in the computer operator and programming positions. (Table 8) Eight out of thirty of the data processing managers indicated that their experience with computer operators, programmers, systems analysts, systems managers, and cooperative computer programmer trainees educated in a community college or technical institute was poor.

Cooperative Work Experience Students

Of the thirty-one data processing managers surveyed, eighteen (58.6 percent) indicated that they would be interested in employing cooperative work experience students from the data processing programs in the community colleges and technical institutes, with ten managers (32.2 percent) indicating no interest. Three managers (9.7 percent) commented that they would be interested in employing students, but there would be problems in their companies because of the size of their installation and the lack of time for training students.

COMPUTER LANGUAGES

Three computer languages were reported as being used to a great extent in computer installations: COBOL, RPG, and assembly/machine programming languages. (Table 9) FORTRAN and canned/library programming languages were reported as being used to a small extent in some installations. Other languages mentioned were peculiar to a particular computer installation.

Table 8

Rating of Data Processing Personnel by Job Classification
Educated in Community Colleges and Technical Institutes
as Reported by 30 Data Processing Managers*

Rating	Comp. Oper.	Prgmr.	Prgmr. Mgr.	Sys. Anal.	Sys. Mgr.	Cooper. Comp. Prgmr. Trainee	Data Processor	D. P. Coordinator	D. P. Mgr.	Key Punch Oper.	Key Punch Supv.
Excellent	3	3				1	1		2	1	
Very Good	3	4	2	2	2	5	1	1	2	4	2
Good	10	8	1	1	1	5	3	3	1	7	4
Poor	1	2		3	1	1					
Total	17	17	3	6	4	12	5	4	5	12	6

*The number refers to the data processing managers responding to this question.

Table 9

Programming Languages Used in Businesses and Industries with Computer Installations*

Languages	Number of Businesses and Industries
RPG	21
Assembly	20
COBOL	20
FORTRAN	13
Canned Programs	9
AUTOCODER	6
PL 1	3
ALGOL	1
Other	
1410FFS	1
ANSCOBOL	1
Control Data/ CDC	1
Easycoder	1
Grasp/Optical Scanner	1
SOBEL Assembly	1
Work/Precomputer Shorthand	1

*The thirty-one data processing managers responding to this question could indicate more than one language.

TEST SELECTION

The only test reported as being used to any extent by data processing managers (seventeen out of twenty-six) is the International Business Machines (IBM) Programmers Aptitude Test which is administered to prospective computer programmers. (Table 10) This test is also administered by some managers to computer operators, programming managers, systems analysts, systems managers, and cooperative computer programmer trainees. Mathematics aptitude and achievement and logic tests are used to some extent by computer installations. Key punch operators are given various tests including key punch operator test, key punch aptitude test, machines operator test, and quantitative test. Some data processing managers indicated that tests were used, but other factors such as experience and education were important. On the questionnaire managers were asked if scholastic aptitude quantitative or other programmers tests were used. Responses on the questionnaire revealed that these tests were not in use; therefore, they were not included in the table.

CHARACTERISTICS OF DATA PROCESSING EMPLOYEES

Data Processing Experience

The data processing managers were asked to indicate the amount of data processing experience required of employees prior to employment in their companies. Replies varied, depending on the data processing job classification. For employees in the classifications of computer operator, cooperative computer programmer trainee, data processor, and key punch operator, eleven or more of

Table 10

Tests Used in Selecting Data Processing Personnel Reported
by 26 Data Processing Managers for Each Job Classification

Test	Comp. Oper.	Prgmr.	Prgmr. Mgr.	Sys. Anal.	Sys. Mgr.	Cooper. Comp. Prgmr. Trainee	Data Processor	D. P. Coordinator	D. P. Mgr.	Key Punch Oper.	Key Punch Supv.
Mathematics Aptitude	4	6	4	6	4	3	2	2	3	2	1
Mathematics Achievement	3	5	4	5	3	2	1	2	2		
Logic	4	5	4	5	3	1	1	3	2	2	2
Scholastic Aptitude--											
Language	1	1	1	1	1	1	1	1	1	1	1
Reading	2	1	1	1	1	1	1	1	1	2	2
IBM Programmers	5	17	7	6	5	6	2	2	3	1	1
Other	4	2	2	2	2	1		2	2	9	4
Total	23	37	23	26	19	15	8	13	14	17	11

the managers reported that they would accept persons with no previous data processing experience. (Table 11) The experience for computer programmers ranged from no experience to thirteen to eighteen months' experience, with 23.3 percent or seven of the managers requiring either seven to twelve months' experience or thirteen to eighteen months' experience. However, 20.0 percent or six managers required no experience for programmers. For the positions of computer programming manager, computer systems analyst, systems manager, data processing manager, and key punch supervisor eleven or more of the managers reported that more than twenty-four months of data processing experience was required.

Data Processing Skills

Data processing managers were asked to check the skills other than the skills required for the particular data processing classification which they would desire employees to have before employment. However, data processing managers' responses to this question dealt only with the skills that were required for each classification. Therefore, this question was analyzed in terms of the specific skill requirements for each classification.

The skills preferred by data processing managers for employees in each data processing job classification are identified in Table 12. Total responses from managers to each skill are listed together with the percentage of managers responding in each of the eleven classifications. If there were no responses to a skill, the skill was not listed.

Analysis of Table 12 indicates that not only key punch operators and key punch

Table 11

Amount of Data Processing Experience Required for Employees by Job Classification as Reported by 30 Data Processing Managers

Months of Experience	Comp. Oper. N	Comp. Oper. %	Prgmr. N	Prgmr. %	Prgmr. Mgr. N	Prgmr. Mgr. %	Sys. Anal. N	Sys. Anal. %	Sys. Mgr. N	Sys. Mgr. %	Cooper. Comp. Prgmr. Trainee N	Cooper. Comp. Prgmr. Trainee %	Data Processor N	Data Processor %	D. P. Coordinator N	D. P. Coordinator %	D. P. Mgr. N	D. P. Mgr. %	Key Punch Oper. N	Key Punch Oper. %	Key Punch Supv. N	Key Punch Supv. %
None	12	40.0	6	20.0			2	6.7			14	46.7	11	36.7	4	13.3	2	6.7	13	43.3	3	10.0
6 or less	6	20.0	5	16.7			1	3.3			3	10.0	3	10.0	2	6.7			3	10.0		
7-12	5	16.7	7	23.3			1	3.3			1	3.3	5	16.7	2	6.7	1	3.3	6	20.0	4	13.3
13-18	3	10.0	7	23.3			1	3.3			4	13.3			3	10.0	1	3.3	4	13.3	3	10.0
19-24			1	3.3	4	13.3	5	16.7	3	10.0	1	3.3	2	6.7	3	10.0	2	6.7			4	13.3
More than 24			2	6.7	17	56.7	11	36.7	19	63.3	1	3.3			6	20.0	22	73.3			11	36.7

Table 12

Data Processing Skills Reported by Managers as Required for Each Job Classification

Skill	Comp. Oper. (N=25)		Prgmr. (N=27)		Prgmr. Mgr. (N=21)		Sys. Anal. (N=20)		Sys. Mgr. (N=20)		Cooper. Comp. Prgmr. Trainee (N=16)		Data Processor (N=16)		D. P. Co-ordinator (N=14)		D. P. Mgr. (N=18)		Key Punch Oper. (N=19)		Key Punch Supv. (N=23)	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Key Punching	9	36.0	11	40.7	6	28.6	9	45.0	4	20.0	6	37.5	10	62.5	6	42.9	5	27.8	14	73.7	12	52.2
Operating Concepts of Unit Record Equipment	15	60.0	8	29.6	8	38.1	7	35.0	6	30.0	6	37.5	10	62.5	8	57.1	12	66.7	5	26.3	7	30.4
Verifying	2	8.0	3	11.1	2	9.5	1	5.0	2	10.0	1	6.3	7	43.8	2	14.3	3	16.7	15	78.9	11	47.8
Wiring Boards (Reproducer, Collator, etc.)	6	24.0	2	7.4	2	9.5	1	5.0	1	5.0	2	12.5	8	50.0	4	28.6	6	33.3			3	13.0
Programming	4	16.0	12	44.4	10	47.6	11	55.0	7	35.0	4	25.0	2	12.5	3	21.4	9	50.0				
Flowcharting	4	16.0	16	59.3	12	57.1	14	70.0	12	60.0	7	43.8	2	12.5	3	21.4	12	66.7			1	4.3
Computer Console Operations	14	56.0	17	63.0	11	52.4	8	40.0	5	25.0	3	18.8	3	18.8	4	28.6	11	61.1	1	5.3	1	4.3
Block Diagramming	5	20.0	15	55.6	11	52.4	11	55.0	8	40.0	6	37.5	3	18.8	3	21.4	9	50.0				
Debug Programs	3	12.0	15	55.6	10	47.6	8	40.0	6	30.0	3	18.8	2	12.5	1	7.1	6	33.3				
Problem Solving	7	28.0	14	51.9	14	66.7	14	70.0	14	70.0	3	18.8	5	31.3	9	64.3	13	72.2			4	17.4
Design Systems	2	8.0	9	33.3	12	57.1	13	65.0	14	70.0	2	12.5	1	6.3	2	14.3	8	44.4				
Feasibility Studies	1	4.0	4	14.8	7	33.3	14	70.0	15	75.0	1	6.3	1	6.3	4	28.6	11	61.1			9	39.1
Supervisory Duties	2	8.0	3	11.1	13	61.9	9	45.0	16	80.0	1	6.3	1	6.3	6	42.9	12	66.7				
Coordinate Data Processing Activities	5	20.0	4	14.8	9	42.9	9	45.0	13	65.0	1	6.3	2	12.5	9	64.3	15	83.3	1	5.3	4	17.4
Prepare Written Reports	2	8.0	9	33.3	14	66.7	15	75.0	16	80.0	2	12.5	3	18.8	6	42.9	16	88.9	1	5.3	8	34.8
Train New Employees	13	52.0	7	25.9	13	61.9	6	30.0	11	55.0	1	6.3	4	25.0	6	42.9	13	72.2	4	21.1	11	47.8

Table 12 (continued)

Skill	Comp. Oper. (N=25)		Prgmr. (N=27)		Prgmr. Mgr. (N=21)		Sys. Anal. (N=20)		Sys. Mgr. (N=20)		Cooper. Comp. Prgmr. Trainee (N=16)		Data Processor (N=16)		D. P. Co-ordinator (N=14)		D. P. Mgr. (N=18)		Key Punch Oper. (N=19)		Key Punch Supv. (N=23)	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Design Forms	1	4.0	8	29.6	8	38.1	13	65.0	10	50.0	1	6.3	2	12.5	6	42.9	11	61.1	1	5.3	2	8.7
Plan Card Layout and Design	1	4.0	11	40.7	10	47.6	13	65.0	8	40.0	2	12.5	2	12.5	4	28.6	10	55.6	2	10.5	6	26.1
Evaluate Work Loads	6	24.0	5	18.5	12	57.1	10	50.0	14	70.0	1	6.3	4	25.0	6	42.9	13	72.2	2	10.5	9	39.1
Code and Condense Data	1	4.0	7	25.9	7	33.3	7	35.0	2	10.0	2	12.5	4	25.0	3	21.4	3	16.7	6	31.6	5	21.7
Oral Communication	12	48.0	15	55.6	14	66.7	14	70.0	15	75.0	8	50.0	6	37.5	11	78.6	15	83.3	5	26.3	12	52.2
Teleprocessing Techniques	7	28.0	8	29.6	10	47.6	11	55.0	11	55.0	1	6.3	2	12.5	4	28.6	13	72.2				
Terminal Unit Concepts	8	32.0	7	25.9	8	38.1	11	55.0	9	45.0	1	6.3	1	6.3	2	14.3	8	44.4				
Subroutines	2	8.0	12	44.4	9	42.9	8	40.0	5	25.0	2	12.5	1	6.3	2	14.3	4	22.2				
Loops and Indexing	3	12.0	12	44.4	8	38.1	7	35.0	5	25.0	2	12.5	1	6.3	1	7.1	5	27.8				
Canned (Library) Programs (Use, Maintenance and Modification)	5	20.0	14	51.9	10	47.6	8	40.0	8	40.0	2	12.5	2	12.5	3	21.4	7	38.9	1	5.3	1	4.3
Magnetic Tape Library (Use, Maintenance and Modification	11	44.0	8	29.6	7	33.3	3	15.0	5	25.0	2	12.5	2	12.5	4	28.6	6	33.3	1	5.3	1	4.3

supervisors should have skill in key punching, but this skill is also important for programmers and data processors as well. Computer operators, data processors, and data processing managers should be familiar with operating concepts of unit record equipment. One half of the data processing managers responding to the classification of data processor desired that the processor have skill in wiring boards for the reproducer, collator, etc. Managers reported that writing programs was an important skill not only for programmers but for programming managers and systems analysts as well. Flow charting was a skill desired for the programming, systems and data processing manager positions. Managers reported that not only computer operators, but programmers, programmer managers, and data processing managers as well should have skill relating to computer console operation. Problem solving was a skill desired by managers for programming, systems, and data processing manager positions. Coordinating data processing activities was a skill important not only for data processing managers, but for systems managers also. Preparing written reports was among the most frequently mentioned skill for the management positions. Training new employees was a skill not only desirable for managers and supervisors, but for the computer operator as well. Oral communication was mentioned frequently in all the classifications, but particularly in relation to the positions of programming manager, systems analyst, systems manager, co-operative computer programmer trainee, data processing coordinator, data processing manager, and key punch supervisor.

Education

Data processing managers were asked what level of education they desired employees in each data processing job classification to have before employing them in their company. At least a high school education was desired by managers for all classifications. Managers reported that employees in the managerial positions should have a four-year degree. (Table 13) For the position of key punch operator, 67.7 percent of the managers desired a high school education, with no managers requiring a four-year degree for this position. For the computer operator, 48.4 percent of the managers indicated that a high school education was sufficient; 35.5 percent indicated that a technical degree was desirable; and no managers required a four-year degree. For the position of data processor, a high school education was desired by 41.9 percent of the managers, with 22.6 percent of the managers desiring the processor to have a technical institute education. Only 12.9 percent of the managers reported that a high school education was desired for programmers. For the programmer, 48.4 percent of the managers desired a technical education; 19.4 percent indicated that a community college education was sufficient; and 35.5 percent of the managers desired a four-year degree for programmers. Data processing managers (45.2 percent) indicated that cooperative computer programmer trainees should have a technical education, with only 16.1 percent of the managers desiring a four-year degree. A four-year degree was desired by 45.2 percent of the managers for the position of computer programming manager; by 51.6 of the managers for systems analyst; by 58.1 percent for systems manager; and by 61.3 percent of the managers for

Table 13

Level of Education Desired by 31 Data Processing Managers for Each Data Processing Job Classification

Level of Education	Comp. Oper.		Prgmr.		Prgmr. Mgr.		Sys. Anal.		Sys. Mgr.		Cooper. Comp. Prgmr. Trainee		Data Processor		D. P. Coordinator		D. P. Mgr.		Key Punch Oper.		Key Punch Supv.	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
High School	15	48.4	4	12.9	4	12.9	2	6.5	2	6.5	6	19.4	13	41.9	7	22.6	3	9.7	21	67.7	17	54.8
Community College	5	16.1	6	19.4	2	6.5	1	3.2	1	3.2	2	6.5	1	3.2	3	9.7	1	3.2	2	6.5	5	16.1
Technical Institute	11	35.5	15	48.4	6	19.4	6	19.4	1	3.2	14	45.2	7	22.6	6	19.4	5	16.1	6	19.4	4	12.9
Four-Year Degree			11	35.5	14	45.2	16	51.6	18	58.1	5	16.1	1	3.2	5	16.1	19	61.3				
Business School	1	3.2	1	3.2	1	3.2	3	9.7	4	12.9					1	3.2	2	6.5	2	6.5	1	3.2
Any Post High School			1	3.2							1	3.2			1	3.2					2	6.5

the position of data processing manager.

Courses of Study

Courses for general education, business, and data processing were ranked by frequency of mention for each course. No course with less than five responses from data processing managers was included in the table. Statistical procedures were used for ranking where more than one course received the same number of responses.

General Education Courses

The most frequently mentioned post secondary general education course for data processing employees was general mathematics. (Table 14) In all job classifications, with the exceptions of data processing coordinator, data processing manager, and key punch supervisor, general mathematics was ranked one. Algebra, trigonometry, analytic geometry, and calculus were frequently mentioned for the programming and systems classifications. English/literature and philosophy/logic were frequently mentioned for the programming and systems positions. The only general education courses not mentioned for data processing managers were calculus, foreign language(s), and art/and/or music.

Business Courses

The post secondary school business course mentioned most frequently by data processing managers was introduction to business. For all classifications, with the exception of systems manager and key punch operator, introduction to business was ranked from one to three. (Table 15) Bookkeeping/

Table 14

General Education Courses Preferred by 30 Data Processing Managers for Employees in Each Job Classification*
(Ranked by Frequency of Mention)

Courses	Comp. Oper.	Prgmr.	Prgmr. Mgr.	Sys. Anal.	Sys. Mgr.	Cooper. Comp. Prgmr. Trainee	Data Processor	D. P. Coordinator	D. P. Mgr.	Key Punch Oper.	Key Punch Supv.
Gen. Math.	1	1	1	1	1	1	1	2.5	2	1	3
Algebra	3	2	2	3	4.5	2	2.5	4	5		
Trigonometry		4.5	6	6	5.5	4.5			9		
Anal. Geometry		6	5	5	5.5	6			12		
Calculus		7	9	7.5	8.5	9					
Comm./Oral	2	4.5	4	3	4.5	4.5	2.5	1	2	2	1.5
Comm./Written	4	3	3	3	4.5	3	4	2.5	2	3	1.5
Eng./Literature		9	7	10	11	7.5	5.5	5	6.5		5
Social Studies				13	12.5				9		
Science		10	10	10	12.5		5.5		11		
Education		11.5	11	12	8.5				9		
Psychology		11.5	9	10	8.5				4		4
Philosophy/ Logic		8	9	7.5	8.5	7.5			6.5		
Foreign Language(s)											
Art and/or Music											

*Courses with less than five responses were not included in the ranks.

Table 15

Business Courses Preferred by 30 Data Processing Managers
for Employees in Each Job Classification*
(Ranked by Frequency of Mention)

Courses	Comp. Oper.	Prgmr.	Prgmr. Mgr.	Sys. Anal.	Sys. Mgr.	Cooper. Comp. Prgmr. Trainee	Data Processor	D. P. Coordinator	D. P. Mgr.	Key Punch Oper.	Key Punch Supv.
Intro. to Business	1	2.5	3	3	5	1	2	1	2.5	4	1
Bookkeeping/Acc.	2.5	1	1	1.5	2	2	3	2	2.5		5
Business Law				6.5	6				6		
Clerical Practice				6.5	7.5			4	9	1	2
Sec. Practice											
Typewriting										2.5	6
Office Machines	2.5						1	4	8	2.5	3.5
Management		4.5	3	4	1			4	1		3.5
Economics		4.5	5	5	4				5		
Statistics		2.5	3	1.5	3	3			4		
Intro. to Office Occupations	4			8	7.5			6	7		7
Coop. Off. Occ.											
Prep. Off. Occ.											

*Courses with less than five responses were not included in the ranks.

accounting was ranked from one to three for all classifications, with the exception of rank five for key punch supervisor and no rank for key punch operator.

Other post secondary school business courses receiving a rank from one to three for some of the classifications included clerical practice for key punch operator and supervisor; typewriting for key punch operator; office machines for computer operator, data processor, and key punch operator; management for programming manager, systems manager, and data processing manager; statistics for programming and systems positions. Secretarial practice, cooperative and preparatory office occupations did not receive any significant rank. More business courses were ranked for the systems management and supervisory positions than for programming and operating positions.

Data Processing Courses

Introduction to automated data processing and electronic data processing were frequently mentioned and ranked from one to six for all data processing classifications by data processing managers. (Table 16) All data processing courses with the exception of ALGOL and AUTOCODER programming languages were ranked for the programmer classification. COBOL programming language and introduction to electronic data processing and introduction to programming were mentioned frequently by data processing managers for the programmer. All programming languages with the exception of ALGOL and AUTOCODER were mentioned for programmers, programming managers, systems analysts, systems manager, and data processing managers. For the lower level data processing positions--computer operator, key punch operator, data processor,

Table 16

Data Processing Courses Preferred by 30 Data Processing Managers
for Employees in Each Job Classification*
(Ranked by Frequency of Mention)

Courses	Comp. Oper.	Prgmr.	Prgmr. Mgr.	Sys. Anal.	Sys. Mgr.	Cooper. Comp. Prgmr. Trainee	Data Processor	D. P. Coordinator	D. P. Mgr.	Key Punch Oper.	Key Punch Supv.
Intro. to Automated Data Processing	1	4	6	5	4	1	2.5	1.5	2	2	1
Intro. to Electronic Data Processing	2.5	2.5	2	2.5	2	2	2.5	1.5	1	4	2.5
Unit Record Systems	5	17		15		8	1	3.5	6	1	2.5
Data Processing Systems	2.5	7	11.5	8.5	8	4	4	3.5	3.5	3	4
Intro. to Systems Analysis		9	4.5	1	1	5.5		5.5	9.5		
Intro. to Programming	7	1	4.5	2.5	4	3		7	7.5		
Intro. to Digital Computer	6	7	14.5	12.5	12	7			7.5		
Data Processing Applications	8.5	5	7	4	4	11	5.5	5.5	3.5		5
Data Processing Mathematics		11.5	8	8.5	10	11			16		

Table 16 (continued)

Courses	Comp. Oper.	Prgmr.	Prgmr. Mgr.	Sys. Anal.	Sys. Mgr.	Cooper. Comp. Prgmr. Trainee	Data Processor	D. P. Coordinator	D. P. Mgr.	Key Punch Oper.	Key Punch Supv.
Field Work in Data Processing	8.5	14	11.5	6	6	11	5.5		5		
Computer Theory/ Logic		11.5	9	7	8				9.5		
Computer Console Operation	4	11.5	16.5		15.5			8	11.5		
Adv. Programming		7	2	11	8	11			14		
Operations Research		19			14				11.5		
COBOL		2.5	2	10	12	5.5			13		
FORTRAN		15	11.5	12.5	12	11					
PL 1 (Programming Language)		18	16.5								
RPG (Report Program Generator)		11.5	11.5						16		
ALGOL											
AUTOCODER											
Canned Programs (Library)		16	14.5	14	15.5				16		

*Courses with less than five responses were not included in the ranks.

key punch supervisor--the introductory data processing courses, unit record, and data processing systems courses were the courses most frequently preferred by data processing managers. Introduction to systems analysis was most frequently mentioned for systems analysts and systems managers.

PROMOTION PATTERNS

To determine whether certain data processing jobs were dead-end jobs and to discover possible promotional patterns in the data processing field, data processing managers were asked to indicate the probability of promotion for employees from their present data processing job (Table 17) and to name the jobs into which data processing employees in each job category might be promoted. (Table 18) One manager indicated that there were no limits to promotional patterns for data processing employees, if the employees applied themselves and had the ability to perform.

The responses as to the probability of promotions for data processing employees varied, with computer operator, programmer, and key punch operator receiving a large number of responses as having an average probability for promotion. (Table 17) The data processing manager position received the same number of responses for average and low probability of promotion. With the exception of key punch supervisor, all other classifications received high to average probability of promotion. For the systems manager classification the opinions were quite evenly divided.

Key punch operators tend to be promoted to key punch supervisors, with

Table 17

Probability of Promotions for Data Processing Employees in Each Job Classification Reported by 28 Data Processing Managers*

Probability	Job Classification										
	Comp. Oper.	Prgmr.	Prgmr. Mgr.	Sys. Anal.	Sys. Mgr.	Cooper. Comp. Prgmr. Trainee	Data Processor	D. P. Coordinator	D. P. Mgr.	Key Punch Oper.	Key Punch Supv.
High	4	9	4	5	4	7	5	3	5	3	1
Average	19	13	6	7	4	5	9	8	7	13	9
Low	3	1	4	4	4		1	2	1	9	7
Hardly any or none	1	1	2	3	3	1		2	7	2	4

*The number refers to the number of times the job was mentioned by data processing managers.

Table 18

Jobs to Which Data Processing Employees May Be Promoted
Reported by 25 Data Processing Managers*

To	From										
	Comp. Oper.	Prgmr.	Prgmr. Mgr.	Sys. Anal.	Sys. Mgr.	Cooper. Comp. Prgmr. Trainee	Data Processor	D. P. Coordinator	D. P. Mgr.	Key Punch Oper.	Key Punch Supv.
Key Punch Oper.	1						2			1	2
Key Punch Supv.	2						2			14	
Data Typist							2			3	
Coding Clerk							2			2	1
Tape Librarian	2						5			3	2
Unit Record Equipment Oper.							2			2	
Comp. Oper.	1	2				2	10	1		6	3
Comp. Prgmr.	13		1	4		10	5	4	1	2	4
Comp. Prgmr. Mgr.		14		4	4	3	1	1		1	1
Comp. Sys. Anal.	1	12	10			2	2	1		1	1
Comp. Sys. Mgr.	1	5	6	14		2	1	1	1	1	1
Data Processor	1	1								2	1
D. P. Coordinator	3			2	1		1		1	1	5
D. P. Manager	4	5	4	4	7	1	2	6		2	2

*The number refers to the number of times the job was mentioned by data processing managers.

about half as many responses indicating that they might become computer operators. (Table 18) Computer operators and cooperative programmer trainees tend to be promoted to computer programmers. On the other hand, computer programmers tend to be promoted to computer programming managers and computer systems analyst. Programming managers are usually promoted to computer systems analysts, with systems analysts being promoted to systems managers. In some instances there is the probability that systems managers will be promoted to data processing managers. Promotion for data processing managers tends to be transfer to another department, division, or company.

Data processing managers were asked to indicate the probable effect of education on the promotion of data processing employees. (Table 19) The managers (44.4 percent) indicated that education would have some effect on the key punch operator's probability for promotion, with 18.5 percent of the managers indicating that education would have little or no effect on promotion. For the position of programmer, 44.0 percent of the data processing managers indicated that education would definitely affect the probability of promotion. For systems analysts, 52.6 of the managers reported that education would definitely affect the probability of promotion, with 43.5 percent of the managers reporting that the probability of promotion for data processing manager would also be definitely affected by education. Managers (34.6 percent) reported that the computer operator's probability for promotion was affected either some or definitely by education. For the programming manager position, 38.9 percent of the managers reported that education would either have some effect or would definitely affect

Table 19

Effect of Level of Education on Promotion of Data Processing Employees by Job Classification Reported by 27 Data Processing Managers*

Effect	Comp. Oper. N	Comp. Oper. %	Prgmr. N	Prgmr. %	Prgmr. Mgr. N	Prgmr. Mgr. %	Sys. Anal. N	Sys. Anal. %	Sys. Mgr. N	Sys. Mgr. %	Cooper. Comp. Prgmr. Trainee N	Cooper. Comp. Prgmr. Trainee %	Data Pro-cessor N	Data Pro-cessor %	D. P. Coor-di-nator N	D. P. Coor-di-nator %	D. P. Mgr. N	D. P. Mgr. %	Key Punch Oper. N	Key Punch Oper. %	Key Punch Supv. N	Key Punch Supv. %
Definitely	9	34.6	11	44.0	7	38.9	10	52.6	8	47.1	5	35.7	6	37.5	8	44.4	10	43.5	7	25.9	6	26.1
Quite a bit	6	23.1	4	16.0	3	16.7	2	10.5	2	11.8	1	7.1	3	18.8	5	27.8	4	17.4	3	11.1	3	13.0
Some	9	34.6	7	28.0	7	38.9	6	31.6	6	35.3	6	42.9	6	37.5	4	22.2	7	30.4	12	44.4	10	43.5
None or Little	2	7.7	3	12.0	1	5.6	1	5.3	1	5.9	2	14.3	1	6.3	1	5.6	2	8.7	5	18.5	4	17.4
Total	26		25		18		19		17		14		16		18		23		27		23	

*The number refers to the number of times the job was mentioned by data processing managers.

the probability for promotion. Managers (47.1 percent) indicated that education would definitely affect promotion probability for the systems manager. The probability for promotion in the cooperative computer programmer trainee position was reported by 42.9 percent of the managers as being affected some by education. Managers (37.5 percent) reported that the data processor's probability for promotion was affected either some or definitely by education. For the data processor coordinator, managers (44.4 percent) indicated that education would have a definite affect on promotion. The probability for promotion in the key punch supervisor's position was reported by 43.5 percent of the managers as being affected some by education.

FUTURE CHANGES IN DATA PROCESSING

In order to obtain the opinions of data processing managers about the future of the data processing field, and its effect on the education of future employees, data processing managers were asked about the predictions for their installations in the next three to five years. The questionnaire was designed to discover the plans for technological changes in hardware, software, input, output, and personnel that might have an effect on the education offered to future data processing employees.

Only 9.7 percent or eight of the data processing managers indicated that their firms were not planning to make any major changes in their data processing system in the next three to five years. Twenty-eight managers (90.3 percent) indicated that changes would be made. Data processing managers reported that the primary changes would probably be in the areas of hardware and software. (Table 20) Managers indicated that all data processing jobs would require additional data processing education to meet future changes; special attention was given to the need for additional education for computer operator and computer programmer. (Table 21)

Managers (65.5 percent) indicated that the data processing personnel now employed would have to be retrained to meet future changes. Other managers (34.5 percent) indicated that retraining would not be necessary. Data processing managers (72.4 percent) reported that from their experiences, the present educational institutions would not be able to meet the future educational requirements needed to train or retrain data processing employees. Only 27.6 percent of the managers indicated that the educational institutions could educate employees for future changes. As shown in Table 22, 55.9 percent of the managers reported that data processing employees would be educated within the company to meet any future data processing changes, with 38.2 percent indicating that education would occur with manufacturers of data processing equipment. The other responses (5.9 percent) referred to special education programs.

In this chapter, analysis was made of the responses to the questionnaire from the businesses and industries with computer installations; and this information was organized around five major areas: (1) General information concerning the specific business or industry and its computer installation. (2) Test selection procedures used in computer installations. (3) Characteristics of data processing employees employed in computer installations including experience,

Table 20

Proposed Data Processing Changes Reported by 27 Data Processing Managers in Businesses and Industries in the Next Three to Five Years

Change	Number of Businesses and Industries	
	N	%
Hardware	27	29.0
Software	20	21.5
Input	18	19.4
Output	11	11.8
Personnel	15	16.1
Other	2	2.2
Total	93	100.0

Table 21

Job Classifications Reported by 22 Data Processing Managers as Requiring Additional Data Processing Education to Meet Future Changes

Job Classification	Number of Data Processing Managers Reporting	
	N	%
Computer Operator	19	18.1
Computer Programmer	22	21.0
Computer Programmer Manager	7	6.7
Computer Systems Analyst	13	12.4
Computer Systems Manager	7	6.7
Cooperative Computer Program Trainee	3	2.9
Data Processor	3	2.9
Data Processor Coordinator	5	4.8
Data Processing Manager	11	10.5
Key Punch Operator	7	6.7
Key Punch Supervisor	6	5.7
Other	2	1.9
Total	105	

Table 22

Educational Centers Reported by 19 Data Processing Managers Equipped to Educate Data Processing Employees to Meet Future Changes*

Educational Center	Manager Responses	
	N	%
Within Company	19	55.9
Manufacturer	13	38.2
Other	2	5.9
Total	34	100.0

*Some data processing managers gave more than one response.

education skills, and courses of study. (4) Promotional patterns in computer installations. (5) Future changes in computer installations.

CHAPTER V

ANALYSIS OF THE CURRENT DATA PROCESSING INSTRUCTIONAL PROGRAMS

Description of the Sample

Of the fifty-six community colleges and technical institutes in North Carolina, twenty-one reported having a two-year data processing degree program; one community college is experimenting with a degree program during the academic year 1972-73; twenty-three offer an introductory course in data processing; five offer several data processing courses but have no degree program; and six schools have no data processing program or data processing course(s). (See the Appendix for a listing of the community colleges and technical institutes in North Carolina and a listing of the schools included in this survey. Appendix C-2 and Appendix C-3).

Information pertaining to the status of data processing instruction in the community colleges and technical institutes of North Carolina was gathered through interviews with heads of the data processing instructional departments in nine community colleges and twelve technical institutes. Questionnaires were completed for each school concerning the development of its program, the students enrolled, the data processing teachers, the status of the curriculum, and the skills and knowledges included in each data processing course.

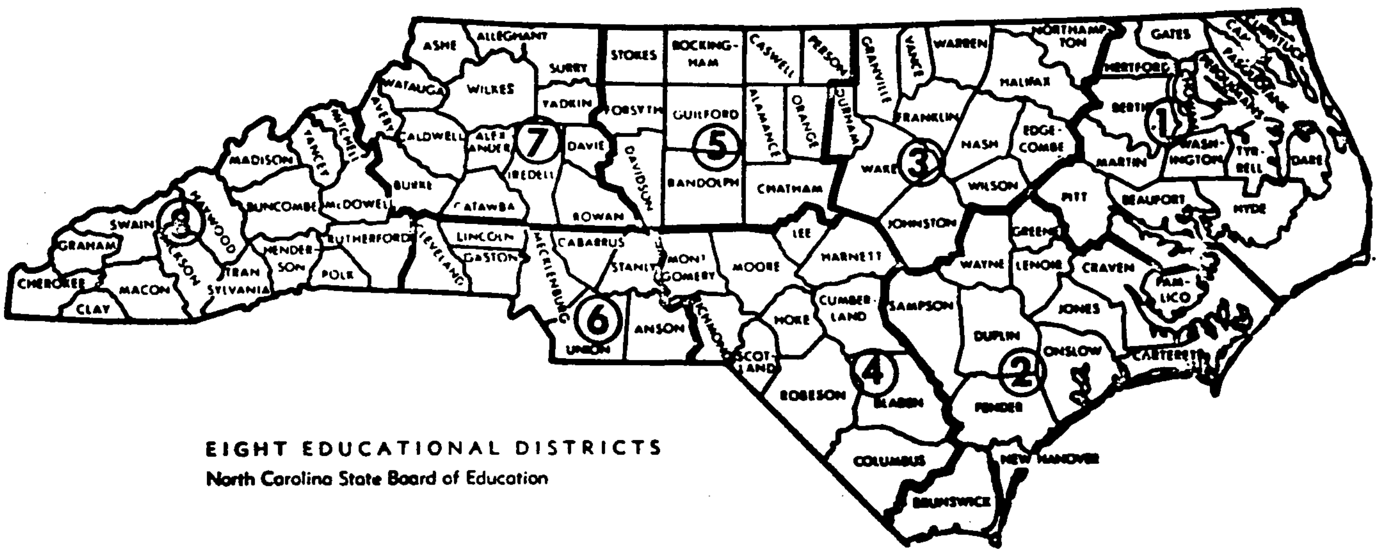
Only three of the schools had initiated data processing programs before the passage of the Vocational Education Act of 1963, with 80.9 percent of the institutions starting programs after 1965. Federal funds were made available in 1964 for the purpose of purchasing equipment and supplies for data processing instructional programs. The slow start in data processing in North Carolina was due to lack of funds to support the program and/or lack of interest by business and industry for trained data processing personnel from community colleges and technical institutes. During this period, a large proportion of companies preferred to promote and train employees within the company.

Location of Programs

The community colleges and technical institutes offering data processing programs are distributed throughout the state, with a heavy concentration of the schools in the Piedmont section--Regions 5 and 6. (Refer to Figure 1 and Table 23.) Regions 5 and 6 also contain a heavy concentration of the businesses and industries utilizing computers. If there is a need for data processing in an area, the community, with the assistance of educators and businessmen, will plan and initiate a program to fulfill this need.

Enrollment in Business and Data Processing Courses

Of the community colleges in North Carolina, Region 6 has the largest enrollment in business courses. (Table 24) A large concentration of the population in North Carolina and of business and industry in North Carolina is located in the Central Piedmont region and probably accounts for the large enrollment in



EIGHT EDUCATIONAL DISTRICTS
North Carolina State Board of Education

Table 23

Regional Distribution of the 21 Data Processing Instructional Programs in the Community Colleges and Technical Institutes

Region	Number of Data Processing Instructional Programs	
	Community Colleges	Technical Institutes
1		1
2	3	
3		3
4	1	2
5	1	3
6	2	
7	2	2
8		1
Total	9	12

Table 24

Regional Distribution of the Students Enrolled in Business Course(s) in Programs Offered by the 21 Community Colleges and Technical Institutes*

Region	Number of Students Enrolled in Programs					
	Two-Year		Part-Time		Elective for Other	
	CC	TI	CC	TI	CC	TI
1		209				
2	628		419		125	
3		620		91		80
4	139	384	40	291	75	45
5	170	821	25	600	15	143
6	1,864				75	
7	339	600	60	150	30	40
8		78		145		44
Total	3,140	2,712	544	1,277	320	352

*Figures are based on enrollment for Spring quarter, 1972.

this area in business courses. The community colleges in Region 2 cater to more business students in part-time programs than do the other regions. The technical institutes in Region 5 or the Piedmont section cater to more business students in the two-year program, with Regions 3 and 4 having the next largest enrollments.

Region 6 (Table 25) again leads the community colleges in total enrollment in data processing course(s) for the two-year program, with Region 5 having the largest enrollment for the technical institutes. The community colleges in Region 2 and the technical institutes in Region 7 have the next largest enrollments. Regions 3, 5, and 6 tend to have the largest enrollment of students taking data processing course(s) as electives.

These enrollment figures are not surprising, considering the regions of the state in which the schools are located. As was stated previously for the business courses, Region 6 has a large concentration of North Carolina's population and business and industry. Therefore, one of the largest and more important regions of the state should be part of the Computer Revolution occurring in the nation, thus creating the need for data processing personnel and the need for institutions to educate these personnel. In the eastern part of the state, the demand for data processing personnel has increased due to the installation of computers and use of computer services in banks. The various types of business and industry, home offices for insurance companies and banks in the Piedmont region have increased the demand for data processing personnel.

Table 25

Regional Distribution of the Students Enrolled in Data Processing Course(s) in Programs Offered by the 21 Community Colleges and Technical Institutes*

Region	Number of Students Enrolled in Programs					
	Two-Year		Part-Time		Elective for Other	
	CC	TI	CC	TI	CC	TI
1		63		23		37
2	88		68		93	
3		103		12		410
4	14	50		30	120	275
5	25	142	15	54	70	373
6	349		7		709	
7	58	120	26	75	32	182
8		58		8		30
Total	534	536	116	202	1,024	1,307

*Figures are based on enrollment for Spring quarter, 1972.

Graduates in Data Processing

Region 7 was first in number of 1970-71 graduates in data processing, with Region 6 being second, and Region 5, third. (Table 26) All the regions with the exception of Regions 2, 6, and 8, showed an increase in data processing graduates from 1970-71 to 1971-72. Overall, the graduates from the community colleges decreased from sixty-five to fifty-two in 1970-71 to 1971-72, while graduates from the technical institutes increased by fifty students.

DATA PROCESSING CURRICULUM

Initiating the Programs

When asked how data processing was first included in their school, 76.2 percent (sixteen) of the data processing department heads indicated that data processing instruction was initiated as a fully organized two-year program. (Table 27) All twenty-one schools, with the exception of one technical institute, indicated that the primary objective for offering an instructional program in data processing was to prepare students for gainful employment as computer programmers in computer installations. The one technical institute with a different objective indicated that data processing instruction was offered to provide students with general data processing knowledge.

Changes in Curriculum

Department heads in the community colleges and technical institutes indicated that necessary changes in the data processing curriculum were determined mainly by the college advisory committee and by teachers, with fourteen

Table 26

Regional Distribution of Graduates Reported by the 21 Community Colleges and Technical Institutes from Two-Year Data Processing Programs for the Years 1970-71 and 1971-72

Region	Number of Graduates by Years					
	1970-71		Total	1971-72		Total
	CC	TI		CC	TI	
1		15	15		22	22
2	14		14	11		11
3		28	28		40	40
4		15	15	2	15	17
5	6	14	20	6	43	49
6	30		30	20		20
7	15	42	57	13	49	62
8		24	24		19	19
Total	65	138	203	52	188	240

Table 27

Ways Data Processing Instruction Was Introduced into Curriculum Reported by 21 Community Colleges and Technical Institutes

Ways	Community Colleges		Technical Institutes		Total	
	N	%	N	%	N	%
Integrated with Other Courses			* 2	12.5	2	12.5
Introductory	2	22.2	* 2	12.5	4	16.7
Organized Program	7	77.8	9	75.0	16	76.2
Total	9		12		21	

*One technical institute made two responses.

of the twenty-one schools responding this way. (Table 28) Five of the technical institutes indicated that needed changes were determined by a curriculum study committee, and five indicated that a follow-up of data processing graduates was the basis for making curriculum changes. Other determinants for curriculum changes were initiated by the Department of Community Colleges, board of trustees, college administration, manufacturers, visits in other schools, and suggestions from business and industry.

Table 28

Bases for Making Curriculum Changes in Data Processing Programs Reported by 21 Community Colleges and Technical Institutes*

Bases for Change	Community Colleges		Technical Institutes		Total	
	N	%	N	%	N	%
State Board of Education						
Department of Community Colleges			1	2.5	1	1.7
Board of Trustees			2	5.0	2	3.4
College Advisory Committee	5	26.3	9	22.5	14	23.7
College Administration	2	10.5	4	10.0	6	10.2
Teacher(s)	5	26.3	9	22.5	14	23.7
Student(s)	2	10.5	2	5.0	4	6.8
Curriculum Study Committee	1	5.3	5	12.5	6	10.2
Follow-up Study of Graduates	2	10.5	5	12.5	7	11.9
Research						
Journals						
Manufacturers			1	2.5	1	1.7
Other	2	10.5	2	5.0	4	6.8
Total	19		40		59	

*Respondents could check more than one change.

Advisory Committees

Six community colleges and eleven technical institutes maintained a data processing advisory committee, with one school having an institutional committee and two schools maintaining business advisory committees (Table 29). The three schools with no data processing committee do not anticipate the use of such a committee. One technical institute uses an ad hoc advisory committee and does not plan to add a data processing committee.

The majority of the community colleges and technical institutes (34.1 percent) use the assistance of the data processing advisory committee for curriculum suggestions. (Table 30) Twenty-eight percent of the technical institutes reported that their data processing advisory committees evaluate the curriculum periodically and 24.0 percent indicated that they recommend new courses to offer in data processing. Approximately 19 percent of the community colleges reported that their data processing committees assist in evaluating the data processing curriculum or recommend new courses. Other assistance provided by the data processing committees included assistance in placing students, purchasing equipment, providing internship programs, and helping with curriculum objectives.

ADULT EVENING CLASSES IN DATA PROCESSING

Seven of the community colleges and seven of the technical institutes offer adult evening classes in data processing. Two community colleges and four technical institutes offer no evening classes in data processing. One

Table 29

Type of Advisory Committee Reported by 21 Community Colleges and Technical Institutes

Type of Advisory Committee	Community Colleges		Technical Institutes		Total	
	N	%	N	%	N	%
Institutional	1	11.1	1	8.3	2	9.5
Business	2	22.2			2	9.5
Data Processing	6	66.7	11	91.7	17	81.0
Total	9	100.0	12	100.0	21	100.0

Table 30

Assistance in Data Processing Programs Provided by Advisory Committee Reported by 21 Community Colleges and Technical Institutes*

Means of Assistance	Community Colleges		Technical Institutes		Total	
	N	%	N	%	N	%
Offers Curriculum Suggestions	6	37.5	8	32.0	14	34.1
Evaluates Curriculum Periodically	3	18.8	7	28.0	10	24.4
Designs New Courses in Data Processing	1	6.3			1	2.4
Recommends New Courses in Data Processing	3	18.8	6	24.0	9	22.0
Other	3	18.8	4	16.0	7	17.1
Total	16		25		41	

*Columns add to more than N since the schools may have listed more than one problem.

technical institute offers adult evening classes in data processing only when asked by the community, but not on a regular basis.

Among the schools offering adult evening programs in data processing, approximately half of the community colleges (50.0 percent) indicated that they offer the same program in both the evening and day classes. (Table 31) Only two technical institutes (10.0 percent) indicated that they offer the same program in both the evening and day classes. Fifteen percent of the technical institutes reported that less advanced work and a slower pace of work was presented to their adult evening classes. In other areas of differences between adult evening and regular programs, no consistent pattern was found. Other differences reported by the technical institutes between the adult evening classes and the regular classes included less hands-on-experience, fewer courses available, and a different approach and emphasis for the adult evening classes.

Four of the department heads from the community colleges and four from the technical institutes indicated that adult students enroll primarily for retraining purposes, that is, for the purpose of moving from their present job into a data processing job. (Table 32) Five of the technical institutes reported that adults were interested in upgrading their knowledges and skills, that is, for the purpose of moving from one data processing job to another. Other reasons given by both community colleges and technical institutes included general knowledge or interest in data processing.

The reasons for adult students enrolling in evening classes did not vary in the community colleges and technical institutes in terms of retraining, while

Table 31

Differences Between Adult Evening School and Regular Data Processing Programs Reported by 14 Community Colleges and Technical Institutes*

Differences in Programs	Community Colleges		Technical Institutes		Total	
	N	%	N	%	N	%
More Advanced Work to Adults			1	5.0	1	3.6
Less Advanced Work to Adults	1	12.5	3	15.0	4	14.3
Work Presented at a More Rapid Pace						
Work Presented as a Slower Pace			3	15.0	3	10.7
More Courses Available						
Fewer Courses Available			2	10.0	2	7.1
More Hands-on Experience	1	12.5			1	3.6
Less Hands-on Experience			2	10.0	2	7.1
Work Presented in Larger Blocks of Time and Less Often			1	5.0	1	3.6
Different Approach and Emphasis			2	10.0	2	7.1
Same Program	4	50.0	2	10.0	6	21.4
Other	2	25.0	4	20.0	6	21.4
	8	100.0	20	100.0	28	

*Respondents could make more than one response to this question.

Table 32

Reasons Given by 14 Data Processing Department Heads for Adult Evening Students' Enrolling in Data Processing Courses in Community Colleges and Technical Institutes*

Reasons	Community Colleges		Technical Institutes		Total	
	N	%	N	%	N	%
Retraining: Moving from Present Job into a Data Processing Job	4	26.7	4	26.7	8	26.7
Upgrading: Moving from One Data Processing Job to Another	1	6.7	5	33.3	6	20.0
Pre-Employment Training	4	26.7	1	6.7	5	16.7
Updating for Managers and Accountants	1	6.7			1	3.3
Other	5	33.3	5	33.3	10	33.3
Total	15		15		30	

*Respondents may have given more than one reason.

upgrading was considered more important in the technical institutes and pre-employment training was indicated the same number of times as retraining in the community colleges.

All the schools offering data processing evening classes for adults reported that their data processing courses were designed for the specific needs of their students.

DATA PROCESSING STUDENTS

The classification of students enrolled in data processing programs in the community colleges and technical institutes in North Carolina is shown in Table 33. The majority of the students in both schools are post-high school day students. In both community colleges and technical institutes, adult evening classes appear to be relatively popular, in that fourteen of the twenty-one schools reported offering adult evening courses in data processing and enrolling adult students. Only one technical institute offered data processing courses for the Manpower Development Training Act (MDTA) program, and two community colleges offered special courses in data processing for high school students on a part-time basis. Some of the schools offered data processing courses to teachers for in-service training programs and special courses for business employees.

The open door policy of the Community College System does not permit the schools in the system to use rigid selection procedures for students. If consultation with the student indicates that he will probably not succeed in the data processing program, he is advised to enter another program(s). If the student insists on staying in the data processing program, he is given the opportunity to apply himself to the introductory course(s). Three community colleges and eight technical institutes reported that they used selection procedures for prospective data processing students.

The most popular method for selecting students was on the basis of test scores. Three community colleges and eight technical institutes reported that they used test scores. (Table 34) Two community colleges and six technical institutes used the tests by setting established cut-off scores; whereas, one technical institute used an over-all pattern of test scores and one used established norms. (Table 35)

The test used by the majority of the technical institutes, five out of twelve, was the International Business Machine Programmers Aptitude Test. (Table 36) Only one community college used this programming test. Mathematics aptitude and achievement tests were used by six out of the twelve technical institutes. Only two community colleges used this type of test. Reading was used by two community colleges and one technical institute to select students for the data processing program.

Some of the schools indicated that certain courses were prerequisite for entry into the study of data processing. (Table 37) One-half of the community colleges and one-half of the technical institutes reported that mathematics was a prerequisite for entry into the data processing program. Other prerequisites included English and science in two of the community colleges and English in two of the technical institutes. Typewriting and bookkeeping/

Table 33

Classification of Students Enrolled in Data Processing Programs Reported by the 21 Community Colleges and Technical Institutes

Classification of Students	Community Colleges		Technical Institutes		Total	
	N	%	N	%	N	%
High School Part-Time	2	10.5			2	4.8
Post-High School Day	9	47.4	12	52.2	21	50.0
Adult Evening	7	36.8	7	30.4	14	33.3
MDTA			1	4.3	1	2.4
Other	1	5.3	3	13.0	4	9.5
Total	19	100.0	23	100.0	42	100.0

Table 34

Criteria for Selecting Students for Data Processing Programs Reported by Department Heads in 11 Community Colleges and Technical Institutes*

Criteria for Selection	Community Colleges		Technical Institutes		Total	
	N	%	N	%	N	%
Test Scores	3	30.0	8	47.1	11	40.7
GPA--General			1	5.9	1	3.7
GPA--Specific Courses	1	10.0	1	5.9	2	7.4
Certain Characteristics			2	11.8	2	7.4
No Selection Is Done	6	60.0	4	23.5	10	37.0
Other			1	5.9	1	3.7
Total	10		17		27	

*Totals are greater than number of schools because some schools used more than one criterion in the student selection procedure.

Table 35

Use of Tests in Selecting Data Processing Students Reported by Department Heads in 11 Community Colleges and Technical Institutes

Use of Tests	Community Colleges		Technical Institutes		Total	
	N	%	N	%	N	%
Established Cut-Off Scores	2	50.0	6	60.0	8	57.1
Over-All Pattern of Test Scores			1	10.0	1	7.1
Established Norms			1	10.0	1	7.1
Other	2	50.0	2	20.0	4	28.6
Total	4	100.0	10	100.0	14	

Table 36

Kinds of Tests Used in Selecting Data Processing Students Reported by Department Heads in 11 Community Colleges and Technical Institutes*

Tests	Community Colleges		Technical Institutes		Total	
	N	%	N	%	N	%
Mathematics Aptitude	1	12.5	3	13.0	4	12.9
Mathematics Achievement	1	12.5	3	13.0	4	12.9
Logic			2	8.7	2	6.5
Scholastic Aptitude Quantitative			2	8.7	2	6.5
Scholastic Aptitude Language			2	8.7	2	6.5
Reading	2	25.0	1	4.3	3	9.7
IBM Programmers	1	12.5	5	21.7	6	19.4
Other Programmers						
Other	3	37.5	5	21.7	8	25.8
Total	8		23		31	

*Totals are greater (or smaller) than the number of schools because some schools used several tests or used no tests in the selection procedure.

Table 37

Prerequisites for Entry into Data Processing Courses Reported by Department Heads in 21 Community Colleges and Technical Institutes

Prerequisite	Community Colleges		Technical Institutes		Total	
	N	%	N	%	N	%
Mathematics	4	50.0	6	66.7	10	58.8
Science	2	25.0			2	11.8
Typewriting						
Bookkeeping/ Accounting						
English	2	25.0	2	22.2	4	23.5
Office Procedures						
Introduction to Business						
Other			1	11.1	1	5.9
Total	8	100.0	9	100.0	17	100.0

accounting were not considered prerequisites.

COUNSELING AND PLACEMENT OF STUDENTS

All schools indicated that the primary interest of students after completion of the two-year data processing program was to seek gainful employment in a data processing job, specifically programming. Only three of the nine community colleges and three of the twelve technical institutes reported that their graduates attended a four-year institution. (Table 38)

Seven of the nine community colleges with data processing programs have placement offices and eight of the twelve technical institutes have placement offices. All the schools have counseling centers for students in all programs offered in the individual schools.

The placement offices and counseling centers work in a variety of ways to assist data processing students and graduates. However, the majority of the data processing department heads reported that they worked more closely with business and industry in placing students in data processing jobs than did the placement or counseling centers. In ten of the schools, the placement offices were reported as working with local businesses and industries in locating data processing jobs and scheduling interviews for students. (Table 39)

The counseling services reported by the schools were primarily in relation to informing students of opportunities in data processing. (Table 40) Other services described by data processing department heads included administration of financial aid programs, recruiting and testing students, advising students in

Table 38

Areas of Student Interest After Completing Data Processing Program Reported by Department Heads in 21 Community Colleges and Technical Institutes*

Area	Community Colleges	Technical Institutes
	N	N
Seek Gainful Employment	9	12
Attend Four-Year Institution	3	3
Attend Manufacturer's School	1	
Train Further in Specific Data Processing Area	1	
Do Not Know What Students Do After Leaving School		
Other		1

*Respondents could indicate more than one area of interest.

Table 39

Services Provided by Placement Office Reported by 15 Department Heads in Community Colleges and Technical Institutes *

Services	Community Colleges	Technical Institutes	Total
School Works with Local Businesses and Industries	4	6	10
School Works with Public Employment Agencies	1	3	4
School Works with Private Employment Agencies	-	1	1
School Schedules Interviews for Students	4	6	10
Other	4	6	10
Total	13	22	35

*Respondents could make more than one response to this question.

Table 40

Services Provided by Counseling Centers Reported by 21 Department Heads in Community Colleges and Technical Institutes *

Services	Community Colleges	Technical Institutes	Total
Provides Library of DP Materials, Pamphlets, etc.		1	1
Informs Students of Opportunities in Data Processing	3	5	8
Works Closely with Data Processing Instructors	3	2	5
Other	6	8	14
Total	12	16	28

*Respondents could make more than one response to this question.

all programs, and assisting students with personal problems.

Most of the jobs in which students are employed are in local businesses or industries, with sixteen of the twenty-one schools, indicating local employment for data processing graduates. (Table 41) Three of the technical institutes reported that their students entered state employment, while one community college and one technical institute indicated that their students found employment in nearby large cities, and one community college reported that one of its students entered national employment.

Twenty-five percent of the technical institutes and 22.2 percent of the community colleges indicated that there were no particular problems in placing students after graduation. (Table 42) Both the community colleges and technical institutes (22.2 percent) reported that business and industry were reluctant to hire females. Three schools indicated that business and industry often hire students before their course work is completed. Miscellaneous problems included inexperienced students, immobility of students, shift in the job market, and reluctance to hire community college and technical institute graduates.

DATA PROCESSING CURRICULUM AND PROGRAMS

Changes in Curricula and Programs

Only two of the community colleges and two of the technical institutes reported that their data processing curricula and programs were not adequate. The schools reporting inadequate curricula and programs responded in various ways as to changes that should be made in their curricula and programs. One

Table 41

Location of Jobs in Which Students Are Placed Reported by 21 Department Heads in Community Colleges and Technical Institutes

Location	Community Colleges	Technical Institutes	Total
National Employment	1		1
State Employment		3	3
Local Employment	7	9	16
Employment in Nearby Large Cities	1	1	2
Total	9	13*	22

*One technical institute made more than one response.

Table 42

Problems in Placing Data Processing Students Reported by 21 Department Heads in Community College and Technical Institutes*

Problems	Community Colleges		Technical Institutes		Total	
	N	%	N	%	N	%
No Particular Problems	2	22.2	3	25.0	5	23.8
Students Hired Before Courses Completed	1	11.1	2	22.2	3	14.3
Business and Industry Reluctant to Hire Females	2	22.2	2	22.2	4	19.0
Business and Industry Require More Education than Provided by School			1	11.1	1	4.8
Other	6	66.7	8	66.7	14	66.7

*Respondents indicated more than one problem.

community college suggested additional courses, particularly in the area of more advanced courses in programming. One technical institute indicated revision of courses, which would also require the addition of computer hardware. Another community college reported that revision of the data processing curricula was necessary. One technical institute reported the need for a curriculum advisory committee, the upgrading of courses, and the need for a change in course content to meet the needs of the community.

Data Processing Education Integrated with Business Courses

Two-thirds (six) of the community colleges and slightly more than one-half (seven) of the technical institutes reported that their data processing education program was integrated with business course(s). The business course mentioned most frequently in which data processing education was integrated was bookkeeping/accounting. (Table 43) Management and statistics were equally reported by technical institutes as being integrated with data processing education. Introduction to business, office machines, and economics were also mentioned. Business law, clerical and secretarial practice, typewriting, introduction to office occupations, and cooperative and preparatory office occupations were not integrated with data processsing course(s) in any of the schools.

General Education Course Requirements

Data processing department heads in the community colleges and technical institutes were asked to identify the general education courses required of students in their data processing programs. Three of the courses that were

Table 43

Business Courses Integrated with Data Processing Education
Reported by 13 Department Heads in Community
Colleges and Technical Institutes

Business Course	Community Colleges	Technical Institutes
Introduction to Business	2	2
Bookkeeping/Accounting	6	5
Office Machines	1	1
Management	2	4
Economics	1	2
Statistics	1	4

required in eight of the nine community colleges are identified in Table 44. Algebra and oral and written communication were required by 88.9 percent of the community colleges, and social studies and trigonometry required in 44.4 percent of the community colleges. In the technical institutes, written communication was required in all twelve; and oral communication was required in eleven (91.7 percent) of the technical institutes. Social studies, psychology, and general mathematics were required in several of the technical institutes. Courses mentioned by the schools but not listed on the questionnaire included various mathematics courses, technical report writing, and reading comprehension.

Table 44

General Education Course Requirements for Data Processing Program Reported by 21 Department Heads in Community Colleges and Technical Institutes

Courses	Community Colleges (N=9)		Technical Institutes (N=12)		Total (N=21)	
	N	%	N	%	N	%
General Mathematics	2	22.2	5	41.7	7	33.3
Algebra	8	88.9	4	33.3	12	57.1
Trigonometry	4	44.4	2	16.7	6	28.6
Analytic Geometry	1	11.1	1	8.3	2	9.5
Calculus	2	22.2			2	9.5
Communications/Oral	8	88.9	11	91.7	19	90.5
Communications/Written	8	88.9	12	100.0	20	95.2
English/Literature	3	33.3	6	50.0	9	42.9
Social Studies (History, Gov't.)	4	44.4	8	66.7	12	57.1
Science Education	1	11.1			1	4.8
Psychology	3	33.3	6	50.0	9	42.9
Philosophy/Logic						
Foreign Language(s)						
Art and/or Music			1	8.3	1	4.8
Other	4	44.4	3	25.0	7	33.3

Business Course Requirements

The business courses required in the data processing programs in the community colleges and technical institutes are shown in Table 45. Bookkeeping/accounting was required in all twenty-one community colleges and technical institutes. Management was required in 66.7 percent of the community colleges, and statistics in 77.8 percent of the community colleges. Economics was required in 75.0 percent of the technical institutes, with business law, management, and statistics being required in 66.7 percent of the technical institutes. Other courses required but not listed on the questionnaire included business mathematics, business communications, and principles of supervision. Taxes, money and banking, insurance, marketing, finance, and sales development were other courses that were mentioned by department heads as being requirements for data processing programs. Clerical practice, secretarial practice, introduction to office occupations, and cooperative and preparatory office occupations were not required in any of the data processing programs.

COURSES AND COURSE CONTENT

Procedure for Analyzing Data

Data processing department heads were asked to list the courses presently being offered in their data processing programs, plus any additional courses that were in the planning stage. With the exception of one school offering a one-year data processing program and a few schools offering data processing courses upon request through extension, all the data processing programs were

Table 45

Business Course Requirements for Data Processing Program Reported by 21 Department Heads in Community Colleges and Technical Institutes

Business Course	Community Colleges (N=9)		Technical Institutes (N=12)		Total (N=21)	
	N	%	N	%	N	%
Introduction to Business	4	44.4	6	50.0	10	47.6
Bookkeeping/ Accounting	9	100.0	12	100.0	21	100.0
Business Law	4	44.4	8	66.7	12	57.1
Clerical Practice						
Secretarial Practice						
Typewriting	1	11.1	1	8.3	2	9.5
Office Machines	4	44.4	5	41.7	9	42.9
Management	6	66.7	8	66.7	14	66.7
Economics	3	33.3	9	75.0	12	57.1
Statistics	7	77.8	8	66.7	15	71.4
Introduction to Office Occupations						
Cooperative Office Occupations						
Preparatory Office Occupations						
Other	3	33.3	8	66.7	11	52.4

two-year programs.

This study asked for course titles of each school's courses presently being offered in the data processing program. Analysis of the data required a grouping of the North Carolina data processing courses under selected data processing course titles based on the Bangs-Hillestad study. Courses were grouped according to content, concepts discussed, and skills developed in each course. Since the data processing department heads indicated that the primary objective of their data processing programs was to train programmers for gainful employment, analysis of the data was divided into a discussion of programming language courses and data processing courses being offered in the schools. The programming language courses were grouped under the particular language covered in the course, i.e., Assembly, COBOL, FORTRAN, etc. The individual course titles listed by the department heads in each school were grouped under the headings selected for this study and listed in Appendix F, Table 60.

Primary Objectives of Data Processing Courses

Programming language courses. The primary objective of each data processing course(s) is shown in Table 46. Relatively, all the community college and technical institute data processing department heads reported that the emphasis in programming language courses was on the development of production skills and understanding. Hands-on-experience was also mentioned frequently by the department heads as being emphasized in programming courses.

Data processing courses. Approximately 88 percent of the community

Table 46

Data Processing Courses Offered Indicating the Primary Objective(s) of Each Course Reported by Department Heads in Community Colleges and Technical Institutes*

Data Processing Courses	Total Schools Offering			Primary Course Objectives																							
				Cognitive Understanding						Acquaintanceship Skills						Hands-On Experience						Production Skills and Understanding					
	CC	TI	Total	CC		TI		Total		CC		TI		Total		CC		TI		Total		CC		TI		Total	
				N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Programming Languages																											
Assembly	9	11	20	3	33.3	1	9.1	4	20.0	3	33.3	5	45.5	8	40.0	4	44.4	9	81.8	13	65.0	7	77.8	5	45.5	12	60.0
COBOL	8	11	19	1	12.5	2	18.2	3	15.8	3	37.5	4	36.4	7	36.8	5	62.5	6	54.5	11	57.9	7	87.5	10	90.9	17	89.5
FORTRAN	7	9	16	2	28.6	1	11.1	3	18.8	1	14.3	5	55.6	6	37.5	4	57.1	7	77.8	11	68.8	4	57.1	6	66.7	10	62.5
PL-1	4	6	10	2	50.0	1	16.6	3	30.0	2	50.0	3	50.0	5	50.0			6	100.0	6	60.0	3	75.0	2	33.3	5	50.0
RPG	5	6	11	1	20.0	1	16.6	2	18.2			1	16.7	1	9.1	1	20.0	5	83.3	6	54.5	5	100.0	3	50.0	8	72.7
Canned Programs	4	2	6	1	25.0			1	16.7	1	25.0	2	100.0	3	50.0	2	50.0	1	50.0	3	50.0	3	75.0			3	50.0
Combination	2	1	3	1	50.0			1	33.3	1	50.0			1	33.3	2	100.0	1	100.0	3	100.0	2	100.0			2	66.7
Other		2	2			1	50.0	1	50.0			2	100.0	2	100.0			2	100.0	2	100.0			1	50.0	1	50.0
Unit Record Systems and Equipment	4	4	8	1	25.0	1	25.0	2	25.0	1	25.0	2	50.0	3	37.5	4	100.0	3	75.0	7	87.5	2	50.0	1	25.0	3	37.5
Introduction to Data Processing	7	4	11	7	100.0	2	50.0	9	81.8			2	50.0	2	18.2	3	42.9	2	50.0	5	45.5	1	14.3	1	25.0	2	18.2
Introduction to Digital Computer	6	9	15	5	83.3	6	66.7	11	73.3	1	16.7			1	6.7	1	16.7	1	11.1	2	13.3						

Table 46 (continued)

Data Processing Courses	Total Schools Offering			Primary Course Objectives																																	
				Cognitive Understanding						Acquaintanceship Skills						Hands-On Experience						Production Skills and Understanding															
	CC	TI	Total	CC		TI		Total		CC		TI		Total		CC		TI		Total		CC		TI		Total											
				N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%										
Introduction to Computer Programming	2	5	7			1	20.0	1	14.3			2	40.0	2	28.6	2	100.0	2	40.0	4	57.1	2	100.0	1	20.0	3	42.9										
Introduction to Systems Analysis	5	8	13	1	20.0	2	25.0	3	23.1	2	40.0	1	12.5	3	23.1	2	40.0	3	37.5	5	38.5	1	20.0	3	37.5	4	30.8										
Data Processing Applications	1	5	6									1	20.0	1	16.7			3	60.0	3	50.0	1	100.0	3	60.0	4	66.7										
Data Processing Mathematics	3	7	10	3	100.0	5	71.4	8	80.0	1	33.3	4	57.1	5	50.0	1	33.3	4	57.1	5	50.0	1	33.3	4	57.1	5	50.0										
Data Processing Systems	5	5	10	1	20.0	1	20.0	2	20.0							1	20.0	2	40.0	3	30.0	3	60.0	3	60.0	6	60.0										
Programming Systems	2	3	5			2	66.7	2	40.0	1	50.0	2	66.7	3	60.0			1	33.3	1	20.0	1	50.0	1	33.3	2	40.0										
Field Work in Data Processing	8	11	19	1	12.5	1	9.1	2	10.5			2	18.2	2	10.0	5	62.5	4	36.4	9	47.4	8	100.0	10	90.9	18	94.7										

*Data processing department heads could indicate more than one objective.

college and technical institute department heads indicated that their unit record systems and equipment course had as its primary emphasis hands-on-experience. Cognitive understanding was the primary objective reported by the department heads in both the community colleges and technical institutes as being the primary objective in the introductory courses in data processing and the digital computer. In the community colleges, department heads reported the primary objective of introduction to computer programming as being hands-on-experience and production skills and understanding; whereas, the technical institute department heads reported that cognitive understanding and acquaintanceship skills were the primary objectives of this course. Acquaintanceship skills and hands-on-experience were the primary objectives reported by department heads in the community colleges in introduction to systems analysis. In the technical institutes, department heads reported their objectives in this course as being hands-on-experience and production skills and understanding.

In the one community college offering data processing applications, the data processing department head reported that this course had as its primary objective production skills and understanding. Sixty percent (five) of the department heads in the technical institutes reported hands-on-experience and production skills and understanding as being the primary objective in data processing applications. Data processing department heads in three of the community colleges and five of the technical institutes reported that the primary objective of data processing mathematics was a cognitive understanding. Four (57.1 percent) technical institute department heads reported equal emphasis being given acquaintanceship skills, hands-on-experience, and production skills and understanding in data processing mathematics.

Sixty percent (six out of ten) of the department heads in both the community colleges and technical institutes reported the primary objective of data processing systems as being production skills and understanding. In the technical institutes, department heads reported the primary objectives in programming systems as being cognitive understanding and acquaintanceship skills, with the community college department heads reporting that primary emphasis was on acquaintanceship skills and production skills and understanding.

Of the nineteen data processing department heads reporting, indications were that field work in data processing had as its primary objective production skills and understanding.

Total Data Processing Program

Concepts discussed and/or presented. Concepts discussed and/or presented in the total data processing programs in the twenty-one community colleges and technical institutes are shown in Table 47. The figures include the total responses to each concept listed on the questionnaire. Concepts related to the unit record system, history and principles of data processing, coding and condensing data, computer equipment, central processing unit, registers, characteristics of core memory, and input/output controls were included in all twenty-one of the schools. The purposes and functions of ALGOL and AUTOCODER programming languages were included in only one community college and

Table 47

Concepts Included in Total Data Processing Program in Community Colleges and Technical Institutes Reported by Data Processing Department Heads

Concepts	Community Colleges (N=9)	Technical Institutes (N=12)	Total (N=21)
Functions of Key Punch	7	10	17
Functions of Verifier	8	10	18
Functions of Sorter	8	10	18
Functions of Reproducer	8	10	18
Functions of Interpreter	8	9	17
Functions of Collator	8	10	18
Functions of Accounting Machine/Tabulator	7	10	17
Overview of Unit Record System	9	12	21
History of Data Processing	9	12	21
Principles of Data Processing	9	12	21
Principles/Theory of Digital Computer	8	11	19
Principles of Computer Languages	9	12	21
Computer Applications	8	10	18
Functions of Computer Console	8	7	15
Functions of Card Processor	7	8	15
Card Layout and Design	9	10	19
Form(s) Design	9	9	18
Flow Charting	8	10	18
Purpose and Function of Program Card	9	10	19
Coding and Condensing Data	9	12	21
Procedures Development	8	9	17
Data Scheduling Systems	6	5	11
Analysis of Information Systems	9	7	16
Computer Equipment	9	12	21
Evaluation of Auxiliary Equipment	9	10	19
Boolean Algebra	6	7	13
Logic	6	7	13
Fixed and Floating Point	9	10	19
Number Systems	9	10	19
Computer Logic	8	9	17
Programming Instructions	9	9	18
Programming Essentials	9	7	16
Programming Systems	9	10	19
Uses of Assembly Programming and Compiler	9	8	17

Table 47 (continued)

Concepts	Community Colleges (N=9)	Technical Institutes (N=12)	Total (N=21)
Purpose and Function of COBOL	9	9	18
Purpose and Function of FORTRAN	9	8	17
Purpose and Function of PL 1	7	8	15
Purpose and Function of RPG	9	8	17
Purpose and Function of ALGOL	1	2	3
Purpose and Function of AUTOCODER	1	2	3
Purpose and Function of Canned Programs	7	8	15
Uses and Modification of Magnetic Tape Library	8	7	15
Central Processing Unit	9	12	21
Registers	9	12	21
Technique(s) of Teleprocessing	9	10	19
Functions and Use of Terminal Unit	9	10	19
Characteristics of Core Memory	9	12	21
Subroutine(s)	9	9	18
Loops and Indexing	9	10	19
Input-Output Controls	9	12	21
Job Timing	6	8	14
Program Random Access Device	9	11	20
Debug Programs	9	9	18
Sort-Merge Program	9	8	17

two technical institutes. High responses were received for all other concepts listed on the questionnaire. Other concepts mentioned by department heads but not listed on the questionnaire included software systems, operating systems, documentation, file organization, job control language, table searches, decision tables, simulation, feasibility study, and critical path method simplex trans-portation.

Performance skills developed. The performance skills reported by data processing department heads as being developed in their total data processing programs are identified in Table 48. Flow charting was the only performance skill receiving responses from all the community colleges and technical institutes. Other performance skills receiving high responses (twenty) by department heads included card layout and design, designing of forms, and COBOL programming language. All programming languages, with the exception of ALGOL and AUTO-CODER, received many responses. Skills receiving low responses included unit record equipment, data scheduling and information systems, computer and auxiliary equipment, central processing unit, job timing, maintenance of magnetic tape library, boolean algebra, and logic. According to the high number of responses received, operation of the key punch and sorter and operation and wiring of the reproducer are emphasized in the community colleges and technical institutes even though unit record equipment was not considered by department heads as being utilized extensively in business and industry. Utilization of Triangle Universities College Computation (TUCC) in the Community College System requires the use of key-punched cards and sorted cards in most data

Table 48

Performance Skills Developed in Total Data Processing Program in Community Colleges and Technical Institutes Reported by Data Processing Department Heads

Performance Skills	Community Colleges (N=9)	Technical Institutes (N=12)	Total (N=21)
Operate Key Punch	7	8	15
Operate Verfier	2	1	3
Operate Sorter	6	7	13
Operate and Wire Reproducer	5	5	10
Operate and Wire Interpreter	2	3	5
Operate and Wire Collator	4	4	8
Operate and Wire Accounting Machine/ Tabulator	3	5	8
Computer Applications	7	8	15
Operate Computer Console	3	3	6
Operate Card Processor	6	4	10
Card Layout and Design	8	12	20
Design Forms	9	11	20
Flow Charting	9	12	21
Plan and Punch Program Card	8	6	14
Coding and Condensing Data	9	7	16
Procedures Development	5	8	13
Data Scheduling System	3	1	4
Information Systems	2	1	3
Computer Equipment	3	5	8
Auxiliary Equipment	1	4	5
Boolean Algebra	2	3	5
Logic	2	5	7
Fixed and Floating Point	6	5	11
Number Systems	3	7	10
Computer Logic	2	8	10
Programming Instructions	7	11	18
Programming Essentials	6	8	14
Programming Systems	5	7	12
Assembly Language	9	10	19
COBOL	8	12	20
FORTRAN	9	10	19
PL 1	6	9	15
RPG	7	11	18

Table 48 (continued)

Performance Skills	Community Colleges (N=9)	Technical Institutes (N=12)	Total (N=21)
ALGOL		1	1
AUTOCODER		1	1
Canned Programs	4	8	12
Maintaining Magnetic Tape Library	4	1	5
Central Processing Unit	2	6	8
Registers	6	8	14
Technique(s) of Teleprocessing	4	7	11
Operate Terminal Unit	6	8	14
Subroutine(s)	8	9	17
Loops and Indexing	9	8	17
Input/Output Controls	5	9	14
Job Timing	1	3	4
Programming Random Access Device	6	6	12
Debug Programs	9	9	18
Sort-Merge Programming	6	7	13

processing problems; therefore these skills must be emphasized in the system. Other skills mentioned but not on the questionnaire were the same as listed under concepts discussed and/or presented on page 161 with emphasis on documentation and operating systems.

Concepts and Performance Skills Included in Programming Language Courses

The table presented in the discussion of concepts discussed and performance skills developed in the programming language courses represents the number of community colleges and technical institutes reporting that a language course(s) was being offered in their data processing program and the concepts and performance skills developed in the language course(s).

The figures in Table 49 indicate the number of schools discussing concepts or developing skills in each of the programming language courses. ALGOL and AUTOCODER are not taught as separate language courses in any of the schools, but are included in three of the schools as concepts discussed and/or presented in course(s) in the total data processing program as shown in Table 47 on page 159.

Assembly language. Assembly programming language is taught in nine of the community colleges and eleven of the technical institutes as a separate course. Flow charting, coding and condensing data; logic; fixed and floating point decimals; programming instructions, essentials, and systems; registers; loops and indexing; input/output controls; and debugging programs were concepts and skills mentioned.

Table 49

Concepts Discussed and Performance Skills Developed in Programming Language Courses in Community Colleges and Technical Institutes Reported by Data Processing Department Heads

Concepts and Performance Skills	Languages															
	Assembly		COBOL		FORTRAN		PL 1		RPG		Canned Programs		Com-bination		Other	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Key Punch	3	1	3	2	4	3	2	2	2	1	1		1	1		
Verifier													1			
Sorter					1								1			
Reproducer													1			
Interpreter													1			
Collator													1			
Accounting Machine/Tabulator													1			
Overview of Unit Record System											1		1			
History of Data Processing					1	1					1					
Principles of Data Processing	1		1	1	2	2		1			1		1			1

Table 49 (continued)

Concepts and Performance Skills	Languages															
	Assembly		COBOL		FORTRAN		PL 1		RPG		Canned Programs		Comb-bination		Other	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Principles/Theory of Digital Computer	4	2	1	2	2	2	1	1	1	1	1	1	1			1
Principles of Computer Languages	3	4	4	5	3	5	2	2		2	1		2	1		1
Computer Applications	6	7	5	6	5	6	2	3	3	2	2	2	2	1		1
Computer Console	5	3	3	5	5	1	2	1	2	1	2	1	1			
Card Processor	3	2	1	3	2	1	1	1	1		1	1	1			
Card Layout and Design	4	3	4	5	4	5	2	3	2	2	2	1	1			1
Form(s) Design	5	4	4	5	4	5	2	3	2	2	1	1	1			1
Flow Charting	9	7	8	7	7	6	4	3	3	1	2	1	1	1		1
Program Card	2			1	2		1									
Coding and Condensing Data	5	5	6	6	5	4	2	3	3	1	4	1	2			1
Procedures Development	2	3	3	5	2	2	1	2	1		2	1	1			1
Data Scheduling System		1	2		2						2	1	2			

Table 49 (continued)

Concepts and Performance Skills	Languages															
	Assembly		COBOL		FORTRAN		PL 1		RPG		Canned Programs		Com-bination		Other	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Information Systems		1	3	2	2			1			4	1				
Computer Equipment	4	2	2	5	3	3	1	3	1	2	4	1	1			
Auxiliary Equipment	1	1	2	1	1	2	1	1		1	3	1	1			
Boolean Algebra	1	1	1		1	1	1	1					1			
Logic	5	5	3	6	4	4	3	3	1		1					1
Fixed and Floating Point	5	4	4	5	6	10	4	4	1	1	1		1			1
Number Systems	3	2	2	3	2	3	2	4	1							1
Computer Logic	4	5	4	7	2	5	2	4	2	2	1		1	1		1
Programming Instructions	10	10	8	9	6	9	4	6	5	6	2		2	1		2
Programming Essentials	8	6	7	7	5	7	4	6	5	5	1		2			2
Programming Systems	5	4	5	5	3	4	3	4	1	3	3		2			2
Assembly Language (machine or symbolic)	9	11	2		1						1		1			1

Table 49 (continued)

Concepts and Performance Skills	Languages															
	Assembly		COBOL		FORTRAN		PL 1		RPG		Canned Programs		Com-bination		Other	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
COBOL			8	11									2			1
FORTRAN					7	9		1		1			2	1		
PL 1 (Programming Language)							4	6					2	1		
RPG (Report Generator	1								5	6			1			
ALGOL													1			
AUTOCODER													1			
Canned Program(s) Library	1	2	2	1	1	3	1	1		1	4	2	1			1
Magnetic Tape Library	2	1	3	1	4	2	2	3	1		4	1	1			
Central Processing Unit (CPU)	4	4	1	3	2	3	1	2		1	3		1			2
Registers	8	8	2	3	2	4	1	1		1	3		2			2
Technique(s) of Teleprocessing		5	1	2	3	3		2		1	4	1	2			1
Terminal Unit	3	4	3	4	3	4	2	4	3	2	3	1	2	1		1

Table 49 (continued)

Concepts and Performance Skills	Languages															
	Assembly		COBOL		FORTRAN		PL 1		RPG		Canned Programs		Com-bination		Other	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Characteristics of Core Memory	4	4	1	2	2	3	1	4		2	2		1			
Subroutine(s)	2	3	4	6	3	6	2	5		2	2		2			1
Loops and Indexing	7	8	5	10	6	9	2	6	1	5	1		2			2
Input/Output Control(s)	5	5	5	6	4	8	1	5	2	4	2		2			2
Job Timing	1	2		3	1	1		4		2	3	1	2			
Program Random Access Device	2	4	3	8	3	6		4	1	4	4		2			2
Debug Programs	8	6	6	8	5	5	3	4	4	3			2	1		1
Sort-Merge Program	1	3	6	6	1	2	1	1	1	1	3		1			1

COBOL language. COBOL was discussed and a vocational skill level developed in eight of the community colleges and eleven of the technical institutes. As mentioned in assembly language courses, flow charting; coding and condensing data; programming instructions, essentials, and systems; registers, loops and indexing; input/output controls; and debugging were mentioned as concepts discussed and performance skills developed in COBOL. Computer applications, computer logic, subroutines, and sort-merge programs were also mentioned quite frequently by department heads. The technical institutes also mentioned program random access device as being one of the concepts discussed and skills developed in COBOL.

FORTRAN language. FORTRAN was mentioned in seven of the community colleges and nine of the technical institutes. FORTRAN is a scientific language and is not utilized in business data processing programs on as large a scale as COBOL, PL 1, or RPG. Generally, the same concepts were discussed and skills developed in FORTRAN as in COBOL and assembly language. Programming systems and registers were mentioned quite frequently. Fixed and floating point decimals were mentioned by six of the community colleges and all of the technical institutes offering a course(s) in FORTRAN.

PL 1 language. This programming course was offered in four community colleges and six technical institutes. Again, the same concepts were discussed in PL 1 and the same skills developed as in the preceding languages. As in FORTRAN, fixed and floating point decimals were mentioned quite frequently. The technical institutes also frequently mentioned job timing, program random access device, terminal units, and core memory.

RPG language. RPG programming language was offered in five community colleges and six technical institutes. Only programming instructions and essentials were frequently mentioned as concepts discussed and performance skills developed in this language course. The technical institutes also mentioned loops and indexing, input/output controls, and program random access device. Debugging programs was mentioned by four of the community colleges and three of the technical institutes.

Canned programs. Canned programs were often utilized with other languages in other data processing courses and were only mentioned by four of the community colleges and two of the technical institutes as being separate courses in the data processing programs. Computer applications was the only concept and performance skill mentioned by the two technical institutes as being developed in their course. In the four community colleges, emphasis was in several areas including coding and condensing data, information systems, computer and auxiliary equipment, programming systems, magnetic tape library, central processing unit, registers, techniques of teleprocessing, terminal unit, job timing, program random access device, and sort-merge programming. Debugging programs and the program card were not characteristic of canned programs.

Combination languages. Two community colleges and one technical institute used a combination of FORTRAN and PL 1, COBOL and PL 1, assembly and canned, or all programming languages in one programming language course. Generally, the same concepts and skills as mentioned in the description of the other programming languages were mentioned in the combination languages. Principles of computer languages was frequently mentioned by the schools as a concept discussed.

Other programming languages. Two technical insitutes utilized languages that were peculiar to their business community. NEAT 3, SPS, and S/370, OS (operating systems) were the languages discussed and developed in these schools. The concepts discussed and skills developed in these courses included programming instructions, essentials, and systems; central processing unit; registers; loops and indexing; input/output controls; and program random access device.

Concepts and Performance Skills Included in Data Processing Courses

The table presented in the discussion of concepts discussed and performance skills developed in data processing courses represents the number of community colleges and technical institutes reporting that a particular data processing course(s) was being offered in their data processing program and the concepts and performance skills developed in the course(s).

Unit record systems and equipment. This course was being offered in approximately one-half (four) of the community colleges and one-third (four) of the technical institutes. (Table 50) An overview of the unit record system and functions and operation of unit record equipment were the concepts discussed and performance skills developed in this course.

Introduction to data processing. The Introduction to Data Processing course was a broad course covering the field of data processing and giving students an insight into the field of data processing, i.e., what it is and how it is used in the business office. The concepts developed in this course included an overview of the unit record system and the functions of the machines involved in such a system. In approximately 43 percent of the schools such concepts as history and principles of data processing, principles of computer languages, card layout and design, flow charting, program card, coding and condensing data, computer and auxiliary equipment, central processing unit, terminal unit, and characteristics of core memory were reported by department heads as being covered in the introductory course. In 20 percent or less of the schools, topics such as computer console, card processor, forms design, procedures development, data scheduling systems, boolean algebra, logic, fixed and floating point decimals, programming essentials, computer programming languages, magnetic tape library, job timing, and debugging programs were discussed in the introductory course.

Introduction to digital computers. Approximately 67 percent of the schools had a course that could be entitled Introduction to Digital Computers in which the history of data processing, the principles of computer languages,

Table 50

Concepts Discussed and Performance Skills Developed in Data Processing Courses in Community Colleges and Technical Institutes Reported by Data Processing Department Heads

Concepts and Performance Skills	Data Processing Courses																			
	Unit Record Sys. & Equip.		Intro. to D. P.		Intro. to Digital Comp.		Intro. to Comp. Prog.		Intro. to Sys. Anal.		D. P. Appli.		D. P. Math.		D. P. Sys.		Prog. Sys.		Field Work in D. P.	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Key Punch	3	3	6	4	2	5									2				2	3
Verifier	3	2	5	4	2	6														2
Sorter	4	3	5	4	2	6														2
Reproducer	4	4	5	4	2	5														2
Interpreter	2	3	5	4	2	4														2
Collator	4	4	5	4	2	5														2
Accounting Machine/Tabulator	3	4	4	4	2	6														2
Overview of Unit Record System	4	4	5	4	3	7								2						2
History of D. P.	1	1	5	4	4	8									1					1
Principles of D. P.	1	1	7	4	3	8		2	2			2		1	2					1

Table 50 (continued)

Concepts and Performance Skills	Data Processing Courses																			
	Unit Record Sys. & Equip.		Intro. to D. P.		Intro. to Digital Comp.		Intro. to Comp. Prog.		Intro. to Sys. Anal.		D. P. Appli.		D. P. Math.		D. P. Sys.		Prog. Sys.		Field Work in D. P.	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Principles/Theory of Digital Computer			4	3	3	8					1	1		2	1		2			1
Principles of Computer Languages			5	4	4	7	1			1		1			1		1	1	1	2
Comp. Applications		1	7	4	3	4	2	2	2	3		5	2	7	3	2	1	2	4	8
Computer Console		1	2	2	1	3		1		2	1				1			1	1	3
Card Processor	2		2	2	1	5		1		3		1			1			1		4
Card Layout and Design	2	1	5	4	3	4	2	1	3	5	1	3		5	3	1	1	1	4	6
Form(s) Design	1	1	2	3	3	2	3	1			1	3		5	2	1		1	3	8
Flow Charting		1	6	4	3	4	3	2	3	3	1	3	1	8	4	2		1	5	7
Program Card	4	3	5	4	1	4										1				1
Coding and Condensing Data			5	3	3	3	2	2	3	4	1	2	1	6	3	2	1	1	5	5
Procedures Development			1	2	1	2	2	1	5	6	1	3		6	3	2	1	1	5	7
Data Scheduling System				2	1		2		3	3	1	1	1	1	1	1	2		3	3

Table 50 (continued)

Concepts and Performance Skills	Unit Record Sys. & Equip.		Intro. to D. P.		Intro. to Digital Comp.		Intro. to Comp. Prog.		Intro. to Sys. Anal.		D. P. Appli.		D. P. Math.		D. P. Sys.		Prog. Sys.		Field Work in D. P.	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Information Sys.			4	2	2		1	1	3	4	1	2		2	2	1		1	4	3
Comp. Equipment			6	4	4	7	1		1	5		3		2		2	2	2	2	6
Auxiliary Equip.	1	1	5	4	2	6			1	5		4				2	2	1	1	5
Boolean Algebra			2	2	2									8					1	4
Logic			3	2	4	2		1		2		2	2	9		1	1			1
Fixed and Floating Point			2	2	4	1			1					3			1			1
Number Systems			3	3	6	8							1	5			1			4
Computer Logic	1		3	2	4	7		1		3		1		5		1	2	2	3	5
Prog. Instructions			3	4	2	7	2	2				1	1	1		1		2	3	4
Prog. Essentials			2	2	3	5	2	1				3	1	3				1	2	7
Prog. Systems			2	2	3	3	1	1	1	3		3		1	1	3		2	1	3
Assembly Language (Machine or Symbolic)			1	4		3									1	1	1	1	3	8
COBOL			1	3		2	2	1							2		1	1	2	3
FORTRAN			3	2	2	2	1	1						1	2			1	1	1

Table 50 (continued)

Concepts and Performance Skills	Data Processing Courses																			
	Unit Record Sys. & Equip.		Intro. to D. P.		Intro. to Digital Comp.		Intro. to Comp. Prog.		Intro. to Sys. Anal.		D. P. Appli.		D. P. Math.		D. P. Sys.		Prog. Sys.		Field Work in D. P.	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
PL 1 (Progamming Language)			1	2		1	2	2							1		1	1	1	2
RPG (Report Generator)			1	3		1	2	3										1		
ALGOL			1	1			1	1												
AUTOCODER			1	1				1												
Canned Program(s) (Library)			1	3	3	2	1	1	2	2	1	1	2	5	2	1				2
Magnetic Tape Library			1	2	4	1	1	1	2	2	1	2			1		1			2
Central Processing Unit (CPU)			4	4	4	6				1		1		3			2	2		4
Registers	1		2	2	5	3		1							1		1	1	1	2
Technique(s) of Teleprocessing			3	2	3	3	1	2	1	4		2		1		3	1	1	2	3
Terminal Unit			4	3	3	3	2	2	1	3		2	1	1		2	1	1	3	3
Characteristics of Core Memory			4	4	6	6						1				1		1		3

Table 50 (continued)

Concepts and Performance Skills	Data Processing Courses																			
	Unit Record Sys. & Equip.		Intro. to D. P.		Intro. to Digital Comp.		Intro. to Comp. Prog.		Intro. to Sys. Anal.		D. P. Appli.		D. P. Math		D. P. Sys.		Prog. Sys.		Field Work in D. P.	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Subroutine(s)			1	2	1	2	2	1	1	1		1		3	2	1			2	3
Loops and Indexing			1	2	2	4	2	1				1		3	1	1		1	2	4
Input/Output Control(s)			3	1	1	1	1	1	1	1	1	1		4	1	1			2	4
Job Timing			1	1	1	1	1		1	1	1	2		2	1	1	1		1	2
Program Random Access Device			3	1	2	4	1	3	1	1	1	1		1	1		2	1	1	4
Debug Programs				1	1	1	2	2			1	2		2	1	1		2	2	3
Sort-Merge Program				2		1	1	1						1	1	2	1	1	1	2

computer equipment, number systems, computer logic, programming instructions, essentials, and systems, registers, and characteristics of core memory were discussed and developed in preparation for the computer programming languages.

Introduction to computer programming. This introductory course was offered in only 25 percent of the community colleges and technical institutes. Emphasis in this course was in the areas of computer applications, flow charting, coding and condensing data, programming instructions, debugging programs, and an introduction to the various computer programming languages.

Introduction of systems analysis. Approximately one-half of the schools offered a course that was grouped under the course title Introduction to Systems Analysis. The primary concept discussed in this course was procedures development.

Data processing applications. This course was offered in only one community college and in five technical institutes. Computer applications was the primary emphasis in this course in the technical institutes. Other concepts discussed and performance skills developed in this course included card layout and design, designing of forms, flow charting, procedures development, computer and auxiliary equipment, and programming essentials and systems.

Data processing mathematics. Courses related to mathematics were listed under the course title Data Processing Mathematics. (Refer to Appendix F,

Table 60) Seventy-five percent of the technical institutes and 22 percent of the community colleges offered a course in data processing mathematics. Some of the concepts discussed and skills developed in this course included such topics as computer applications, flow charting, coding and condensing data, procedures development, boolean algebra, logic, number systems, and computer logic.

Data processing and programming systems. These two courses were offered in approximately 25 percent of the community colleges and technical institutes. Various concepts and skills were included in these courses with primary emphasis on coding and condensing data, procedures development, computer equipment, and logic.

Field work in data processing. Various course titles were given by department heads to the course identified as Field Work in Data Processing in this study. All of the community colleges and technical institutes with the exception of one community college and one technical institute offered this course. The course was designed for student application of skills and knowledges developed in the total data processing program. Students were either required to select a business problem or were assigned a problem to program in any language emphasized in the data processing program.

Additional Courses

The data processing department heads were asked if additional courses were in the planning stage for their data processing programs. Some of the schools were planning to add data processing courses in the fall quarter of 1972, with others planning courses for the future. Planned additional courses included:

Computer Augmented Accounting

Algorithmic Process, Functions, and Iteration

Operating Systems

Advanced Language Courses in BAL, PL 1, COBOL, and Assembler

Programming Languages RPG and COBOL

Data Processing Mathematics

These courses were to be designed primarily for hands-on-experience or production skills and understanding.

The community colleges and technical institutes indicated that courses in data processing were sometimes taught through extension upon request and were not part of the regular curriculum. These courses included:

Key Punching

Introduction of Data Processing

Data Processing Applications

Review for Certified Data Processing Education

COOPERATIVE PART-TIME WORK EXPERIENCE PROGRAMS

Training students in data processing through a cooperative work experience program is not a common practice in North Carolina, with only five of the twenty-one schools reporting programs. A greater proportion of community colleges (33.3 percent or three) have cooperative work experience in data processing than do technical institutes (16.7 percent or two). One technical institute in the eastern part of the state indicated that its data processing students work for 166 hours in a business or industry without pay. Another technical institute in the east had discussed the possibility of the cooperative program in its area, but business and industry were reluctant to place students, with only three out of ten students being offered placement opportunities. One community college in the eastern part of the state recently started its cooperative program for data processing students, and two community colleges were discussing the possibilities of programs in their areas. There does not seem to be any pattern in relation to the location of the cooperative programs, with one program located in Region 2, one in Region 1, one in Region 3, one in Region 5, and one in Region 6--the programs are distributed across the state. (Refer to Figure 1, page 120)

Three cooperative work experience programs in data processing are coordinated by various personnel, with the majority of the schools having a special data processing coordinator. Two community colleges and one technical institute reported that the cooperative education coordinator for the school was in charge of the program, with one technical institute indicating that the data processing head worked closely with the coordinator in placement of students. One community college indicated that the special data processing coordinator was also the data processing department chairman.

Only one community college and one technical institute reported that students must complete all course work before being placed in a work station.

One technical institute indicated that data processing students in work stations were required to take business management and an elective after entering the cooperative work experience program.

There was no apparent pattern in the amount of on-the-job training required for data processing cooperative students. The community colleges and technical institutes required from five to more than twelve weeks of on-the-job training. One community college required five to eight weeks; two community colleges and one technical institute required nine to twelve weeks; and one technical institute required more than twelve weeks on-the-job training. One data processing department head reported that no standards had been set in his school because the cooperative program was only an experimental program at this time.

In general, data processing students were relatively easy to place in work stations, with three of the five schools with programs reporting that the data processing students were as easily placed or more easily placed as the office occupations students. One community college department head reported that employees in his area often called and asked for data processing students; whereas, another community college department head reported that the lack of computer installations in his county and area made the task of placing data processing students in a work station difficult. The community colleges and technical institutes reporting no cooperative programs made comments relative to frustrating experiences with data processing cooperative programs and with businesses' reluctance to accept such a program. In one case, computer installations in the area were too small to support such a program financially;

and, in another case, students were often encouraged to leave school and work full time in the installation.

DATA PROCESSING EQUIPMENT

North Carolina may have a unique system in terms of equipment utilized in its data processing programs. The twenty-one schools having data processing programs, with the exception of one technical institute, have computer terminals connected with the Triangle Universities College Computation (TUCC). Other data processing equipment reported by the schools was generally unit record, i.e., key punch, card sorter, accounting machine, reproducer, and collator. (Table 51) Seven key punch-interpreters were reported by department heads in the technical institutes. Interpreters and verifiers were reported to a lesser extent in the schools, with three of each reported by department heads in the technical institutes. More key punch machines were found in the community colleges and technical institutes than any other item of equipment. Two community colleges and five technical institutes maintain their own computer, with peripheral equipment.

Nine of the community colleges and eleven of the technical institutes lease most of their equipment. Six of the community colleges and six of the technical institutes purchased or received donations of unit record equipment. The main source of funds for purchasing equipment for the data processing programs is the state school fund. (Table 52) Only one community college received all its funds for equipment from county funds.

Table 51

Items of Data Processing Equipment and Quantity Used by the 21 Community Colleges and Technical Institutes Reporting

Item of Equipment	Community Colleges (N=9)	Technical Institutes (N=12)	Total (N=21)
Key Punch	22	46	68
Computer, Terminal*	9	11	20
Card Sorter	6	9	15
Accounting Machine/Tabulator	3	8	11
Reproducer	4	6	10
Disc Drive	2	7	9
Key Punch-Interpreter	2	7	9
Card Reader	2	5	7
Collator	3	4	7
Computer, In-House	2	5	7
Printer	2	5	7
Verifier	2	3	5
Interpreter	1	3	4
Paper-Tape Machine	1	2	3
Tape-Card Machine	1	1	2
Card-to-Tape Converter	1		1
Optical Scanner		1	1
Teletype		1	1
Magnetic Tape Typewriter			
Other			
Card Output Punch Terminal	1		1
Input/Output Writer		1	1
Magnetic Reader/Printer Terminal	1		1
Punch-In Terminal		1	1

*All computer terminals have a reader and a printer.

Table 52

Source of Funds Reported by Data Processing Department Heads for Purchasing Equipment for Data Processing Programs in Community Colleges and Technical Institutes

Source	Community Colleges	Technical Institutes*
	N	N
County		1
Local		1
State	9	11
Federal		1

*Some technical institute data processing department heads reported more than one source.

The monthly cost of data processing equipment for 76.2 percent (sixteen) of the community colleges and technical institutes is under $2, 000. (Table 53) Monthly expenses over $2, 000 were in the community colleges and technical institutes operating sophisticated computers and/or equipment. No school reported maintaining equipment costing over $5, 000 a month.

All the department heads reported that their equipment was available for student use, with 28.6 percent of the community colleges and technical institutes indicating that data processing equipment was also available for administrative use. (Table 54) One community college maintained separate equipment for educational use only. Three community colleges indicated that their equipment was available for teacher use, community services, and occupational research.

Table 53

Monthly Cost Range of Data Processing Equipment in 21 Community Colleges and Technical Institutes Reported by Data Processing Department Heads

Monthly Cost Range	Community Colleges		Technical Institutes	
	N	%	N	%
Under $2,000	8	88.9	8	66.7
$2,001 - $5,000	1	11.1	4	33.3
Total	9		12	

Table 54

Utilization of Data Processing Equipment in 21 Community Colleges and Technical Institutes Reported by Data Processing Department Heads*

Use	Community Colleges		Technical Institutes		Total	
	N	%	N	%	N	%
Student	9	50.0	12	70.6	21	60.0
Administrative	5	27.8	5	29.4	10	28.6
Time Sharing	1	5.6			1	2.9
Other	3	16.7			3	8.6
Total	18		17		35	

*Respondents could indicate more than one use.

STAFFING DATA PROCESSING INSTRUCTIONAL DEPARTMENTS

Data Processing Teachers

The community colleges reported having twenty full-time data processing teachers; and the technical institutes, twenty-five. (Table 55) The community colleges reported having twelve part-time data processing teachers; and the technical institutes, twenty-three. The mean number of full-time teachers was 2.2 for the community colleges and 2.1 for the technical institutes.

The programs in the community colleges and technical institutes show an obvious contrast in full-time and part-time teachers. (Table 56) The pattern of staffing varies from one community college to another and from one technical institute to another, and between community colleges and technical institutes. Every community college and technical institute employed at least one full-time data processing teacher. The range of full-time teachers for the technical institutes is from one to four teachers. Even though the range for community college full-time teachers is from one to five or more, this is misleading since one community college reported employing five or more teachers and one-third reported only two teachers. Only seven community colleges and nine technical institutes employed part-time data processing teachers. Slightly over half of the community colleges and one-third of the technical institutes reported employing only one part-time teacher. One community college and one technical institute reported employing two data processing teachers. One-fourth of the technical institutes reported employing four part-time teachers and only one community

Table 55

Full-Time and Part-Time Data Processing Teachers Reported by 21 Data Processing Department Heads in Community Colleges and Technical Institutes

	Community Colleges	Technical Institutes	Total
Full-Time Teachers			
Number of Schools	9	12	21
Number of Teachers	20	25	45
Mean No. of Teachers	2.2	2.1	
Part-Time Teachers			
Number of Schools	9	12	21
Number of Teachers	13	23	36
Mean No. of Teachers	1.4	1.9	

Table 56

Full-Time and Part-Time Data Processing Teachers in Community Colleges and Technical Institutes with Data Processing Programs

Classification of Community Colleges and Technical Institutes as to Number of Teachers	Number of Community Colleges and Technical Institutes with Full-Time Teachers		Number of Community Colleges and Technical Institutes with Part-Time Teachers	
	CC	TI	CC	TI
1	5	5	5	4
2	3	2	1	1
3		4		
4		1		3
5 or More	1		1	1
Total	9	12	7	9

college and one technical institute employed five or more part-time data processing teachers.

Data Processing Work Experience

When asked to respond to the data processing work experience required of data processing teachers, six community college and four technical institute data processing department heads reported that work experience was not required. (Table 57) However, five department heads required that their data processing teachers have more than 24 months' experience.

Educational Degree

Approximately one-half (41.7 percent) of the department heads in the technical institutes reported that their data processing teachers had a bachelor's degree, and 27.3 percent of the department heads in the community colleges. (Table 58) The same percentage (27.3) of the community colleges reported that their data processing teachers had either a master's degree or a bachelor's degree. Data processing department heads in the community colleges (24.2 percent) and in the technical institutes (22.9 percent) indicated that their data processing teachers had only an associate degree. In fact, most of these teachers were graduates of the data processing programs in the school in which they are now employed. This situation was apparent throughout the community colleges and technical institutes surveyed. Only one school had a data processing teacher with a doctorate; however, the department heads (22.2 percent) indicated that many data processing teachers have either a master's degree or work

Table 57

Amount of Data Processing Experience for Data Processing Teachers as Reported by 21 Data Processing Department Heads in Community Colleges and Technical Institutes

Months of Experience	Community Colleges (N= 9)		Technical Institutes (N=12)	
	N	%	N	%
None	6	66.7	4	33.3
6 or less				
7 to 12	2	22.2	2*	16.1
13 to 18			1	8.3
19 to 24			3	25.0
More than 24	1	11.1	4*	33.3

*Two technical institutes responded twice to this question.

Table 58

Levels of College Work Reported by 21 Data Processing Department Heads in Community Colleges and Technical Institutes Completed by Data Processing Teachers

Levels	Community Colleges		Technical Institutes		Total	
	N	%	N	%	N	%
Bachelor's Degree	9	27.3	20	41.7	29	35.8
Graduate Work, No Degree	5	15.2	9	18.8	14	17.3
Master's Degree	9	27.3	4	8.3	13	16.0
Postgraduate Work, No Doctorate	1	3.0	4	8.3	5	6.2
Doctor's Degree	1	3.0			1	1.2
Other	8	24.2	11	22.9	19	23.5
Total	33	100.0	48	100.0	81	100.0

beyond the master's.

Additional Data Processing Education

Only two community colleges and five technical institutes required additional education for data processing teachers. The schools reporting that data processing teachers did not require additional data processing education indicated that teachers had in-service training in manufacturer's schools or special data processing workshops once they had joined the community college or technical institute faculty.

There were various responses to the most effective means of data processing education for data processing teachers. (Table 59) Data processing workshops and in-service education within own institution were most frequently reported as being more effective for data processing teachers.

In this chapter analysis was made of the responses to the questionnaire and interview sessions with data processing department heads in the community colleges and technical institutes, and this information was organized around eight major headings:

1. General information concerning the community colleges and technical institutes with data processing programs.

2. Schools offering adult evening classes in data processing.

3. Test selection procedures used for selecting data processing students.

4. Counseling and placement of data processing students.

5. General education and business course requirements for the data

Table 59

Sources Providing Most Effective Means of Additional Education Needed by Data Processing Teachers Reported by 21 Data Processing Department Heads in Community Colleges and Technical Institutes*

Sources of Additional Education	Community Colleges	Technical Institutes
Data Processing Workshops	2	3
Summer Session(s) 4-Year Institution		1
In-Service Education--Own Institution	2	2
Manufacturer's School(s)	1	1
Total	5	7

*Some schools gave more than one response.

processing programs.

6. Data processing courses and course content of courses offered in the data processing programs.

7. Schools with cooperative part-time work experience programs in data processing.

8. Characteristics of data processing teachers.

CHAPTER VI

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

SUMMARY

The purposes of this study were threefold:

1. To determine the business data processing job classifications of businesses and industries in North Carolina and the knowledges and technical skills needed for each job classification.

2. To survey the community colleges and technical institutes in North Carolina to determine the current curriculums in the business data processing education programs.

3. To determine the relation of the current curriculums to the job classifications and the knowledges and technical skills needed for each job classification.

The study was designed to answer two questions:

1. What are the data processing job needs in North Carolina?

2. Does the present data processing curriculum in the community colleges and technical institutes respond to these needs?

Information for this study was obtained from thirty questionnaires received from selected businesses and industries in North Carolina with computer installations and from twenty-one personal interview sessions with data processing department heads in the North Carolina community colleges and technical institutes with data processing programs.

Significant findings are summarized in regard to the data processing jobs in businesses and industries in North Carolina and the data processing programs in the North Carolina community colleges and technical institutes.

BUSINESS AND INDUSTRY DATA PROCESSING JOB NEEDS

General Information

The total number of data processing employees reported by data processing managers in businesses and industries was 1,272, with seven managers indicating that they employed more than fifty employees.

Generally, businesses and industries in North Carolina had at least one in-house computer or purchased computer services, although unit record equipment was being utilized to a limited extent in some computer installations. Video display/terminal scopes are being utilized to a great extent in businesses and industries, particularly those purchasing computer services or maintaining real-time systems.

Sixteen data processing managers reported between six and ten data processing job classifications in their installation. Computer operators, programmers, key punch operators, and data processing technicians comprise the majority of employees in computer installations, and generally tend to have the greatest turnover rate.

Positions difficult to fill with qualified personnel included computer operator, programmer, systems analyst, and key punch operator. Data processing managers seemed to agree that computer operators and programmers educated in a community college or technical institute were generally good employees. Eighteen (58.6 percent) of the data processing managers reported that they would be interested in hiring part-time cooperative work experience data processing students.

Three computer languages were generally used in businesses and industries: COBOL, RPG, and Assembly language. The International Business Machines (IBM) Programmers Aptitude Test was used to test prospective computer programmers. Various technical and aptitude tests were used in selecting key punch operators.

Characteristics of Data Processing Employees

No previous data processing experience was required for computer operators, cooperative computer programmer trainees, data processors, and key punch operators. Experience requirements for computer programmers ranged from no experience to thirteen to eighteen months' experience, with seven to eighteen months of experience being required by fourteen of the data processing managers. The higher level management and supervisory data processing positions required more than twenty-four months' experience.

Data processing managers tended to look for skills other than those commonly associated with a specific job classification, particularly in relation to programming, systems, and management positions.

High school education was required for all data processing job classifications, with a technical institute education desirable for computer operator, programmer, programmer trainee, and data processor. Key punch operators and supervisors were required to have at least a high school education. Four-year degrees were highly desirable for data processing manager, computer programmer manager, systems analyst, and systems manager.

General mathematics was required for most data processing job classifications, with exceptions including data processing coordinator, data processing manager, and key punch supervisor. Oral and written communication were desirable for all classifications. Introduction to business was highly recommended for all data processing classifications except systems manager and key punch operator. All programming languages with the exception of ALGOL and AUTOCODER were recommended for the programmer, systems analyst, and management positions. Introduction to automated data processing and electronic data processing were generally recommended for all data processing job classifications.

Promotional Patterns

Key punch operators, computer operators, and computer programmers tend to have an average probability of being promoted from one data processing job to another. Key punch operators are often promoted to key punch supervisors or computer operators; computer operators to computer programmers; and programmers to computer programmer manager or systems analyst. Education had a definite effect on promotion opportunities for computer programmer, systems analyst, and data processing manager.

Future Changes

Primary changes in computer installations within the next three to five years will consist of changes in hardware and software. To meet these changes further education in data processing will be required for computer programmers, computer operators, systems analysts, and data processing managers. Over half of the data processing managers reported that the present educational systems would not be able to provide the education and training necessary to meet future changes. Education to meet changes would probably be provided by manufacturers of data processing equipment.

COMMUNITY COLLEGE AND TECHNICAL INSTITUTE DATA PROCESSING PROGRAMS

General Information

Information concerning the data processing programs in the community colleges and technical institutes was gathered through interview sessions with data processing department heads during the summer of 1972 and is summarized in the following paragraphs.

The schools with data processing programs included nine community colleges and twelve technical institutes, or a total of twenty-one schools out of fifty-six. Most of the data processing programs in North Carolina were initiated after 1965, with only four having been started before this time. The largest enrollment of students in business and data processing courses was in community colleges and technical institutes located in the Piedmont section of the state. The number of data processing graduates from the community colleges decreased from sixty-five to fifty-two from 1970-71 to 1971-72, while the number of graduates from the technical institutes increased by fifty students during this same time period.

Data processing programs began as fully organized two-year programs in sixteen of the twenty-one community colleges and technical institutes. All schools, with the exception of one technical institute, reported that the primary objective of their data processing program was to prepare students for gainful employment as computer programmers in computer installations.

Changes in the data processing programs and curriculums were usually recommended by the college advisory committee or the data processing teachers. Six community colleges and eleven technical institutes have data processing committees which assist the schools with curriculum suggestions, curriculum evaluations, recommendations for new data processing courses, placement of students, and purchasing data processing equipment.

Adult Evening Classes

Adult evening classes were offered in seven of the community colleges and seven of the technical institutes, with six of the schools offering the same program to adult and regular students. Adult evening students entered data processing courses for retraining or upgrading purposes.

Test Selection Procedures

The student population in the community college and technical institute data processing programs consists primarily of post high school day students. Selection procedures for data processing students are limited because of the open door policy practiced in the Community College System. Batteries of tests and counseling procedures are utilized in the schools in placing all students. Some of the technical institutes, five of twelve, utilized the International Business Machines (IBM) Programmers Aptitude Test for testing prospective data processing students. Mathematics was a prerequisite for entry into the data processing programs in over half of the schools. All schools reported that the primary interest of data processing graduates was gainful employment in a computer installation. Approximately one-fourth of the graduates were interested in attending a four-year institution. Most graduates were employed in a local business or industry.

Counseling and Placement of Students

Placement offices were found in the majority of the community colleges and technical institutes, with all schools maintaining a counseling center. Data processing department heads indicated that they worked more closely with business and industry in placing and counseling data processing students than did the placement or counseling centers.

Approximately one-fourth of the community colleges and technical institutes indicated that there were no problems in locating data processing positions for graduates. Data processing department heads reported placement problems developing because of inexperience of students, shift in the job market, reluctance to hire community college and technical institute graduates, and immobility of students.

General Education and Business Course Requirements

The majority of the schools reported that their data processing programs were adequate. The schools reporting inadequate programs cited such things as need for advanced courses, need for revision of courses and content, and need for additional hardware as inadequacies.

Bookkeeping/accounting was the business course mentioned most frequently in which data processing was integrated, with management and statistics being equally reported as integrated with data processing by the technical institutes. General education course requirements mentioned most frequently by the schools were algebra, oral and written communication, social studies, and trigonometry. Business education course requirements included bookkeeping/accounting, management, statistics, and economics.

Data Processing Courses and Course Content

Concepts discussed and presented in the total data processing program in all schools included unit record systems, history and principles of data processing, coding and condensing data, computer equipment, central processing unit, registers, characteristics of core memory, and input/output controls. Flow charting was the only performance skill receiving the majority of responses from the schools. Other skills mentioned frequently included card layout and design, designing forms, and COBOL programming language.

The programming languages offered in the community colleges and technical institutes included Assembly, COBOL, FORTRAN, PL 1, RPG, and canned programs. Basically, the same concepts were presented and performance skills developed in Assembly, COBOL, FORTRAN, and PL 1 programming languages. These topics included flow charting; coding and condensing data; programming instructions, essentials, and systems; registers; loops and indexing; input/output controls; and debugging programs. RPG programming language emphasized programming instructions and essentials, with loops and indexing, input/output controls, program random access devices, and debugging being mentioned frequently. Emphasis in canned programs was on computer applications.

Several introductory courses were offered in the community colleges and technical institutes including data processing, digital computers, computer programming, and systems analysis. Basically, these courses covered concepts related to the particular discipline. Unit Record Systems and Equipment was offered in many of the schools with emphasis on wiring unit record equipment and utilization of the program card. The course, Data Processing Applications, was primarily concerned with developing skills in computer applications and knowledge about auxiliary equipment and programming essentials and systems. Data Processing Mathematics content was primarily concentrated in the areas of boolean algebra, logic, number systems, and computer logic. Data Processing and Programming Systems were courses placing emphasis on coding and condensing data, procedures development, computer equipment, and logic. Field Work in Data Processing was being offered in all schools with the exception of one community college and one technical institute, and was a course designed for application of the concepts and skills developed by students in the total program.

Hands-on-experience and production skills and understanding were the primary objectives of the programming language courses. The primary objective of Data Processing Applications, Data Processing Systems, and Field Work in Data Processing was also production skills and understanding. Introductory courses emphasized as their primary objectives cognitive understanding, acquaintanceship skills, and hands-on-experience. Data Processing Mathematics and Programming Systems had as their primary objective cognitive understanding.

Cooperative Work Experience Programs

Relatively few schools in the North Carolina Community College System operate a cooperative part-time work experience program. There are only five programs in the state, three in the community colleges and two in the technical institutes. Special data processing coordinators generally direct the programs. No trend in the on-the-job training requirements was evident. Each school had its own requirements ranging from five to more than twelve weeks.

Data Processing Equipment

All schools, with the exception of one technical institute, maintain terminals connected with the Triangle Universities College Computation (TUCC). Equipment in the schools was available for student use.

Data Processing Teachers

Approximately half of the schools do not require data processing experience for their data processing teachers. After employment, teachers often attend special data processing workshops or manufacturer's schools. Various degrees were held by data processing teachers, including bachelor's degree, master's degree, and associate degree.

CONCLUSIONS

The following conclusions can be made concerning data processing job classifications and needs in North Carolina:

1. Graduates of the technical institutes and community colleges may enter the following data processing jobs: computer operator, computer programmer, data processor, cooperative computer programmer trainee, and data processing coordinator. For the job classifications of computer programming manager, systems analyst, systems manager, and data processing manager more experience and education were desirable. The desirable education level for computer operators, data processors, key punch operators, data processing coordinators, and key punch supervisors was a high school degree.

2. Job opportunities were more numerous for the positions of computer

operator, programmer, cooperative computer programmer trainee, key punch operator, and data technician.

3. Programmers, programming managers and systems analysts need to be proficient in COBOL, RPG, and assembly programming languages.

4. Testing in businesses and industries is limited, To a great extent the International Business Machines (IBM) Programmers Aptitude Test is being used to test prospective programmers.

5. Oral and written communication are skills desirable for all data processing classifications. Writing programs are essential not only for programmers, but for programming managers and systems analysts as well.

6. General mathematics, oral and written communication are the general education courses recommended for most data processing job classifications. Introduction to business and bookkeeping/accounting were mentioned frequently for data processing employees. Introduction to automated and electronic data processing were recommended by data processing managers for all job classifications. COBOL, introduction to electronic data processing and introduction to programming were mentioned for programmers.

7. Opportunities for advancement in data processing jobs are good, with some positions requiring additional education and experience.

8. Data processing managers indicated that little change would take place in their computer installation in the next three to five years, with the exception of a few changes in hardware and software.

9. Data processing managers do not feel that the present educational institutions will be able to meet the future changes in data processing, but felt

that education would take place within the company or with data processing equipment manufacturers.

10. In order to deal with the data in this study, it was found that the use of more data processing job classifications was necessary than in the earlier definitive study by Bangs and Hillestad. Therefore, from this study, conclusions can be made that the entire area of data processing is growing and differentiating.

The following conclusions can be made about the data processing programs in the community colleges and technical institutes:

1. There is a need for the community colleges and technical institutes to provide educational programs in data processing to train computer operators, computer programmers, data processors, data processing coordinators, key punch operators, and key punch supervisors.

2. The primary objective of the community colleges and technical institutes has been to educate students for gainful employment as computer programmers.

3. Data processing advisory committees are prevalent in the community colleges and technical institutes. They provide useful assistance and information to data processing department heads concerning curriculum, equipment, and job opportunities.

4. Adult evening classes in data processing are provided to retrain employees so that they can move from their present job to a data processing job and for upgrading employees so that they can move from one data processing job to another data processing job.

5. Testing procedures are not usually utilized for selecting prospective data processing students. A few schools use the International Business Machines (IBM) Programmers Aptitude Test.

6. Mathematics is considered a prerequisite in the majority of the community colleges and technical institutes. Data processing managers also recommended mathematics for prospective data processing employees.

7. Placement centers are found in the majority of the schools, with all schools maintaining a counseling center. Some assistance is provided by these centers for data processing students, but data processing department heads usually advise, counsel, and place students in data processing jobs.

8. The only business course consistently integrated with data processing was bookkeeping/accounting.

9. Oral and written communication were recommended for employees by data processing managers. These courses are general education course requirements in most of the schools.

10. Bookkeeping/accounting was required in all the data processing programs, with management and statistics being required in many.

11. Data processing courses and course content in the community colleges and technical institutes seem to be adequate for preparing students with a vocational skill as a programmer.

12. Relatively few schools operate a cooperative part-time work experience program in data processing. Only five schools out of the twenty-one schools surveyed have such a program.

13. In-house computers, computer terminals, and computer services are becoming prevalent in businesses and industries. The community colleges and technical institutes maintain computer terminal connections with the Triangle Universities College Computation (TUCC) center, but continue to utilize and teach unit record equipment. Sorters, key punch machines, key punch-interpreters, and verifiers are being utilized in businesses and industries and should continue to be used in the schools; but less emphasis should be put on the collator, reproducer, interpreter, and accounting machine.

14. In regard to data processing programs, this study was not in variance of the earlier definitive study conducted by Bangs and Hillestad in 1967-68. Based upon the findings of the earlier study, there does not seem to be any significant change in the data processing programs offered in the community colleges and technical institutes in North Carolina; and the data processing courses in the programs are receiving basically the same emphasis.

The following conclusions can be made concerning data processing teachers in community colleges and technical institutes:

1. Only five out of the twenty-one schools surveyed required their data processing teachers to have more than twenty-four months' data processing experience. Ten of the schools required no experience for their data processing teachers.

2. Degrees of various types were held by data processing teachers including bachelor's degree, master's degree, and associate degree. Associate degrees are acceptable in the community colleges and technical institutes, but not

in the secondary schools.

3. After employment, additional data processing education is often obtained by data processing teachers in special data processing workshops and manufacturers' schools. The Triangle Universities College Computation (TUCC) center often holds various workshops for data processing teachers.

RECOMMENDATIONS

Based on the findings of this study the following recommendations are made:

1. The community colleges and technical institutes seem to be fulfilling their primary objective of preparing students for gainful employment as programmers. More effort needs to be exerted by the schools to provide programs in data processing to prepare students for other job opportunities in data processing. The programs should be designed to meet future changes in computer installations and to meet the local needs of the community, particularly in areas where computer services, real-time systems, and on-line/off-line systems are being utilized. A plan should be developed to constantly update and modify the data processing programs.

2. The various data processing course titles in the community colleges and technical institutes should be examined and efforts should be made to establish more uniform course titles. With more uniform course titles, examining and comparing programs listed in the school catalogues and/or reading school transcripts would be easier for prospective students, secondary school

counselors, employers in businesses and industries, admissions officers in higher education, or other interested persons.

3. More effort should be made to dissolve the communication gap between businesses and industries and community colleges and technical institutes. In order for the data processing programs to survive academically and financially, it is recommended that the schools consider working very closely with businesses and industries.

4. Utilization of the data processing advisory committees is strongly recommended because of the practical services that such a committee can provide.

5. In order to solve articulation problems that exist between the educational institutions, it is recommended that an introductory course in data processing and courses in fundamental mathematics be offered in the secondary schools. The four-year institutions should introduce more business-oriented courses in data processing. Teacher-training institutions need to provide summer programs and in-service programs for data processing teachers. Further research is needed in the development of adequate teacher-training programs for data processing teachers. Competition should be eliminated from the educational institutions and cooperation and articulation problems should be considered.

6. More thorough investigation is needed in a community before establishing new data processing programs in order to avoid duplication of programs in an area and saturation of the job market with programmers.

7. The North Carolina Community College System should consider the possibility of returning to the stand-alone computer since educational opportunities in data processing are prevalent, changes in hardware technology do not demand as much responsibility and requirements as did assembly, and generally, enrollments in data processing have increased, thus creating the need for more in-house equipment. Also, local support is available to the schools and there are qualified personnel in the programs who can handle the responsibilities and requirements applicable to the stand-alone computer. Alternatives to the in-house computer concept that could be considered are the probability of utilizing time sharing or utilizing equipment available in local businesses and industries.

This study has shown that up to this point, there has been little research completed concerning data processing at the post secondary level. Studies should be conducted in all phases of data processing to supply administrators, teachers, department heads, data processing managers, data processing employees, and other interested persons with information necessary to make decisions about offering data processing programs at the post secondary school levels. The following phases of data processing should be considered for further research:

1. The need for test selection procedures for data processing students.
2. The need for cooperative part-time work experience programs.
3. The need for more integrated courses in data processing.
4. The need for equipment and supplies for data processing programs in relation to other programs in the schools.

5. The need for special programs to train data processing students for jobs requiring less than two years of education.

6. The need to design more uniform course titles in the community colleges and technical institutes.

7. The need to provide more data processing courses for the non-data processing student.

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APPENDIXES

APPENDIX A

North Carolina Community College System

Suggested Business Data Processing Curriculum
1968-69 Study

I. Curriculum Objectives:

A graduate of this program is to be employable immediately as a computer programmer with the academic background needed to advance in the data processing profession.

II. Suggested Curriculum to meet this Objective:

First Quarter

Course	Lect	Lab	Cr. Hrs.	Computer Programs or Equivalent
Int. to Computer Concepts	3	0	3	12
Compiler Language I	2	2	3	
Functional Wiring Principles	2	2	3	
Mathematics (or math and accounting)	5	0	5	
English	3	0	3	
	15	4	17	

Second Quarter

Course	Lect	Lab	Cr. Hrs.	Computer Programs or Equivalent
Assembly Language	2	4	4	12
Mathematics	5	0	5	
Accounting	5	2	6	
English	3	0	3	
	15	6	18	

Third Quarter

Course	Lect	Lab	Cr. Hrs.	Computer Programs or Equivalent
Compiler Language II	2	4	4	8
Accounting	5	2	6	
English	3	0	3	
Selection	Minimum		6	
			19	

Fourth Quarter

Course	Lect	Lab	Cr. Hrs.	Computer Programs or Equivalent
Data Processing App. I	2	4	4	6
Computer Systems I	2	2	3	6
Accounting (or mathematics)	Minimum		5	
Selection	Minimum		6	
			18	

Fifth Quarter

Course	Lect	Lab	Cr. Hrs.	Computer Programs or Equivalent
Data Processing App. II	2	4	4	7
Computer Systems II	2	2	3	6
Selection	Minimum		9	
			16	

Sixth Quarter

Course	Lect	Lab	Cr. Hrs.	Computer Programs or Equivalent
Data Processing Project	1	8	5	6
Selection	Minimum		12	
			17	

Selection: Courses are to be selected by the institution according to the following guidelines. (These selections are not student electives.)

1. Selections from social studies must be at least 6 credit hours.

2. Selections from business related must be at least 9 credit hours.

3. Selection from data processing alternatives must be at least 6 credit hours.

Course	Lect	Lab	Cr. Hrs.	Computer Programs or Equivalent
Linear Programming	3	2	4	6
Computer Language Survey	2	2	3	8
Systems and Procedures	3	0	3	
Applied Business Systems	3	0	3	
User Programs	2	2	3	6
Statistical Programming	2	2	3	6
Symbolic Logic				

4. Selection from technical studies must be at least 12 credit hours. This selection can include additional courses from business related, social studies, data processing or others. If student electives are desired they can be included as part of the technical electives.

III. Course Description:

These are submitted as an individual effort by the secretary and not as a result of the meeting.

Introduction to Computer Concepts

An introductory course in computers for the student who plans to pursue the degree in data processing as well as the student who desires a general non-technical knowledge of terminology and concepts. No previous knowledge or experience in data processing is required.

Compiler Language I

A fundamental course in FORTRAN or PL/1 programming. The FORTRAN or PL/1 language structure, statements, and programming methods and techniques are studied. The student will develop program logic and write FORTRAN or PL/1 programs for solving sample problems.

Compiler Language II

This course is designed to provide basic training in COBOL programming. The COBOL language structure, statements, and programming methods and techniques are studied. The student will develop program logic and write COBOL programs for solving sample problems.

Assembly Language

The study of symbolic computer languages with emphasis on a particular example of such a language. The student will develop program logic and write programs using assembly language to solve appropriate assigned problems.

Linear Programming

Mathematical models effective in management planning, scheduling and control are studied. The student investigates problems applicable to linear programming models, critical path, simulation, and queing theory. The computer will be used for problem solution using available library programs.

Data Processing Applications I

This course is designed to provide the student with sufficient knowledge in computer methodology to permit the use of computers in business. Emphasis will center around the computer environment with an in-depth study of the integration of the computer within business and industry.

Data Processing Applications II

This course emphasizes the preparation and utilization of operations data used in a typical business; case problems involving systems established for collecting the data and generating information for organizational units are studied. Audit trails enabling the tracing of transactions back to the original source or forward to the first report are analyzed. Simulated data is used to demonstrate programming techniques (using COBOL) required in processing management information. Statistical analysis programming using a scientific language is studied as an aid to business decision making.

Computer Systems I

A study of computer systems involving such concepts of architecture and/or programming as channels, interrupts, multiprogramming, job scheduling, file devices, and file organization.

Computer Systems II

A study of computer systems involving such concepts of architecture and/or programming for operating systems, job control language, resident packs, teleprocessing, and system utilities.

Functional Wiring Principles

A study of unit record procedures and operating practices. Student laboratory work emphasizes concepts of punched-card data processing equipment.

Symbolic Logic

Topics include an introduction to numbering systems with bases other than ten, transformation from one system to another, and fundamental operations in systems other than the decimal. The fundamental operations, theorems, functions and operations of Boolean Algebra are studied and applied to computer logic designs and switching circuits. The logic of circuit design is considered rather than the electronic components used.

Systems and Procedures

An introductory course in the principles of management systems applied to information data flows. Particular attention is given to forms flowcharting, forms analysis, and design and systems analysis.

Applied Business Systems

A continuation of management systems applied to information data flow. Practical work in systems flow charting and analysis is implemented. The conduction of feasibility studies, the preparation and maintenance of standard practice, policies and organization manuals, and computer application are stressed.

User Programs

A study of the documentation, applications, and use of various user-supplied programs.

Computer Language Survey

A survey and comparison of various computer languages. Students will write and execute basic programs in several computer languages.

Statistical Programming

A study of FORTRAN programming as applied to solution of statistical problems. The student will analyze statistical problems and develop the programs and/or use library programs for computer solution.

APPENDIX B

APPENDIX B-1

Introductory Letter

THE UNIVERSITY OF NORTH CAROLINA

AT GREENSBORO

School of Business and Economics

July 26, 1972

TO: Data Processing Manager

FROM: R. Jean Overton, Doctoral Candidate R. Jean Overton

SUBJECT: North Carolina Data Processing Study

I am undertaking a study of data processing education programs in the North Carolina Community College System in which you, as manager of a computer installation, can contribute useful information.

The study has as its principal purposes the description of data processing job classifications in business and industry and a survey of community college and technical institute data processing education programs. North Carolina businesses and industries may be able to assist the North Carolina Community College System in making appropriate future educational plans for data processing programs by providing information for this study.

I am requesting that you complete the enclosed survey form and return it in the enclosed pre-addressed envelope within two weeks. A taxonomy of job classifications is enclosed for your convenience.

The questionnaire is multiple choice with the exception of questions 1-4. Questions 1-12 relate to general information and future plans of your company. Questions 13-28 pertain to questions directed to data processing job classifications in business and industry.

The data provided will be analyzed and summarized in such a manner that your particular response cannot be identified.

Thank you for your assistance in this matter.

Enclosures

ADVISORY COMMITTEE MEMBERS: Dr. Lois V. Edinger, Chairman, School of Education
Dr. Vance T. Littlejohn, School of Business and Economics
Dr. Dwight F. Clark, III, School of Education
Dr. Ernest W. Lee, School of Education

APPENDIX B-2

Management Questionnaire

NORTH CAROLINA DATA PROCESSING STUDY

The University of North Carolina at Greensboro
Greensboro, North Carolina

Company ____________________
Standard Industrial Classification ____________________

1. Number of Office Personnel ____________________ 1-1
2. Number of Data Processing Personnel ____________________ 2-1
3. Number of Data Processing Job Classifications in Your Company (Refer to Taxonomy of Job Classifications) ____________________ 3-1

4. From the following list, indicate the number of machines in your company:

EQUIPMENT	NUMBER	EQUIPMENT	NUMBER
Key Punch	____4-1	Paper-Tape Machine	____4-13
Key Punch-Interpreter	____4-2	Tape-Card Machine	____4-14
Verifier	____4-3	Teletype	____4-15
Reproducer	____4-4	Card-to-Tape Converter	____4-16
Card Sorter	____4-5	Magnetic Tape Typewriter	____4-17
Interpreter	____4-6	Optical Scanner	____4-18
Collator	____4-7	Disc Drive	____4-19
Accounting Machine or Tabulator	____4-8	Other (Specify) ____________	____4-20
Computer, In-House	____4-9	____________	____4-21
Computer, Terminal	____4-10	____________	____4-22
Printer	____4-11	____________	____4-23
Card Reader	____4-12	____________	____4-24

5. Please check the language(s) used in your data processing installation.
   COBOL ____5-1 RPG ____5-4 CANNED PROGRAMS ____5-7
   FORTRAN ____5-2 AUTOCODER ____5-5 ASSEMBLY(MACHINE) ____5-8
   PL 1 ____5-3 ALGOL ____5-6 Other (Specify) ____5-9
   ____

6. What is your opinion concerning the hiring of selected students on part-time cooperative work experience if they had received thorough training on unit record machines, were versed in computer concepts and had at least one programming language?
   Interested in hiring ____6-1 Other (Specify) ____6-3
   Not interested in hiring ____6-2 WRITE ANY COMMENTS ON BACK OF THIS FORM.

7. Do you plan to change your data processing system in the next three to five years? . . . . YES____7-1 NO____7-2

8. If yes, indicate the changes by checking the appropriate change from the list below:
   Hardware ____8-1 Output ____8-4 COMMENTS MAY BE
   Software ____8-2 Personnel ____8-5 WRITTEN ON BACK
   Input ____8-3 Other (Specify) ____8-6 OF FORM.

9. Will proposed changes require additional data processing education for present employees in the following job classifications? If yes, check appropriate classification(s).
   Computer Operator ____9-1 Data Process Manager ____9-9
   Computer Programmer ____9-2 Key Punch Operator ____9-10
   Computer Programmer Manager ____9-3 Key Punch Supervisor ____9-11
   Computer Systems Analyst ____9-4 Other (Specify) ____9-12
   Computer Systems Manager ____9-5 ____________
   Cooper. Computer Program Trainee ____9-6 ____________
   Data Processor ____9-7 ____________
   Data Processor Coordinator ____9-8 ____________

10. Will present data processing staff need to be retrained to meet changes? . . . . YES____10-1 NO____10-2

11. According to your experience and knowledge will the present educational institutions offering data processing programs be able to educate employees to meet proposed changes? YES____11-1 NO____11-2

12. If no, where do you think the education will take place?
    Within company ____12-1 Other (Specify) ____12-3
    Manufacturer ____12-2 ____________

1 Comptr Oper	2 Comptr Prgmr	3 Comptr Prgmr Mgr	4 Comptr Systems Analyst	5 Comptr Systems Mgr	6 Cooper Comptr Prgmr Trainee	7 Data Processor	QUESTIONS AND ANSWERS	8 Data Process Coordinator	9 Data Process Mgr	10 Key Punch Oper	11 Key Punch Supv	12 OTHER (Specify)			
							13. What is the desirable amount of education for these job classifications? Please check the appropriate block for each job.								
							13-1 High School								
							13-2 Community College								
							13-3 Technical Institute								
							13-4 Degree								
							13-5 Business School								
							13-6 Any Post High School								
							13-7 Other (Specify)								
							14. How much previous data processing experience do you require for these job classifications? Please check the appropriate block for each job.								
							14-1 No experience required								
							14-2 6 months or less								
							14-3 7 to 12 months								
							14-4 13 to 18 months								
							14-5 19 to 24 months								
							14-6 More than 24 months								
							15. How many employees are presently employed in each job classification? Please put the number in the appropriate block for each job.								
							16. How many employees in each classification do you anticipate hiring within the next year? Put the number anticipated in the appropriate block for each job.								
YES___ NO___	YES___ NO___	YES___ NO___	YES___ NO___	YES___ NO___	YES___ NO___	YES___ NO___	17. Have you experienced difficulty in finding qualified personnel for any of these classifications? Please check YES or NO.	YES___ NO___	YES___ NO___	YES___ NO___	YES___ NO___	YES___ NO___	YES___ NO___	YES___ NO___	YES___ NO___
							18. What has been your experience, if any, with prospective employees who have studied data processing in the community college or technical institute? Check the appropriate block for each job?								
							18-1 Excellent								
							18-2 Very Good								
							18-3 Good								
							18-4 Poor								
							18-5 Other (Specify)								

1 Comptr Oper	2 Comptr Prgmr	3 Comptr Prgmr Mgr	4 Comptr Systems Analyst	5 Comptr Systems Mgr	6 Cooper Comptr Prgmr Trainee	7 Data Processor	QUESTIONS AND ANSWERS	8 Data Process Coordinator	9 Data Process Mgr	10 Key Punch Oper	11 Key Punch Supv	12 OTHER (Specify)			
							19. Which of the following skills would you desire data processing employees to be proficient in other than duties applicable to the particular job? Check the appropriate block(s) for each job.								
							19-1 Key Punching								
							19-2 Operating concepts of unit record equipment								
							19-3 Verifying								
							19-4 Wiring boards (Reproducer, Collator, etc.)								
							19-5 Programming								
							19-6 Flowcharting								
							19-7 Computer console operations								
							19-8 Block diagramming								
							19-9 Debug programs								
							19-10 Problem solving								
							19-11 Design systems								
							19-12 Feasibility studies								
							19-13 Supervisory duties								
							19-14 Coordinate data processing activities								
							19-15 Prepare written reports								
							19-16 Train new employees								
							19-17 Design forms								
							19-18 Plan card layout and design								
							19-19 Evaluate work loads								
							19-20 Code and condense data								
							19-21 Oral communication								
							19-22 Teleprocessing techniques								
							19-23 Terminal unit concepts								
							19-24 Subroutines								
							19-25 Loops and indexing								
							19-26 Canned (library) programs(use, maintenance and modification)								
							19-27 Magnetic tape library(use, maintenance and modification)								
							19-28 Other (Specify)								

1 Comptr Oper	2 Comptr Prgmr	3 Comptr Prgmr Mgr	4 Comptr Systems Analyst	5 Comptr Systems Mgr	6 Cooper Comptr Prgmr Trainee	7 Data Processor	QUESTIONS AND ANSWERS	8 Data Process Coordinator	9 Data Process Mgr	10 Key Punch Oper	11 Key Punch Supv	12 OTHER (Specify)			
							20. Indicate what courses in data processing you prefer employees to have studied in school. Check course(s) for each job.								
							20-1 Introduction to Automated Data Processing								
							20-2 Introduction to Electronic Data Processing								
							20-3 Unit Record Systems (Key Punch, Sorter, Reproducer, Collator, Acct. Machine, etc)								
							20-4 Data Processing Systems (Key Punch, Computer, Peripherial Equipment, etc.)								
							20-5 Introduction to Systems Analysis								
							20-6 Introduction to Programming								
							20-7 Introduction to Digital Computer								
							20-8 Data Processing Applications								
							20-9 Data Processing Mathematics								
							20-10 Field Work in Data Processing								
							20-11 Computer Theory/Logic								
							20-12 Computer Console Operation								
							20-13 Advanced Programming								
							20-14 Operations Research								
							20-15 COBOL								
							20-16 FORTRAN								
							20-17 PL 1 (Programming Language)								
							20-18 RPG (Report Program Generator)								
							20-19 ALGOL								
							20-20 AUTOCODER								
							20-21 CANNED PROGRAMS (Library)								
							20-22 Other (Specify)								
							21. Indicate what business courses you prefer data processing employees to have studied in school. Check course(s) for each job.								
							21-1 Introduction to Business								
							21-2 Bookkeeping/Accounting								
							21-3 Business Law								
							21-4 Clerical Practice								
							21-5 Secretarial Practice								
							21-6 Typewriting								
							21-7 Office Machines								
							21-8 Management								
							21-9 Economics								
							21-10 Statistics								
							21-11 Introduction to Office Occupations								
							21-12 Cooperative Office Occupations								

1 Comptr Oper	2 Comptr Prgmr	3 Comptr Prgmr Mgr	4 Comptr Systems Analyst	5 Comptr Systems Mgr	6 Cooper Comptr Prgmr Trainee	7 Data Processor	QUESTIONS AND ANSWERS	8 Data Process Coordinator	9 Data Process Mgr	10 Key Punch Oper	11 Key Punch Supv	12 OTHER (Specify)			
							BUSINESS COURSES CONTINUED								
							21-13 Preparatory Office Occupations								
							21-14 Other (Specify)								
							22. Indicate what general education courses you prefer data processing employees to have studied in school. Check course(s) for each job.								
							22-1 General Mathematics								
							22-2 Algebra								
							22-3 Trigonometry								
							22-4 Analytic geometry								
							22-5 Calculus								
							22-6 Communications/Oral								
							22-7 Communications/Written								
							22-8 English/Literature								
							22-9 Social Studies(history, govt., etc.)								
							22-10 Science								
							22-11 Education								
							22-12 Psychology								
							22-13 Philosophy/Logic								
							22-14 Foreign Language(s)								
							22-15 Art and/or Music								
							22-16 Other (Specify)								
							23. What tests, if any, do you use for the selection of employees in each category? Check the appropriate test for each job.								
							23-1 Mathematics Aptitude								
							23-2 Mathematics Achievement								
							23-3 Logic								
							Scholastic Aptitude (Specify)								
							23-4 Quantitative								
							23-5 Language								
							23-6 Reading								
							Programmers (Specify)								
							23-7 IBM (Programmer's Aptitude Test--PAT)								
							23-8 Other (Specify)								
							23-9 Other (Specify)								

1 Comptr Oper	2 Comptr Prgmr	3 Comptr Prgmr Mgr	4 Comptr Systems Analyst	5 Comptr Systems Mgr	6 Cooper Comptr Prgmr Trainee	7 Data Processor	QUESTIONS AND ANSWERS	8 Data Process Coordinator	9 Data Process Mgr	10 Key Punch Oper	11 Key Punch Supv	12 OTHER (Specify)			
YES___ NO	YES___ NO	YES___ NO	YES___ NO	YES___ NO	YES___ NO	YES___ NO	24. Do you provide in-service training for data processing employees? Check YES or NO.	YES___ NO	YES___ NO	YES___ NO	YES___ NO	YES___ NO	YES___ NO	YES___ NO	YES___ NO
							25. If yes, where are these classes held? Check the place where held for each job.								
							25-1 Within company								
							25-2 Manufacturer								
							25-3 Local School--on their own								
							25-4 Local School--reimbursed								
							25-5 Other (Specify)								
							26. To what job may each of these personnel be promoted? Check position for each job.								
							26-1 Key punch operator								
							26-2 Key punch supervisor								
							26-3 Data typist								
							26-4 Coding clerk								
							26-5 Tape librarian								
							26-6 Unit record equipment operator								
							26-7 Computer operator								
							26-8 Computer programmer								
							26-9 Computer program manager								
							26-10 Computer systems analyst								
							26-11 Computer systems manager								
							26-12 Data processor								
							26-13 Data processor coordinator								
							26-14 Data processor manager								
							26-15 Other (Specify)								
							27. What is the probability of a person's being promoted from his present job? Check for each job.								
							27-1 High								
							27-2 Average								
							27-3 Low								
							27-4 Hardly any or none								
							28. Other things being equal, would the amount of education affect the employee's chance for promotion? Check for each data processing job.								
							28-1 Definitely								
							28-2 Quite a bit								
							28-3 Some								
							28-4 None or little								

COMMENTS MAY BE WRITTEN ON THE BACK OF THIS FORM. THANK YOU FOR YOUR COOPERATION.

APPENDIX B-3

School Questionnaire

NORTH CAROLINA DATA PROCESSING CURRICULUM STUDY

The University of North Carolina at Greensboro
Greensboro, North Carolina

INTERVIEW GUIDE FOR SCHOOL INTERVIEW

I. GENERAL INFORMATION--SCHOOL AND DATA PROCESSING PROGRAM

Name of School ______________________________

Address ______________________________

1. Total Number of Students Enrolled in Business Course(s)
   - One-year program . . . . ________ 1-1
   - Two-year program . . . . ________ 1-2
   - Part-time program. . . . . ________ 1-3
   - Elective for other programs. . . . . ________ 1-4

2. Of the number of business students listed above, how many are enrolled in data processing course(s)
   - One-year data processing program . . . . ________ 2-1
   - Two-year data processing program . . . . ________ 2-2
   - Part-time data processing program. . . . . ________ 2-3
   - Supporting work for other programs . . . . ________ 2-4

3. Indicate the number of graduates from the following data processing programs

programs	1970-71		1971-72	
One-year program	______	3-1	______	3-4
Two-year program	______	3-2	______	3-5
Part-time program.	______	3-3	______	3-6

4. When was your program in data processing started?. . . . ________ 4-1

5. How was the data processing first included in your school?
   - Integrated with other course(s). . . . . ________ 5-1
   - Introductory . . . . ________ 5-2
   - Organized program. . . . . ________ 5-3
   - Other (Specify). . . ______________________ ________ 5-4

6. What is the primary objective of your school for offering data processing?
   - To prepare students for gainful employment. . . . . ________ 6-1
   - To prepare students for entry into further educational programs ________ 6-2
   - To provide occupational opportunities for culturally disadvantaged students. . . . . ________ 6-3
   - To provide skills for job upgrading . . . . ________ 6-4
   - To provide learnings in academic disciplines. . . . . ________ 6-5
   - To provide general data processing knowledge. . . . . ________ 6-6
   - To provide retraining of employees not now in data processing ________ 6-7
   - Other (Specify) . . . ______________________ ________ 6-8

7. How do you determine any necessary changes in your data processing program?
   - State Board of Education. . . . . ________ 7-1
   - Department of Community Colleges. . . . . ________ 7-2
   - Board of Trustees . . . . ________ 7-3
   - College Advisory Committee. . . . . ________ 7-4
   - College Administration. . . . . ________ 7-5
   - Teacher(s). . . . . ________ 7-6
   - Student(s). . . . . ________ 7-7
   - Curriculum Study Committee. . . . . ________ 7-8
   - Follow-Up Study of Graduates. . . . . ________ 7-9
   - Research. . . . . ________ 7-10
   - Journals. . . . . ________ 7-11
   - Manufacturers . . . . ________ 7-12
   - Other (Specify) . . . ______________________ ________ 7-13

8. Do you have any of the following advisory committees?
Institutional advisory committee . . . . ________ 8-1
Business advisory committee. . . . . ________ 8-2
Data processing advisory committee . . . . ________ 8-3

9. If you do not have a data processing advisory committee, do you plan to have one?. . . . . .Yes ________ 9-1
No ________ 9-2

10. If you have a data processing advisory committee, how does your committee assist in your data processing program?
Offers curriculum suggestions. . . . . ________ 10-1
Evaluates curriculum periodically. . . . . ________ 10-2
Designs new courses in data processing . . . . ________ 10-3
Recommends new courses in data processing. . . . . ________ 10-4
Other (Specify). . . . ________ ________ 10-5

11. Do you have adult evening classes in data processing?. . .Yes ________ 11-1
No ________ 11-2

12. What, if any, differences are there in the program offered to adult evening students and the regular students?
More advanced work offered to adults . . . . ________ 12-1
Less advanced work offered to adults . . . . ________ 12-2
Work presented at a more rapid pace to adults. . . . . . . ________ 12-3
Work presented at a slower pace to adults. . . . . ________ 12-4
More courses are available to adults . . . . ________ 12-5
Fewer courses are available to adults. . . . . ________ 12-6
More hands-on training for adults. . . . . ________ 12-7
Less hands-on training for adults. . . . . ________ 12-8
Work presented in larger blocks of time, less often, for adults . . . . ________ 12-9
Different approach and emphasis in adult classes . . . . . ________ 12-10
Same program . . . . ________ 12-11
Other (Specify). . . . ________ ________ 12-12

13. If you have adult evening students, what reasons do they have for taking the data processing program(s) you offer?
Retraining--moving from present job into data processing job. . . ________ 13-1
Upgrading--moving from one data processing job to another . . . . ________ 13-2
Pre-employment training . . . . ________ 13-3
Updating for managers and accountants . . . . ________ 13-4
Other (Specify) . . . . ________ ________ 13-5

14. Are your adult programs in data processing designed for these specific needs?
. . . . .Yes ________ 14-1
No ________ 14-2

II. STUDENTS

1. What group of students are enrolled in your data processing program?
High school students--part time . . . . ________ 1-1
Post-high school day students . . . . ________ 1-2
Adult evening students. . . . . ________ 1-3
MDTA students . . . . ________ 1-4
Other (Specify) . . . . ________ ________ 1-5

2. Do you have selection procedures for students in data processing?
. . . . .Yes ________ 2-1
No ________ 2-2

3. If yes, how are students selected?
Test scores . . . . ________ 3-1
GPA--general. . . . . ________ 3-2
GPA--specific courses . . . . ________ 3-3
Certain characteristics (Specify) . . . . ________ ________ 3-4
No selection is done. ________ 3-5
Other (Specify) . . . . ________ ________ 3-6

4. If tests are used, specify which ones?
Math Aptitude. . . . . ______ 4-1
Math Achievement . . . . ______ 4-2
Logic. . . . . ______ 4-3
Scholastic Aptitude (Specify)
Quantitative . . . . ______ 4-4
Language . . . . ______ 4-5
Reading. . . . . ______ 4-6
Programmers (Specify)
IBM. . . . . ______ 4-7
Other (Specify). . . ______ ______ 4-8
Other (Specify). . . ______ ______ 4-9

5. How are the tests used?
Established cut-off scores . . . . ______ 5-1
Over-all pattern of test scores. . . . . ______ 5-2
Establishing norms . . . . ______ 5-3
Other (Specify). . . ______ ______ 5-4

6. Courses in what areas are prerequisites for the data processing program? If certain grades are required in courses, please specify.

			GRADE	
Mathematics.	______	6-1	______	6-9
Science.	______	6-2	______	6-10
Typewriting.	______	6-3	______	6-11
Bookkeeping/Accounting	______	6-4	______	6-12
English.	______	6-5	______	6-13
Office Procedures.	______	6-6	______	6-14
Introduction to Business	______	6-7	______	6-15
Other (Specify). . . ______	______	6-8	______	6-16

7. What do your students do upon completion of courses in your data processing program?
Seek gainful employment. . . . . ______ 7-1
Attend a four-year institution . . . . ______ 7-2
Attend a manufacturer's school . . . . ______ 7-3
Train further in specific data processing area . . . . . . ______ 7-4
Do not know what students do after leaving school. . . . . ______ 7-5
Other (Specify). . . ______ ______ 7-6

III. PLACEMENT PROCEDURES

1. Do you have a placement office in your school?. . . . . Yes ______ 1-1
No ______ 1-2

2. How does the placement office assist students in finding employment?
Works with local businesses and industries. . . . . ______ 2-1
Works with public employment agencies . . . . ______ 2-2
Works with private employment agencies. . . . . ______ 2-3
Schedules interviews for students . . . . ______ 2-4
Other (Specify) . . . ______ ______ 2-5

3. If no placement office, do you have a counseling center?. . . . Yes ______ 3-1
No ______ 3-2

4. How does the counseling center assist in making your data processing program more beneficial to students?
Provides a library of materials, pamphlets, etc.. . . . . . . ______ 4-1
Informs students of opportunities in data processing. . . . . ______ 4-2
Works closely with data processing instructors. . . . . ______ 4-3
Other (Specify) . . . ______ ______ 4-4

5. Where do most of your students obtain employment? (Check only one choice.)
National employment . . . . ______ 5-1
State employment. . . . . ______ 5-2
Local employment. . . . . ______ 5-3
Employment in nearby large cities . . . . ______ 5-4
Other (Specify) . . . ______ ______ 5-5

6. Indicate the most crucial problem that you have in placing students?
No particular problem(s). . . . . ______ 6-1
Business and Industry hire students before they complete data processing course work. ______ 6-2
Business and Industry are reluctant to hire females . . . . . ______ 6-3
Jobs above computer operator require more education than provided by our school . . . . ______ 6-4
Other (Specify) . . . ______ ______ 6-5

IV. TEACHERS

1. How many data processing teachers are on your staff?
   - Full-time teachers . . . . ________ 1-1
   - Part-time teachers . . . . ________ 1-2
   - Other (Specify). . . ____________________ ________ 1-3

2. What degree level do your data processing teachers have?
   - Bachelor's degree. . . . . ________ 2-1
   - Graduate work, but no advanced degree. . . . . ________ 2-2
   - Master's degree. ________ 2-3
   - Work beyond master's degree, but not doctorate . . . . ________ 2-4
   - Doctor's degree (Doctorate). . . . . ________ 2-5
   - Other (Specify). . . ____________________ ________ 2-6

3. What data processing experience is required of teachers?
   - No experience required . . . . ________ 3-1
   - 6 months or less . . . . ________ 3-2
   - 7 to 12 months . . . . ________ 3-3
   - 13 to 18 months. ________ 3-4
   - 19 to 24 months. ________ 3-5
   - More than 24 months. . . . . ________ 3-6

4. Do your teachers require additional training before teaching data processing courses?. . . . . .Yes ________ 4-1
   No ________ 4-2

5. If yes, what type(s) of training are most effective?
   - Data processing workshops. . . . . ________ 5-1
   - Summer session(s) in four-year institution . . . . . . ________ 5-2
   - In-service training within own institution . . . . . . ________ 5-3
   - Manufacturer school(s) . . . . ________ 5-4
   - Other (Specify). . . ____________________ ________ 5-5

V. COOPERATIVE PROGRAM

1. Do you have a cooperative program in data processing in your school?
   . . . . .Yes ________ 1-1
   No ________ 1-2

2. If yes, how much on-the-job training is required?
   - Less than 2 weeks . . . . ________ 2-1
   - 2 to 4 weeks. . . . . ________ 2-2
   - 5 to 8 weeks. . . . . ________ 2-3
   - 9 to 12 weeks . . . . ________ 2-4
   - More than 12 weeks. . . . . ________ 2-5

3. Who does the coordinating in the data processing area?
   - Office occupations coordinator. . . . . ________ 3-1
   - Special data processing coordinator . . . . ________ 3-2
   - Vocational education coordinator. . . . . ________ 3-3
   - Division occupations coordinator. . . . . ________ 3-4
   - Other (Specify) . . . . ____________________ ________ 3-5

4. Do the data processing cooperative students complete all their class work in data processing before they are placed in their work stations?
   . . . . .Yes ________ 4-1
   No ________ 4-2

5. Compared with general office occupations placements, how difficult is it to find work stations for data processing students?
   - As easy to place as general office students . . . . . . ________ 5-1
   - More easily placed. . . . . ________ 5-2
   - Not as easily placed. . . . . ________ 5-3

6. If NOT AS EASILY PLACED, what are the reasons given by business and industry for not offering work stations for these students?

VI. CURRICULUM AND PROGRAM COVERAGE

1. Do you consider your present data processing curricula and programs adequate? . . . . .Yes _____ 1-1
No _____ 1-2

2. If no, what changes would you make?
Add more courses . . . . _____ 2-1
Add more hardware . . . . _____ 2-2
Add more software . . . . _____ 2-3
Other (Specify) . . . . ____________________ _____ 2-4
____

3. Is your data processing training program integrated with other business course(s)? . . . . .Yes _____ 3-1
No _____ 3-2

4. If yes, check any of the following business courses in which data processing training is integrated?
Introduction to Business. . . . . _____ 4-1
Bookkeeping/Accounting. _____ 4-2
Business Law. . . . . _____ 4-3
Clerical Practice . . . . _____ 4-4
Secretarial Practice. . . . . _____ 4-5
Typewriting . . . . _____ 4-6
Office Machines . . . . _____ 4-7
Management. . . . . _____ 4-8
Economics . . . . _____ 4-9
Statistics. . . . . _____ 4-10
Introduction to Office Occupations. . . . . _____ 4-11
Cooperative Office Occupations. . . . . _____ 4-12
Preparatory Office Occupations. . . . . _____ 4-13
Other (Specify) . . . . ____________________ _____ 4-14
____

5. From the following list of business courses and general education courses check the course requirements for each data processing program in your school. 5

BUSINESS COURSES	One-Year	Two-Year	Part-Time
5-1 Introduction to Business			
5-2 Bookkeeping/Accounting			
5-3 Business Law			
5-4 Clerical Practice			
5-5 Secretarial Practice			
5-6 Typewriting			
5-7 Office Machines			
5-8 Management			
5-9 Economics			
5-10 Statistics			
5-11 Introduction to Office Occupations			
5-12 Cooperative Office Occupations			
5-13 Preparatory Office Occupations			
5-14 Other (Specify)			
GENERAL EDUCATION COURSES			
5-15 General Mathematics			
5-16 Algebra			
5-17 Trigonometry			
5-18 Analytic geometry			
5-19 Calculus			
5-20 Communications/Oral			
5-21 Communications/Written			
5-22 English/Literature			
5-23 Social Studies--history, govt., etc.			
5-24 Science			
5-25 Education			
5-26 Psychology			
5-27 Philosophy/Logic			
5-28 Foreign language(s)			
5-29 Art and/or Music			
5-30 Other (Specify)			

6. What data processing courses do you offer? List below each data processing course presently being offered in your school plus any additional course(s) that are in the planning stage.

a. Of the courses that you have listed, check the course requirements for your one-year, two-year and part-time data processing programs. 6

b. Check the appropriate column (cognitive understanding, acquaintance-ship skills, etc.) to indicate the primary objective of what is to be taught in each course.

DATA PROCESSING COURSES	One-Year	Two-Year	Part-Time	Cognitive Understanding	Acquaintance-ship skills	Hands-On Experience	Production Skills and Understanding
EXISTING COURSE(S)							
6-1							
6-2							
6-3							
6-4							
6-5							
6-6							
6-7							
6-8							
6-9							
6-10							
6-11							
6-12							
6-13							
6-14							
6-15							
6-16							
6-17							
6-18							
6-19							
6-20							
6-21							
6-22							
6-23							
6-24							
6-25							
PLANNED ADDITIONS							
6-26							
6-27							
6-28							
6-29							

7. **From the list of major topics listed below, give the following information:**

   a. **In COLUMN I check the concepts (discussion and presentation about) covered in your <u>total</u> data processing program.**

   b. **In COLUMN II check the performance skills covered in your <u>total</u> data processing program.**

   c. **In the remainder of the columns check the appropriate concepts and performance skills covered in <u>each</u> course you listed on page 6.**

   d. **In the space at the bottom of the list of topics, list any other major topic that you cover in your course(s) and complete a, b, and c.**

MAJOR TOPIC	I	II	6-1	6-2	6-3	6-4	6-5	6-6	6-7	6-8	6-9	6-10	6-11	6-12	6-13	6-14	6-15	6-16	6-17	6-18	6-19	6-20	6-21	6-22	6-23	6-24	6-25	6-26	6-27	6-28	6-29			
7-1 Key Punch																																		
7-2 Verifier																																		
7-3 Sorter																																		
7-4 Reproducer																																		
7-5 Interpreter																																		
7-6 Collator																																		
7-7 Accounting Machine/Tabulator																																		
7-8 Overview of unit record system																																		
7-9 History of data processing																																		
7-10 Principles of data processing																																		
7-11 Principles/Theory of digital computer																																		
7-12 Principles of computer language																																		
7-13 Computer applications																																		
7-14 Computer console																																		
7-15 Card processor																																		
7-16 Card layout and design																																		
7-17 Form(s) design																																		
7-18 Flow charting																																		
7-19 Program card																																		
7-20 Coding and condensing data																																		
7-21 Procedures development																																		
7-22 Data scheduling system																																		
7-23 Information systems																																		
7-24 Computer equipment																																		
7-25 Auxiliary equipment																																		

MAJOR TOPIC	I	II	6-1	6-2	6-3	6-4	6-5	6-6	6-7	6-8	6-9	6-10	6-11	6-12	6-13	6-14	6-15	6-16	6-17	6-18	6-19	6-20	6-21	6-22	6-23	6-24	6-25	6-26	6-27	6-28	6-29			
7-26 Boolean algebra																																		
7-27 Logic																																		
7-28 Fixed and floating point																																		
7-29 Number systems																																		
7-30 Computer logic																																		
7-31 Programming instructions																																		
7-32 Programming essentials																																		
7-33 Programming systems																																		
7-34 Assembly language (machine or symbolic)																																		
7-35 COBOL																																		
7-36 FORTRAN																																		
7-37 PL 1 (Programming Language)																																		
7-38 RPG (Report Generator)																																		
7-39 ALGOL																																		
7-40 AUTOCODER																																		
7-41 Canned Program(s) (Library)																																		
7-42 Magnetic tape library																																		
7-43 Central processing unit (CPU)																																		
7-44 Registers																																		
7-45 Technique(s) of teleprocessing																																		
7-46 Terminal unit																																		
7-47 Characteristics of core memory																																		
7-48 Subroutine(s)																																		
7-49 Loops and indexing																																		
7-50 Input/Output control(s)																																		
7-51 Job timing																																		
7-52 Program random access device																																		
7-53 Debug programs																																		
7-54 Sort-Merge program																																		
7-55																																		
7-56																																		
7-57																																		
7-58																																		
7-59																																		
7-60																																		

VII. EQUIPMENT

1. From the following list, indicate the number of machines in your school

EQUIPMENT	NUMBER	EQUIPMENT	NUMBER
Key Punch	______1-1	Paper-Tape Machine	______1-13
Key Punch-Interpreter	______1-2	Tape-Card Machine	______1-14
Verifier	______1-3	Teletype	______1-15
Reproducer	______1-4	Card-to-Tape Converter	______1-16
Card Sorter	______1-5	Magnetic Tape Typewriter	______1-17
Interpreter	______1-6	Optical Scanner	______1-18
Collator	______1-7	Disc Drive	______1-19
Accounting Machine or Tabulator	______1-8	Other (Specify) ______	______1-20
Computer, In-House	______1-9	______	______1-21
Computer, Terminal	______1-10	______	______1-22
Printer	______1-11	______	______1-23
Card Reader	______1-12	______	______1-24

2. What is the monthly cost of your equipment?
   - Under $2,000 . . . . ______2-1
   - $2,001-$5,000. ______2-2
   - $5,001-$10,000 . . . . ______2-3
   - $10,001-$20,000. . . . . ______2-4
   - Over $20,001 . . . . ______2-5

3. Who finances the cost of your equipment? Indicate the percentage of financial cost, if financed by more than one agency.

	PERCENTAGE	
County	______	______3-1
Local.	______	______3-2
State.	______	______3-3
Federal.	______	______3-4
Other (Specify). . . ______	______	______3-5

4. Do you lease __________4-1 or purchase __________4-2 your equipment?

5. How is the equipment in your school utilized? Indicate each use, if more than one.
   - Student use . . . . ______5-1
   - Administrative use. . . . . ______5-2
   - Time sharing. ______5-3
   - Other (Specify) . . . . ______________ ______5-4

VIII. FUTURE (If necessary, use the back of this sheet in answering the following questions.)

1. To what extent do you feel that data processing education should take place in your school? Why?

2. What technological factors are developing that would affect your educational program? Discuss in terms of hardware, software, input/output, curriculum, student selection, etc.

3. In your opinion, how may the high school and/or the university or college assist in providing a better data processing program in the community college and/or technical institute?

APPENDIX C

APPENDIX C-1

Businesses and Industries Surveyed

APPENDIX C-1

BUSINESSES AND INDUSTRIES SURVEYED

Type and Name of Company	City
20-39 Manufacturing	
Abbott Laboratories, Inc.	Rocky Mount
Albemarle Paper Company	Pactolus
Burlington Industries, Inc.	Greensboro
Anvil Brand, Inc., BVD Knitwear, Inc.	High Point
Charlotte Pipe and Foundry Company	Charlotte
Corning Glass Works	Raleigh
D S & W Hosiery	Mount Gilead
Delmar Printing Company, Inc.	Charlotte
Dover Mill Company	Shelby
E I DuPont De Nemours & Company	Fayetteville
Federal Pacific Electric Company	Fuquay Varina
The Lane Company, Inc., Hickory Chair Company	Hickory
Laughlin Hosiety Mills, Inc.	Randleman
W. Koury Company, Inc.	Sanford
Magnovox Furniture Inc., Blowing Rock Chair Company	Lenoir
Myrtle Desk Company	High Point
Olin Corporation, Hettrick Manufacturing Company	Pink Hill
The News & Observer Publishing Co., Inc.	Raleigh
Ora Mill Company	Shelby
Pet, Incorporated	Salisbury
Rocky Mount Mills	Rocky Mount
Scoville Manufacturing Company, Hamilton Beach Division	Washington
Southland Manufacturing Company, Inc.	Newton
Texas Gulf Sulphur Company	Aurora
Textiles, Inc.	Gastonia
Valdese Manufacturing Company, Inc.	Valdese
01-07 Construction	
J A Jones Construction Company	Charlotte
40-49 Transportation, Communication, Public Utilities	
Carolina Freight Carriers Corporation	Cherryville
Hennis Freight Lines, Inc.	Winston-Salem
Piedmont Aviation, Inc.	Winston-Salem

Type and Name of Company	City
Eastern Air Lines, Incorporated	Charlotte
Southern Bell Telephone & Telegraph Co.	Charlotte
Carolina Power & Light Company	Raleigh
Duke Power Co., Inc.	Charlotte
Piedmont Natural Gas Co., Inc.	Charlotte
50-59 Trade	
Belk Brothers Company	Charlotte
Cato Corporation	Charlotte
Hudson-Belk Company	Raleigh
Farmers Cooperative Exchange, Inc.	Raleigh
Service Distributing Company, Inc.	Albemarle
Winn-Dixie, Inc.	Raleigh
60-67 Finance, Real Estate, Insurance	
Pilot Life Insurance Company	Greensboro
Branch Banking & Trust Company	Wilson
First Union National Bank of N. C., Inc.	Charlotte
Wachovia Bank and Trust Company, Inc.	Winston-Salem
Integon Corporation	Winston-Salem
Pinehurst, Inc.	Pinehurst
70-89 Services	
Hospitals	
Duke Hospital	Durham
Forsyth Memorial Hospital	Winston-Salem
Memorial Hospital	Charlotte
Mountain Sanitarium and Hospital	Fletcher
Wake County Memorial Hospital	Raleigh
State Government	
N. C. Department of Motor Vehicles	Raleigh
States Ports Authority	Wilmington
Systems Management Division, Department of Administration	Raleigh

Type and Name of Company	City
Secondary Schools and Universities	
Appalachian State University	Boone
East Carolina University	Greenville
Elizabeth City State University	Elizabeth City
Guilford County Schools	Greensboro
University of North Carolina	Greensboro
91-93 Federal Government	
Aircraft Repair Center	Elizabeth City
Fort Bragg--Army--US CONTIC	Fort Bragg

APPENDIX C-2

Name and Location of Institutions Within the
North Carolina Community College System

APPENDIX C-2

NAME AND LOCATION OF INSTITUTIONS WITHIN THE NORTH CAROLINA COMMUNITY COLLEGE SYSTEM

Caldwell Community College and
Technical Institute
P. O. Box 600
Lenoir, North Carolina 28645

Central Piedmont Community College
P. O. Box 4009
Charlotte, North Carolina 28204

Coastal Carolina Community College
222 Georgetown Road
Jacksonville, North Carolina 28540

College of the Albemarle
Elizabeth City, North Carolina 27909

Davidson County Community College
P. O. Box 1287
Lexington, North Carolina 27292

Gaston College
New Dallas Highway
Dallas, North Carolina 28034

Isothermal Community College
P. O. Box 36
Spindale, North Carolina 28160

Lenoir Community College
P. O. Box 188
Kinston, North Carolina 28501

Rockingham Community College
Wentworth, North Carolina 27375

Sandhills Community College
P. O. Box 1379
Southern Pines, North Carolina 28387

Southeastern Community College
P. O. Box 151
Whiteville, North Carolina 28472

Surry Community College
P. O. Box 304
Dobson, North Carolina 27017

Wayne Community College
P. O. Box 1878
Goldsboro, North Carolina 27530

Western Piedmont Community College
P. O. Box 549
Morganton, North Carolina 28655

Wilkes Community College
P. O. Box 120
Wilkesboro, North Carolina 28697

Anson Technical Institute
P. O. Box 68
Ansonville, North Carolina 28007

Asheville-Buncombe Technical Institute
340 Victoria Road
Asheville, North Carolina 28801

Beaufort County Technical Institute
P. O. Box 1069
Washington, North Carolina 27889

Bladen Technical Institute
P. O. Box 128
Dublin, North Carolina 28337

Blue Ridge Technical Institute
101 N. Church Street
Hendersonville, North Carolina 28739

Cape Fear Technical Institute
411 N. Front Street
Wilmington, North Carolina 28401

Carteret Technical Institute
P. O. Box 550
Morehead City, North Carolina 28557

Catawba Valley Technical Institute
Hickory, North Carolina 28601

Central Carolina Technical Institute
Route 2, Box 55
Sanford, North Carolina 27330

Cleveland County Technical Institute
137 S. Post Road
Shelby, North Carolina 28150

Craven Technical Institute
P. O. Box 885
New Bern, North Carolina 28560

Durham Technical Institute
P. O. Drawer 11307
Durham, North Carolina 27703

Edgecombe Technical Institute
P. O. Box 550
Tarboro, North Carolina 27886

Fayetteville Technical Institute
P. O. Box 5236
Fayetteville, North Carolina 28303

Forsyth Technical Institute
2100 Silas Creek Parkway
Winston-Salem, North Carolina 27103

Guilford Technical Institute
P. O. Box 309
Jamestown, North Carolina 27282

Halifax County Technical Institute
P. O. Drawer 809
Weldon, North Carolina 27890

Haywood Technical Institute
P. O. Box 457
Clyde, North Carolina 28721

James Sprunt Institute
P. O. Box 398
Kenansville, North Carolina 28349

Johnston Technical Institute
P. O. Box 29
Smithfield, North Carolina 27577

Martin Technical Institute
P. O. Drawer 866
Williamston, North Carolina 27892

Mayland Technical Institute
147 Oak Street
Spruce Pine, North Carolina 28777

McDowell Technical Institute
P. O. Box 1049
Marion, North Carolina 28752

Montgomery Technical Institute
P. O. Drawer 579
Troy, North Carolina 27371

Nash Technical Institute
P. O. Box 2347
Rocky Mount, North Carolina 27801

Pamlico Technical Institute
P. O. Box 1215
Alliance, North Carolina 28509

Piedmont Technical Institute
P. O. Box 1175
Roxboro, North Carolina 27573

Pitt Technical Institute
P. O. Drawer 7007
Greenville, North Carolina 27834

Randolph Technical Institute
P. O. Box 1009
Asheboro, North Carolina 27203

Richmond Technical Institute
P. O. Box 1189
Hamlet, North Carolina 28345

Roanoke-Chowan Technical Institute
P. O. Box 548
Ahoskie, North Carolina 27910

Robeson Technical Institute
P. O. Box 98
St. Pauls, North Carolina 28384

Rowan Technical Institute
P. O. Box 1555
Salisbury, North Carolina 28144

Sampson Technical Institute
P. O. Drawer 318
Clinton, North Carolina 28328

Southwestern Technical Institute
P. O. Box 95
Sylva, North Carolina 28779

Stanly Technical Institute
621 Wall Street
Albemarle, North Carolina 28001

Technical Institute of Alamance
411 Camp Road
Burlington, North Carolina 27215

Tri-County Technical Institute
P. O. Box 40
Murphy, North Carolina 28906

Vance County Technical Institute
406 Chestnut Street
Henderson, North Carolina 27536

Wilson County Technical Institute
P. O. Box 4305, Woodard Station
Wilson, North Carolina 27893

W. W. Holding Technical Institute
Route 10, Box 200
Raleigh, North Carolina 27603

APPENDIX C-3

Name and Location of Institutes with Business Data Processing Programs within the North Carolina Community College System

APPENDIX C-3

NAME AND LOCATION OF INSTITUTIONS WITH BUSINESS DATA PROCESSING PROGRAMS WITHIN THE NORTH CAROLINA COMMUNITY COLLEGE SYSTEM

Caldwell Community College and
Technical Institute
P. O. Box 600
Lenoir, North Carolina 28645

Central Piedmont Community College
P. O. Box 4009
Charlotte, North Carolina 28204

Coastal Carolina Community College
222 Georgetown Road
Jacksonville, North Carolina 28540

Gaston College
New Dallas Highway
Dallas, North Carolina 28034

Lenoir Community College
P. O. Box 188
Kinston, North Carolina 28501

Rockingham Community College
Wentworth, North Carolina 27375

Sandhills Community College
P. O. Box 1379
Southern Pines, North Carolina 28387

Wayne Community College
P. O. Box 1878
Goldsboro, North Carolina 27530

Wilkes Community College
P. O. Box 120
Wilkesboro, North Carolina 28697

Asheville-Buncombe Technical Institute
340 Victoria Road
Asheville, North Carolina 28801

Catawba Valley Technical Institute
Hickory, North Carolina 28601

Durham Technical Institute
P. O. Drawer 11307
Durham, North Carolina 27703

Fayetteville Technical Institute
P. O. Box 5236
Fayetteville, North Carolina 28303

Forsyth Technical Institute
2100 Silas Creek Parkway
Winston-Salem, North Carolina 27103

Guilford Technical Institute
P. O. Box 309
Jamestown, North Carolina 27282

Pitt Technical Institute
P. O. Drawer 7007
Greenville, North Carolina 27834

Richmond Technical Institute
P. O. Box 1189
Hamlet, North Carolina 28345

Rowan Technical Institute
P. O. Box 1555
Salisbury, North Carolina 28144

Technical Institute of Alamance
411 Camp Road
Burlington, North Carolina 27215

Wilson County Technical Institute
P. O. Box 4305, Woodard Station
Wilson, North Carolina 27893

W. W. Holding Technical Institute
Route 10, Box 200
Raleigh, North Carolina 27603

APPENDIX D

APPENDIX D-1

Pilot Study Subjects

APPENDIX D-1

PILOT STUDY SUBJECTS

COMMUNITY COLLEGES

Name	City
Central Virginia Community College	Lynchburg, Virginia 24500
Danville Community College	Danville, Virginia 24541
John Tyler Community College	Chester, Virginia 23831
Tidewater Community College, Frederick Campus	Portsmouth, Virginia 23700
Virginia Western Community College	Roanoke, Virginia 24000

BUSINESSES AND INDUSTRIES

Babcox and Wilcox	Lynchburg, Virginia 24500
Burlington Industries, Inc.	Clarksville, Virginia 23927
Dan River Mills	Danville, Virginia 24541
Danville City Schools, Board of Education	Danville, Virginia 24541
Fidelity Bank and Trust Company	Lynchburg, Virginia 24500
Keltec Industries, Inc.	Alexandria, Virginia 22300
Lane Company	Altavista, Virginia 24517
Overnite Transportation Line	Richmond, Virginia 23200
Reynolds, Inc.	Richmond, Virginia 23200
Westinghouse, Inc.	South Boston, Virginia 24592

APPENDIX D-2

Questionnaire for North Carolina Hospital Administrators

APPENDIX D-2

March, 1972

Dear Administrator:

I am conducting a study at UNC-G of data processing jobs in businesses and industries in North Carolina and data processing curriculum in community colleges and technical institutes.

I need your assistance, if possible in my study. Would you answer the questions on the attached self-addressed post card and return the card to me as soon as possible.

Thank you for your cooperation.

Jean Overton, School of Business and Economics

______________________________ Hospital

Check either yes or no for the following questions:

	YES	NO
Do you have a computer installation in your hospital?	___	___
Do you have data processing personnel on your staff?	___	___
Do you buy computer services from some agency?	___	___

THANK YOU.

APPENDIX E

APPENDIX E-1

Taxonomy of Job Classifications

APPENDIX E-1

TAXONOMY OF JOB CLASSIFICATIONS

The taxonomy of job classifications is based on job descriptions prepared by the North Carolina State Personnel Department in March, 1971.

Computer Operator

The computer operator is able to operate electronic computers and peripheral equipment during production and testing runs.

Computer Programmer

A computer programmer is able to prepare computer programs and operational routines for electronic data processing systems. Examples of work performed are: block diagrams, flow charts, instruction in computer language to create programs and for debugging computer programs.

Computer Programming Manager

The manager is responsible for supervising, coordinating, and directing the activities of a computer programming staff. Primary responsibility of the manager is direction of the assimilation, preparation, and processing of materials for problem solving by the computer.

Computer Systems Analyst

Beginning analysts assist in the development and installation of working procedures for the adaptation of computer programs to electronic data processing.

Advanced analysts analyze, formulate, and design new or revised systems and methods of applying computer technology for the solution of operational problems.

Some of the duties performed by all analysts are: preparation of proposed systems logic charts, flow process charts, design of punch cards, report formats, conduction of feasibility studies, and project leader for major systems studies.

Computer Systems Manager

The systems manager coordinates and directs the activities of a computer systems analysts staff. The manager provides a consultation service for departments and agencies within the computer system or the installation, operation, and management of automated data processing systems.

Cooperative Computer Programmer Trainee

This position provides for trainees in the areas of Computer Programmer and Computer Operator. The trainee does not meet the training and experience standards for these jobs but has other training, experience, or education that are applicable.

Data Processor

The data processor is skilled in the operation of tabulating equipment (sorters, collators, interpreters, reproducers, accounting machines). Higher level data processors have supervisory duties also.

Data Processor Coordinator

The coordinator is responsible for coordinating data processing activities between a department and central computer installation. Scheduling procedures, preparation of reports, designing and modifying forms, and distribution of data received from the central processing unit are part of the duties of the coordinator.

Data Processing Manager

The manager maintains a supervisory position in coordinating and directing the operations section of a computer installation or tabulating unit.

Key Punch Operator

The key punch operator is responsible for operating alphabetic and numeric key punch machines and verifying machines. The basic responsibility of the operator is key punching cards from source documents and verifying the punched cards.

Key Punch Unit Supervisor

The supervisor is responsible for planning, assigning, directing, and reviewing the work of a group of key punch operators. Training new employees and instructing them in work procedures of the unit are part of the work involved.

APPENDIX E-2

Definitions of Industries Studied

APPENDIX E-2

DEFINITIONS OF INDUSTRIES STUDIED

Shown below is a brief description of each surveyed industry or business. Descriptions are based on the Standard Industrial Classification Manual.

Construction and Other NonManufacturing Industries: SIC 01-17

Included in this division are establishments engaged primarily in contract construction. The three broad types of contract construction activities covered are: (1) building construction by general contractors, (2) other construction by general contractors, and (3) construction by special trade contractors. General building contractors are defined as those engaged primarily in the construction of dwellings, office buildings, etc. Other construction by general contractors include those often referred to as heavy construction contractors who engage in the construction of streets, roads, bridges, tunnels, etc. Special trade contractors are those engaged in activities such as plumbing, painting, or electrical work. Also included in this group are other nonmanufacturing industries such as grain milling, feldspar mining, and greenhouse operations.

Manufacturing Industries: SIC 20-39

This division includes establishments engaged in the mechanical or chemical transformation of inorganic or organic substances into new products. Such operations are usually described as plants, factories, or mills and characteristically use power-driven machines and materials handling equipment. The final product of a manufacturing establishment may be "finished" in that it is ready for utilization or consumption, or it may be "semi-finished" for use in an establishment engaged in further manufacturing.

Transportation, Communication and Public Utilities: SIC 40-49

In this group are enterprises engaged in passenger or freight transportation by rail, highway, water or air or furnishing related services; petroleum pipe line transportation; warehousing; telephone and telegraph communication services; radio and television broadcasting; and the supplying of electricity, gas, steam, water, or sanitary services. Most are legally regarded as having a semipublic character. They are usually regulated by commissions or other public authorities as to rates or prices they may charge and the services they may render.

Trade: SIC 50-59

Included in this classification are two major groups--Wholesale Trade and Retail Trade. The wholesale trade group includes establishments or businesses primarily engaged in selling merchandise to retailers or industrial, commercial, institutional, or professional users; or to other wholesalers; or acting as agents in buying merchandise for or selling merchandise to such persons or companies. The retail trade group includes establishments engaged in selling merchandise for personal, household, or farm consumption, and/or rendering services incidental to the sale of goods. Generally, retail establishments are classified according to the principal lines of commodities sold--groceries, hardware, etc., or the usual trade designation--drug store, cigar store, etc.

Finance, Insurance, and Real Estate: SIC 60-67

Included in this group are establishments operating primarily in the fields of finance, insurance, and real estate. Finance includes banks and trust companies, credit agencies other than banks, holding--but not predominantly operating--companies, other investment companies, brokers and dealers in securities and commodity contracts, and security and commodity exchanges. Insurance includes all types of insurance carriers, agents, and brokers. Real estate includes owners, lessors, lessees, buyers, sellers, agents, and developers of real estate. Generally, establishments in this grouping specialize in either finance, insurance, or real estate. Many small establishments engage in a combination of these activities--no one of which is the principal activity.

Services: SIC 70-39

This category includes establishments engaged primarily in rendering a wide variety of services to individuals and establishments. Hotels and other lodging places; establishments providing personal, business, repair, and amusement services; medical, legal, engineering, and other professional services; educational institutions; nonprofit membership organizations; and other miscellaneous services are included.

Government: SIC 91-93

This division includes Federal and city government activities, such as legislative, judicial and administrative functions, as well as government owned and operated business enterprises.

APPENDIX F

APPENDIX F

Table 60

Titles of Data Processing Courses in Schools

Titles of Data Processing Courses in Schools	Community Colleges	Technical Institutes	Total
ASSEMBLY LANGUAGE*			
Assembly Language	4	4	8
Assembly Language I	2	1	3
Assembly Language II	2	1	3
Assembly Language Programming	1		1
Assembly Language Programming I		2	2
Assembly Language Programming II		2	2
Basic Assembler Language I	1	1	2
Basic Assembler Language II	1	1	2
Business Programming		1	1
Business Programming I	1		1
Compiler Language II		1	1
Program Applications II		1	1
Systems and Procedures		1	1
COBOL LANGUAGE*			
Advanced COBOL		1	1
Advanced COBOL Programming	1		1
Applications I		1	1
Applications II		1	1
Business Applications		1	1

Table 60 (continued)

Titles of Data Processing Courses in Schools	Community Colleges	Technical Institutes	Total
Business Programming		1	1
Business Programming I		2	2
Business Programming II	2	2	4
Business Programming III	1		1
COBOL I	1	3	4
COBOL II	1	3	4
COBOL III	1	1	2
COBOL Programming	2	1	3
COBOL Programming I		1	1
COBOL Programming II		1	1
COBOL Programming III		1	1
Compiler Language I		1	1
Compiler Language II	2	2	4
Computer Language II		1	1
Computer Language IV		1	1
Data Processing Applications II	1	1	2
Program Applications II	1		1
Systems and Procedures		1	1
FORTRAN LANGUAGE*			
Advanced FORTRAN Programming	1		1
Business FORTRAN		1	1
Compiler Language I	2	1	3
Computer Language V		1	1
Data Processing Applications I	1	1	2

Table 60 (continued)

Titles of Data Processing Courses in Schools	Community Colleges	Technical Institutes	Total
FORTRAN	1	2	3
FORTRAN Programming	1	1	2
FORTRAN I		1	1
FORTRAN II		1	1
Introduction to FORTRAN		1	1
Introduction to FORTRAN IV	1		1
Introduction to Scientific Programming		1	1
Programming Applications I	1		1
Programming Concepts I	1		1
Programming Concepts II	1		1
Scientific Programming	1	1	2
Systems and Procedures		1	1
Technical FORTRAN		1	1
PL 1 LANGUAGE*			
Business Programming III		1	1
Business Programming IV	1		1
Computer Language I	1	1	2
Computer Language II	1		1
PL 1	1	1	2
PL 1 I		1	1
PL 1 II		1	1
PL 1 Programming	1	2	3
PL 1 Testing		1	1

Table 60 (continued)

Titles of Data Processing Courses in Schools	Community Colleges	Technical Institutes	Total
RPG LANGUAGE*			
Business Programming		1	1
Business Programming I	1		1
Business Programming III	1		1
Compiler Language II	1		1
Report Program Generator (RPG)	1	1	2
RPG Programming	1	2	3
RPG I		2	2
RPG II		2	2
RPG Testing I		1	1
RPG Testing II		1	1
Systems and Procedures		1	1
CANNED PROGRAMS*			
Computer Systems I	2	1	3
Computer Systems II	2	1	3
Systems Programming I	1		1
Systems Programming II	1		1
Systems Analysis and Techniques I	1		1
Systems Analysis and Techniques II	1		1
Use of Package Programs		1	1
COMBINATION LANGUAGES*			
Compiler Language I	1	1	2
Computer Systems Design I	1		1
Computer Systems Design II	1		1

Table 60 (continued)

Titles of Data Processing Courses in Schools	Community Colleges	Technical Institutes	Total
Data Processing Applications I	1		1
Data Processing Applications II	1		1
Programming Applications I	1		1
OTHER LANGUAGES*			
Business Programming (SPS)		1	1
Introduction to S/370 (OS)		1	1
Neat/3 I		1	1
Neat/3 II		1	1
UNIT RECORD SYSTEMS AND EQUIPMENT*			
Functional Wiring	1		1
Functional Wiring Principals	3	4	7
INTRODUCTION TO DATA PROCESSING*			
Business Data Processing Seminar I	1		1
Business Data Processing Seminar II	1		1
Data Processing Fundamentals	1		1
Introduction to Data Processing	1	2	3
Introduction to Data Processing Technology		1	1
Introduction to Data Processing Systems	4	1	5
Principles of Business Data Processing		1	1

Table 60 (continued)

Titles of Data Processing Courses in Schools	Community Colleges	Technical Institutes	Total
INTRODUCTION TO DIGITAL COMPUTERS*			
Computer Concepts	1		1
Introduction to Computer	1	1	2
Introduction to Computer Concepts	3	6	9
Introduction to Computer Systems	1	1	2
Introduction to Computer Technology		1	1
INTRODUCTION TO COMPUTER PROGRAMMING*			
Computer Language Survey	2	4	6
Introduction to Business Programming		1	1
User Programs	1	2	3
INTRODUCTION TO SYSTEMS ANALYSIS*			
Introduction to Systems Analysis	1		1
Systems Analysis		1	1
Systems Analysis and Design		1	1
Systems Design and Analysis I		1	1
Systems Design and Analysis II		1	1
Systems and Procedures	4	5	9
DATA PROCESSING APPLICATIONS*			
Applications		1	1
Data Processing Applications		2	2

Table 60 (continued)

Titles of Data Processing Courses in Schools	Community Colleges	Technical Institutes	Total
Data Processing Applications I	1	2	3
Data Processing Applications II	1	2	3
DATA PROCESSING MATHEMATICS*			
Computer Mathematics		1	1
Electronic Data Processing Mathematics I		2	2
Electronic Data Processing Mathematics II		2	2
Numbering Systems and Boolean Algebra	1		1
Business Statistics		1	1
Statistical Programming		1	1
Statistics I		1	1
Procedures/Writing, Flow Charting, and Block Diagramming		1	1
Logic and Decision Making		2	2
Symbolic Logic		1	1
Linear Programming	3	3	6
Linear Programming and Critical Path Method	1		1
DATA PROCESSING SYSTEMS*			
Applied Business Systems	2	3	5
Computer Systems	1	3	4
Comparative Computer Systems		1	1
Information Systems	1		1
Operating Systems	1		1
Survey of Data Processing Systems	1		1

Table 60 (continued)

Titles of Data Processing Courses in Schools	Community Colleges	Technical Institutes	Total
PROGRAMMING SYSTEMS*			
Computer Systems I	2	2	4
Computer Systems II	2	2	4
Systems II		1	1
FIELD WORK IN DATA PROCESSING*			
Advanced Projects		1	1
Business Programming Projects		1	1
Data Processing Project	1	3	4
Data Processing Research Project		1	1
Electronic Data Processing Project		1	1
Field Project	1		1
Internship	1		1
Operations Research and Applications Project	1		1
Operations Project	1		1
Programming Language Seminar	1		1
Programming Project	1		1
Research Project	3	3	6
Systems Analyst Project		1	1

*Classification used in analysis of data.

Table 61

Concepts Discussed and Performance Skills Developed in Programming Language Courses in Community Colleges and Technical Institutes Reported by Data Processing Department Heads*

Concepts and Performance Skills	Languages															
	Assembly		COBOL		FORTRAN		PL 1		RPG		Canned Programs		Combination		Other	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Key Punch	4	2	7	4	7	3	2	3	2		2		2	1		
Verifier					1								1			
Sorter					1								1			
Reproducer													1			
Interpreter													1			
Collator													1			
Accounting Machine/ Tabulator													1			
Overview of Unit Record System											1		1			
History of Data Processing					1	1					2					
Principles of Data Processing	1		2	1	3	2		2			2		1			1

Table 61 (continued)

Concepts and Performance Skills	Languages															
	Assembly		COBOL		FORTRAN		PL 1		RPG		Canned Programs		Com-bination		Other	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Principles/Theory of Digital Computers	4	4	1	3	4	2	2	2	1	2	2	2	1			1
Principles of Computer Languages	3	6	5	7	4	5	3	3		3	2		4	1		1
Computer Applications	7	9	9	14	9	9	2	4	3	3	4	3	4	1		1
Computer Console	5	6	5	9	8	2	2	1	2	2	3	2	2			
Card Processor	3	4	2	6	4	2	1	1	1		2	2	1			
Card Layout and Design	5	6	6	12	7	7	2	4	2	3	4	2	2			2
Form(s) Design	5	7	6	12	7	7	2	4	2	3	2	2	2			2
Flow Charting	11	10	14	16	11	9	5	4	3	2	4	2	3	1		2
Program Card	2			2	3		1									
Coding and Condensing Data	6	6	10	13	8	7	2	3	3	2	7	2	3			2
Procedures Development	2	3	5	10	4	4	1	2	1		4	2	2			2
Data Scheduling System		1	4		3						4	2	3			

Table 61 (continued)

Concepts and Performance Skills	Languages															
	Assembly		COBOL		FORTRAN		PL 1		RPG		Canned Programs		Com-bination		Other	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Information Systems		1	5	4	4			1			7	2				
Computer Equipment	4	2	2	10	5	4	1	3	1	3	7	1	2			
Auxiliary Equipment	1	1	2	1	1	2	1	1		1	6	2	2			
Boolean Algebra	1	1	2		2	2	1	1					1			
Logic	4	6	6	10	7	5	3	3	1		1					1
Fixed and Floating Point	5	4	7	10	9	10	4	5	1	2	1		1			1
Number Systems	3	2	3	4	3	5	2	5	1							1
Computer Logic	4	5	6	14	4	7	3	5	2	4	1		2	1		2
Programming Instructions	11	11	14	18	10	13	5	7	5	9	3		5	1		3
Programming Essentials	9	6	13	16	8	9	5	7	5	7	2		4			3
Programming Systems	5	4	8	11	5	6	4	5	1	5	5		4			3
Assembly Language (Machine or Symbolic)	11	11	2		2						1		2			1
COBOL			14	26									3			1
FORTRAN					11	14		1		1			3	1		1

Table 61 (continued)

Concepts and Performance Skills	Languages															
	Assembly		COBOL		FORTRAN		PL 1		RPG		Canned Programs		Com-bination		Other	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
PL 1 (Programming Language)							5	8					5	1		
RPG (Report Generator)	1								5	11			1			
ALGOL													1			
AUTOCODER													1			
Canned Program(s) (Library)	1	2	3	3	1	6	1	1		2	8	3	1			2
Magnetic Tape Library	3	1	4	3	6	2	2	3	1		7	2	1			
Central Processing Unit (CPU)	4	4	2	6	3	7	1	3		2	5		2			4
Registers	8	9	3	7	4	7	1	1		2	6		3			4
Technique(s) of Teleprocessing		6	2	4	4	5		3		2	7	2	4			2
Terminal Unit	3	4	6	9	5	6	2	5	3	3	5	2	4	1		2
Characteristics of Core Memory	4	4	2	4	3	3	1	4		3	4		2			
Subroutine(s)	2	3	4	14	3	9	2	7		2	4		5			2

Table 61 (continued)

Concepts and Performance Skills	Languages																	
	Assembly		COBOL		FORTRAN		PL 1		RPG		Canned Programs		Com-bination		Other	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Loops and Indexing	7	9	6	20	7	14	3	8	1	7	2		4			4
Input/Output Control(s)	5	5	8	15	6	12	1	7	2	7	3		4			4
Job Timing	1	2		8	1	1		4		3	5	2	4			
Program Random Access Device	2	4	3	18	3	8		5	1	9	7		4			4
Debug Programs	9	6	10	16	8	9	4	5	4	5			3	1		2
Sort-Merge Program	1	3	10	10	2	3	1	1	1	2	5		1			2

*Concepts and skills may have been mentioned by the same school more than once in a different course.

Table 62

Concepts Discussed and Performance Skills Developed in Data Processing Courses in Community Colleges and Technical Institutes Reported by Data Processing Department Heads

Concepts and Performance Skills	Data Processing Courses: Unit Record Sys. & Equip.		Intro. to D. P.		Intro. to Digital Comp.		Intro. to Comp. Lang.		Intro. to Sys. Anal.		D. P. Appli.		D. P. Math.		D. P. Sys.		Prog. Sys.		Field Work in D. P.	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Key Punch	3	3	6	5	2	5									2				3	3
Verifier	3	2	5	5	2	6														2
Sorter	4	3	5	5	2	6														2
Reproducer	4	4	5	5	2	5														2
Interpreter	2	3	5	5	2	4														2
Collator	4	4	5	5	2	5														2
Accounting Machine/ Tabulator	3	4	4	5	2	6														2
Overview of Unit Record System	4	4	5	5	3	7								2						2
History of Data Processing	1	1	5	5	4	8									1					1
Principles of Data Processing	1	1	7	5	3	8			2	2		3		2	2					1

Table 62 (continued)

Concepts and Performance Skills	Data Processing Courses																			
	Unit Record Sys. & Equip.		Intro. to D. P.		Intro. to Digital Comp.		Intro. to Comp. Lang.		Intro. to Sys. Anal.		D. P. Appli.		D. P. Math.		D. P. Sys.		Prog. Sys.		Field Work in D. P.	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Principles/Theory of Digital Computer			5	4	3	8					2	2		3	1		4			1
Principles of Computer Languages			5	5	4	7	1			1		1			1		1	1	1	2
Computer Applications		1	8	5	3	4	2	2	2	3		6	2	7	3	3	1	2	5	8
Computer Console		1	2	3	1	3		1		2	2				2			1	1	3
Card Processor	2		2	3	1	5		1		3		1			1			1		4
Card Layout and Design	2	1	5	5	3	4	2	1	3	6	2	4		5	3	2	2	1	5	6
Form(s) Design	1	1	2	4	3	2	3	1			2	4		5	2	2		1	3	8
Flow Charting		1	6	5	3	4	3	2	3	4	2	4	1	8	4	2		2	6	7
Program Card	4	3	5	5	1	4										1				1
Coding and Condensing Data			5	4	3	3	2	2	3	5	2	3	1	6	3	2	2	2	5	5
Procedures Development			1	2	1	2	2	1	5	7	2	4		6	3	3	2	2	6	7
Data Scheduling System				2	1		2		3	4	2	2	1	1	1	1	4		3	3
Information Systems			4	3	2		1	1	3	5	2	3		2	2	1		1	4	3
Computer Equipment			7	5	4	7	1		1	6		4		2		3	4	2	2	6
Auxiliary Equipment	1	1	7	4	2	6			1	6		5				3	4	1	1	5

Table 62 (continued)

Concepts and Performance Skills	Unit Record Sys. & Equip.		Intro. to D. P.		Intro. to Digital Comp.		Intro. to Comp. Lang.		Intro. to Sys. Anal.		D. P. Appli.		D. P. Math.		D. P. Sys.		Prog. Sys.		Field Work in D. P.	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Boolean Algebra			2	2	2									8						
Logic			3	2	4	2		1		2		2	2	9		1	2		1	4
Fixed and Floating Point			2	2	4	1			1					3			2			1
Number Systems			3	4	6	8							1	7			2			1
Computer Logic	1		3	2	4	7		1		3		2		5		1	4	3		4
Programming Instructions			3	5	2	7	2	2				1	1	1		1		3	3	5
Programming Essentials			2	3	3	5	2	1				3	1	3				1	3	4
Programming Systems			2	3	3	3	1	1	1	3		3		1	1	3		2	2	7
Assembly Language (Machine or Symbolic)			1	5		3									1	1	2	1	2	3
COBOL			1	4		2	2	1							2		2	1	4	8
FORTRAN			3	3	2	2	1	1						1	2			1	2	3
PL 1			1	3		1	2	2							1		2	1	1	1
RPG (Report Generator)			1	4		1	2	3										1	1	2
ALGOL			1	1			1	1												
AUTOCODER			1	1				1												
Canned Program(s) (Library)			1	4	3	2	1	1	2	2	2	2	2	5	2	1				2

Table 62 (continued)

Concepts and Performance Skills	Data Processing Courses																			
	Unit Record Sys. & Equip.		Intro. to D. P.		Intro. to Digital Comp.		Intro. to Comp. Lang.		Intro. to Sys. Anal.		D. P. Appli.		D. P. Math.		D. P. Sys.		Prog. Sys.		Field Work in D. P.	
	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI	CC	TI
Matnetic Tape Library			1	3	4	1	1	1	2	2	2	3			1		2			2
Central Processing Unit (CPU)			4	5	4	6				1		2		3			4	3		4
Registers	1		2	2	5	3		1							1		2	1	1	2
Technique(s) of Tele-processing			3	2	3	3	1	2	1	4		4		1		3	2	2	2	3
Terminal Unit			4	4	3	3	2	2	1	3		4	1	1		2	2	2	3	3
Characteristics of Core Memory			4	5	6	6						1				1		1		3
Subroutine(s)			1	2	1	2	2	1	1	1		1		3	2	1			2	3
Loops and Indexing			1	2	2	4	2	1				1		3	1	1		1	2	4
Input/Output Control(s)			3	1	1	1	1	1	1	1	2	1		4	1	1			2	4
Job Timing			1	1	1	1	1		1	1	2	3		2	1	1	2		1	2
Program Random Access Device			3	1	2	4	1	3	1	1	2	1		1	1		4	1	1	4
Debug Programs				1	1	1	2	2			2	3		2	1	1		2	2	3
Sort-Merge Program				2		1	1	1						1	1	2	2	1	1	2

*Concepts and skills may have been mentioned by the same school more than once in a different course.

Table 63

Data Processing Courses Offered Indicating the Primary Objective(s) of Each Course Reported by Departments Heads in Community Colleges and Technical Institutes*

Data Processing Courses	Total Schools Offering			Primary Course Objective																							
				Cognitive Understanding						Acquaintanceship Skills						Hands-On Experience						Production Skills and Understanding					
	CC	TI	Total	CC		TI		Total		CC		TI		Total		CC		TI		Total		CC		TI		Total	
				N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Programming Languages																											
Assembly	12	15	27	3	25.0	2	13.3	5	18.5	4	33.3	5	33.3	9	33.3	4	33.3	11	73.3	15	55.6	7	58.3	7	46.7	14	51.9
COBOL	15	25	40	2	13.3	4	16.0	6	15.0	4	26.7	6	24.0	10	25.0	6	40.0	13	52.0	19	47.5	9	60.0	18	72.0	17	42.5
FORTRAN	11	14	25	4	36.4	1	7.1	5	20.0	2	18.2	5	35.9	7	28.0	5	45.5	10	71.4	15	60.0	7	63.6	8	57.1	15	60.0
PL 1	5	8	13	2	40.0	1	20.0	3	23.1	2	40.0	4	50.0	6	46.2			7	87.5	7	53.8	3	60.0	2	25.0	5	38.5
RPG	5	11	16	1	20.0	1	9.1	2	12.5			2	18.2	2	12.5	1	9.1	10	12.5	11	68.8	5	20.0	7	63.6	12	75.0
Canned Programs	8	3	11	1	12.5			1	9.1	1	12.5	2	66.7	3	27.3	2	25.0	1	33.3	3	27.3	4	50.0			4	36.4
Combination	6	1	7	2	33.3			2	28.5	1	16.7			1	14.2	3	50.0	1	100.0	4	57.1	3	50.0			3	42.9
Other		4	4			1	25.0	1	25.0			2	50.0	2	50.0			2	50.0	2	50.0			1	25.0	1	25.0
Unit Record Systems and Equipment	4	4	8	1	25.0	1	25.0	2	25.0	1	25.0	2	50.0	3	37.5	4	100.0	3	75.0	7	87.5	2	50.0	1	25.0	3	37.5
Introduction to Data Processing	9	5	14	8	88.9	2	40.0	10	71.4			3	60.0	3	21.4	3	33.3	2	40.0	5	35.7	1	11.1	1	20.0	2	14.3

Table 63 (continued)

Data Processing Courses	Total Schools Offering			Primary Course Objective																							
				Cognitive Understanding						Acquaintanceship Skills						Hands-On Experience						Production Skills and Understanding					
	CC	TI	Total	CC		TI		Total		CC		TI		Total		CC		TI		Total		CC		TI		Total	
				N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Introduction to Digital Computers	6	9	15	5	83.3	6	66.7	11	73.3	1	16.7	5	55.6	6	40.0	1	16.7	1	11.1	2	13.3						
Introduction to Computer Languages	3	7	10			2	28.6	2	20.0			2	28.6	2	20.0	3	100.0	2	28.6	5	50.0	3	100.0	1	14.3	4	40.0
Introduction to Systems Analysis	5	9	14	1	20.0	3	33.3	4	28.6	2	40.0	2	22.2	4	28.6	2	40.0	3	33.3	5	35.7	1	20.0	4	44.4	5	35.7
Data Processing Applications	2	7	9									1	14.3	1	11.1			4	57.1	4	44.4	2	100.0	3	42.9	5	55.6
Data Processing Mathematics	4	15	19	3	75.0	7	46.7	10	52.6	1	25.0	7	46.7	8	42.1	1	25.0	6	40.0	7	36.8	1	25.0	5	33.3	6	31.6
Data Processing Systems	5	7	12	1	20.0	1	14.3	2	16.7							1	20.0	3	42.9	4	33.3	3	60.0	4	57.1	7	58.3
Programming Systems	4	5	9			2	40.0	2	22.2	2	50.0	3	60.0	5	55.6			1	20.0	1	11.1	2	50.0	1	20.0	3	33.3
Field Work in Data Processing	10	11	21	1	10.0	1	19.1	2	9.5			2	18.2	2	9.5	5	50.0	4	36.4	9	42.9	9	90.0	10	90.9	19	90.5

*Data processing department heads could indicate more than one objective.