Study to develop a course in electronic data processing for the secondary schools in the greater Seattle area, Washington

Edyth Welborn Henderson

The University of Montana

Let us know how access to this document benefits you.

Follow this and additional works at: https://scholarworks.umt.edu/etd

Recommended Citation
https://scholarworks.umt.edu/etd/3768

This Thesis is brought to you for free and open access by the Graduate School at ScholarWorks at University of Montana. It has been accepted for inclusion in Graduate Student Theses, Dissertations, & Professional Papers by an authorized administrator of ScholarWorks at University of Montana. For more information, please contact scholarworks@mso.umt.edu.
A STUDY TO DEVELOP A COURSE IN ELECTRONIC DATA PROCESSING FOR THE SECONDARY SCHOOLS IN THE GREATER SEATTLE AREA, WASHINGTON

By

Edyth W. Henderson
B.A., University of Washington, 1967
Presented in partial fulfillment of the requirements for the degree of Master of Science UNIVERSITY OF MONTANA 1970

Approved by:

[Signatures]
Chairman, Board of Examiners
Dean, Graduate School
Date August 6, 1970
ACKNOWLEDGEMENTS

I am grateful to Dr. Donald B. Koeppen and Dr. George J. Brabb for the opportunity of participating in the Experienced Teacher Fellowship Program at the University of Montana and for their encouragement and interest throughout the year.

The assistance given by Professor Margaret A. Swanson, which was beyond the call of duty, is sincerely appreciated.
TABLE OF CONTENTS

ACKNOWLEDGEMENTS ........................................ ii
LIST OF TABLES ........................................ v

Chapter

I. INTRODUCTION ........................................ 1
   STATEMENT OF THE PROBLEM ............................ 2
   SIGNIFICANCE ........................................ 2
   LIMITATIONS AND PROCEDURE ............................ 3
   DEFINITIONS .......................................... 3

II. REVIEW OF RELATED LITERATURE ..................... 5
   JOB OPPORTUNITIES IN EDP ............................ 6
   QUALIFICATIONS FOR EMPLOYEES IN EDP ............... 8
   EDP FOR THE COLLEGE-BOUND STUDENT .................. 19
   EDP FOR GENERAL KNOWLEDGE ........................... 24
   EDP COURSE OUTLINES FOR SECONDARY SCHOOLS ........ 26

III. RESULTS AND INTERPRETATION OF DATA ............. 32
   METHOD OF PROCEDURE ................................ 32
   COLLEGE SURVEY ...................................... 33
   BUSINESS SURVEY ..................................... 36
   SUMMARY .............................................. 43

IV. OUTLINE FOR A ONE-SEMESTER DATA PROCESSING
    COURSE AT THE SECONDARY SCHOOL LEVEL .......... 44
    COURSE OUTLINE .................................... 46

V. CONCLUSIONS AND RECOMMENDATIONS ................ 50
   CONCLUSIONS ......................................... 50
   RECOMMENDATIONS .................................... 51

BIBLIOGRAPHY ............................................. 53
<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPENDIXES</td>
<td>61</td>
</tr>
<tr>
<td>A. Letter of Transmittal - College</td>
<td>62</td>
</tr>
<tr>
<td>B. College Questionnaire</td>
<td>63</td>
</tr>
<tr>
<td>C. Letter of Transmittal - Business</td>
<td>64</td>
</tr>
<tr>
<td>D. Business Questionnaire</td>
<td>65</td>
</tr>
<tr>
<td>E. Annotated Textbook Bibliography</td>
<td>68</td>
</tr>
</tbody>
</table>
# LIST OF TABLES

<table>
<thead>
<tr>
<th>Table</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>I. DEGREE OF PREPARATION DESIRABLE FOR COLLEGE-BOUND STUDENTS MAJORING IN EDP</td>
<td>35</td>
</tr>
<tr>
<td>II. UNIT RECORD EQUIPMENT</td>
<td>36</td>
</tr>
<tr>
<td>III. COMPUTER EQUIPMENT</td>
<td>37</td>
</tr>
<tr>
<td>IV. PROGRAMMING METHODS</td>
<td>38</td>
</tr>
<tr>
<td>V. QUALIFICATIONS SOUGHT IN DATA PROCESSING EMPLOYEES</td>
<td>39</td>
</tr>
<tr>
<td>VI. BACKGROUND DESIRABLE FOR EDP EMPLOYEES</td>
<td>41</td>
</tr>
<tr>
<td>VII. INITIAL TRAINING</td>
<td>42</td>
</tr>
</tbody>
</table>
CHAPTER I

INTRODUCTION

Business educators have taught data processing for years, and it became automated data processing when calculators and other machines were introduced into the classroom. Shortly after the invention of the computer, many schools added courses in electronic data processing; and since that time the "field of computers and education has grown impressively."^1

Though the growth has been impressive, there still exists a shortage of electronic data processing personnel; and many students are graduating from both secondary and higher educational institutions without an understanding of what the computer revolution is about. Tondow says:

We think it has as much meaning to the girl who will become a housewife as to someone who plans to go on to college, whether it be in the humanities or the sciences. Unless we provide our students these opportunities we will not be meeting our responsibilities.

... Within ten years it will be as difficult for a person to fulfill his goal as a citizen without some knowledge of the computer sciences as it now is for an individual to exist in our society without an understanding of the automobile, what it is and has done, whether he drives one or not.2

---


STATEMENT OF THE PROBLEM

The purposes of this study were (1) to determine the minimum employment requirements for entry positions in the field of electronic data processing in the Greater Seattle Area, Washington; (2) to determine what post-secondary schools require as preparation for entrance into a course of study in electronic data processing; (3) to develop guidelines for courses in electronic data processing to be taught at the secondary school level.

SIGNIFICANCE

As far as can be ascertained, there has been no study made in the Greater Seattle Area of college entry or job entry requirements in the field of electronic data processing on which to base content of courses taught at the secondary level.

Many high schools are reacting to the great technological changes computers are having by quickly instituting courses in data processing. Because of the cost in time and money for such courses of study, they should be designed to fulfill the needs of the students and community. Education programs at the secondary and college level should be articulated to achieve a continuity in program from one level to the other.

It is hoped the suggestions made here will be helpful to those schools which have existing courses as well as those which are still in the planning stages.
LIMITATIONS AND PROCEDURES

The survey was limited to the Greater Seattle Area which encompasses the City of Seattle, population of 700,000, and numerous suburban municipalities of from ten to twenty thousand population each. The total population of the area is approximately 1,200,000. There are six community colleges and three 4-year colleges in the area. A questionnaire concerning courses desirable for high school students whose college major would be either data processing or computer science was sent to all colleges in the area.

Another questionnaire was sent to six selected commercial firms known to be users of electronic data processing equipment to determine what skills, training, and education were necessary for job entry in the data processing field. The survey was limited to large firms because more opportunity exists in large computer installations for first-level entry occupations open to high school graduates.

College catalogs from the area were consulted regarding prerequisites for data processing courses, and literature on present courses of study at the secondary school level was examined.

DEFINITIONS

DATA PROCESSING. The mechanical or electronic handling of data for the production of records and reports.
EDP. Electronic Data Processing. The processing of data by electronic devices.

SECONDARY SCHOOL. Any school that has a four-year (9th through 12th grade) or a three-year program (10th through 12th grade).

COMMUNITY COLLEGE. Equates to Junior Colleges and the education offered at the freshman and sophomore levels of a college or university.

ARTICULATION. The interrelation of different levels of education (as elementary education, secondary education, higher education) for ensuring continuous advancement in learning.
CHAPTER II

REVIEW OF RELATED LITERATURE

Business education at the secondary level is thought by many to be a course of study for the single purpose of preparing students for job entry. While this is a very important aspect of the business education curriculum, there are other areas of equal importance such as preparation for further study either in business, science, or liberal arts; and general knowledge that will enable students to become productive citizens in today's automated society.

Many writers in the field are proclaiming the necessity of including courses in electronic data processing at the secondary level and suggesting that these courses can best be taught in the business department. In a survey of data processing at any level, Dr. Gibson found "almost all data processing courses in high school are of the business type, 90.5 percent of them." The increasing use of computers in business, education, research, and personal life further emphasizes the need for a business education curriculum that will encourage flexibility and adaptability by the students.

---

Following is a summary of literature reviewed relating to developing guidelines for a course of study in EDP which will benefit the student who is terminating school at the end of high school as well as the college-bound student. This review encompasses literature pertaining to job opportunities and qualifications for employees in the EDP field, articulation between high schools and institutions of higher learning, general education concerning computers which will enable all students to become better informed citizens, and course outlines suggested by educators as a result of intensive investigations concerning content of a high school course in EDP.

**JOB OPPORTUNITIES IN EDP**

Philip H. Weber, management consultant specializing in employee compensation and publisher of the "Annual Salary Survey Report for 81 Data Processing Positions," estimated that the number of people working in data processing would approximate one million by the early 1970s. His projection was based on a 1967 nationwide survey of 2,500 companies in 60 industries in 465 cities, representing a 20 percent sample of the industry. At that time the companies surveyed used 4,000 computers and employed 110,000 people in 81 positions usually found in data processing and unit record equipment.4

4"Should U. S. Schools Teach DP?" *Education Age*, (September-October, 1967), p. 45.
In an article on opportunities in EDP, Robert Kriegbaum stated:

Whatever may happen in the way of future advances in computer technology, it is unlikely that the need for qualified personnel will abate in the near future. In fact, the shortage will probably grow more acute in the 1970s, even though training will become more widespread than it is today.5

Richard L. Castro reported in April, 1970, that the data processing industry had grown from $1.1 billion to $5.6 billion in sales in ten years. This represents an increase of 511 percent.6

Writing on computer development in the Federal Government, specifically the military establishment, Colonel Thomas G. Watkins, Jr., states:

In 1954, there were 10 computer systems in operation within the Federal Government. By 1962, there were over 1,000. Now there are over 5,000, not including an estimated 2,000 systems contractors have either leased or purchased at the Government's expense. Nor do these totals include defense systems, or operational elements in missile and space vehicles.

The Federal Government, with an annual expenditure of between 3 and 4 billion dollars, is the world's largest user of automatic data processing. More significantly than the present usage of ADP in the Government, is the fact that it is likely to double every three years, and to continue to do so indefinitely.7

---


Lois Plowman states that since 1950 white-collar employment has increased twice as fast as total employment, and that the United States Department of Labor says that automation will create 8.4 million more jobs by 1970.  

QUALIFICATIONS FOR EMPLOYEES IN EDP

In a study by Adaline Jones to determine the knowledges and skills needed by high school graduates seeking employment in digital computer units in business, the following summary of findings was made:

1. Twenty-seven first-level entry occupations for which the high school graduate can qualify were found.

2. More opportunity exists for a high school graduate to secure employment in large enterprises and in large computer installations for most of the first-level entry occupations.

3. Opportunities exist for employment as keypunch operators and tabulating machine operators in enterprises and computer installations of all sizes.

4. Training for employment in first-level entry occupations should include getting along with people; performing work according to a schedule and a sequence; typewriting; clerical recordkeeping; handling source documents; preparation of flow charts and block diagrams; filing, including punched cards, magnetic tape, and paper tape; familiarization with tabulating and computer equipment; and, in some cases, introduction to equipment operation.

5. Because of the characteristics of the rapidly developing computer technology, the type of education or training program needed in the high school is one that will provide the student with flexibility; emphasize to him the need for continuing education because of

---

changes in technology, and inform him of the occupa-
tions which exist, the background of education and
work experience he will need, and the agencies which
will provide him with the appropriate education and
training.

6. There seems to be a tendency for employment require-
ments to become more stabilized as the occupations are
in existence for longer periods of time.9

A survey of 540 data processing installations in the
Detroit area revealed that 60 percent of all data processing
personnel are found in two job classifications; keypunch
operators and machine operators. As a result of this survey,
Fred S. Cook feels that:

Basically a high school education is sufficient for
securing employment in a data processing installment.
This has been so in the past, is the pattern today, and
was the projected pattern for the immediate future in all
but two job classifications—systems analysts and super-
visors. In the latter cases, approximately 40 percent of
the companies have or will hire persons with no more than
high school training for even these two positions.10

Mary Jane Andersen surveyed a random sampling of
business teachers in the Minnesota secondary schools to deter-
mine future job opportunities for clerical employment in view
of increased use of electronic business data processing
machines. Her summary included the following:

1. Small-, medium-, and large-sized offices are using
more business data processing machines to perform
routine tasks efficiently and accurately.

9Adaline Dorothy Seitz Jones, "A Survey to Determine the
Knowledges and Skills Needed by Clerical Workers in First-Level
Entry Occupations in Digital Computer Installations," National
Business Education Quarterly, XXXIV (Fall, 1965), 30-31.

10Fred S. Cook, "The Need for In-School Business Data
Processing Programs," National Business Education Quarterly,
XXXVI (Fall, 1967), 15.
2. The number of clerical workers has been increasing rapidly, and some believe that it will continue to increase even with automation.

3. High-school students may secure positions as keypunch and verifier operator, tabulator-equipment operator, console operator, programmer, card method analyst, or computer operator without additional training in data processing.\(^\text{11}\)

An appraisal of occupational opportunities for high school graduates in EDP in 25 firms in Columbus, Ohio, elicited the following:

1. In nine companies computers were being handled by high school graduates.

2. Thirty-six percent of the firms used high school graduates in the programming section.

3. As machines become less and less complicated, more opportunities will be available for high school graduates.

4. There is a high demand for persons with skills in all phases of EDP, but those with more education will obtain better positions.\(^\text{12}\)

A similar survey was made of 219 firms in St. Louis, Missouri, by Sharron Dale Kovach. A summary of her findings follows:

1. The highest educational level required for keypunch operators, tabulating machine operators, tape librarians, and other clerical workers was high school completion.

\(^{11}\text{Mary Jane Andersen, "Integrating Office Automation Knowledge into High School Business Education" (unpublished Master's dissertation, Mankato State College, 1965).}\)

2. The majority of respondents required only a high school education for console and computer operators, programmers, and control clerks; while in the area of systems and management, less than 50 percent required only high school completion.

3. All jobs except tape librarian, control clerk, and miscellaneous clerical required data processing knowledge and training before hiring.

4. In all occupations except systems analyst, the majority of respondents had no preference for any particular training institution when asked to choose between high schools, private business schools, manufacturers' schools, and colleges.

5. To instill the necessary attributes in potential employees, employers felt the high school training most useful would be data processing concepts and theory, mathematics, communication skills, general business subject, bookkeeping, machine operation, and personal traits of dependability, logic, honesty, initiative, and flexibility.

6. Eighty-seven percent of those responding stated that, if at all possible, their policy was to promote to higher level positions from personnel already employed in the company.

7. When asked if advancement was possible from entry-level jobs into management or supervisory positions, 92 percent of the respondents answered "yes." MacDonald noted a tendency for business managers to look to secondary schools as a source of training in data processing. In a summary of his findings he stated:

1. There has been a decrease in the demand for unskilled office employees while the total need for office workers has increased.

2. Office employees of the future who hope to be successful will need an understanding of the principles of data processing.

---

3. As systems and procedures have stabilized, businessmen have found that many positions no longer require the same high set of standards for employees.

4. Frequently, high school graduates with reasonable intelligence and ability to follow directions have been found to be successful employees.\textsuperscript{14}

Bunch also found that business managers are of the opinion public schools should train students for some of the data processing jobs in industry. He surveyed 800 business firms in the Charlotte-Mecklenburg, North Carolina, area and reports the following:

1. Those firms with data processing equipment had 678 keypunch positions and 1,077 programming staff members, giving a total of 1,755 skilled-level positions in data processing employment in this one survey.

2. Fifty-five percent indicated that they train their own keypunch operators; but 95 percent believe that public schools should train keypunch operators, and 75 percent also indicated that the schools should train computer operators.

3. Ninety-one percent want public schools to train students in the basic concepts of programming for vocational purposes; however, only 60 percent felt that unit-record board wiring should be taught in the public schools.

4. Seventy-six percent noted a shortage in the availability of data processing personnel in the positions of programmers, keypunch operators, and machine operators, in that order.

5. Eighty-two percent indicated they would be willing to interview a well-informed graduate in the field of data processing for possible employment.

5. A minimum educational attainment of high school graduation was required by 35 percent of the firms.15

Lois Y. Harrison concluded from her study of 305 business firms in Westchester County, New York, the following:

1. Although the majority of firms require a skill level of pre-employment training for operators of EDP equipment, there were some who require only an acquaintanceship level of training and a lesser number who require no pre-employment training. Most companies give post-employment training on this equipment, either by the company or by outside agencies at the company's expense. Office practice instruction should include a unit on automation, and all students should have a knowledge of the terminology, types of machines and their uses, and job opportunities for operators of EDP equipment. Since it was indicated that the job of card-punch operator was the most difficult to fill, serious consideration should be given to providing training on this machine.

2. The majority of businesses are not interested in clerical workers who are capable of doing only routine, repetitive work and who are not capable of being upgraded for promotion. Although there are openings for this type of person, particularly in large firms employing over 100 clerical workers, the office practice teacher should attempt to give to the students the basic skills, knowledges, and attitudes which will prepare them for upgrading and promotion.16

In 1963 LaSalle did research in the area of preparing high school students for employment in business offices using data processing equipment. He found that business educators and businessmen were in agreement that one of the objectives in business education programs should be to prepare students

---


for employment in offices using automated data processing equipment. Also, business education departments should give more attention to emphasizing and developing problem-solving and logical-thinking skills. Survey participants further indicated that business education departments should offer a separate, one-year course on automation including a study of the following units: types of automated equipment available, employment opportunities in the field of automation, an orientation to data processing, and automated equipment operation.  

Carolyn Godby made a study of clerical employees in data processing occupations in the Pekin-Peoria, Illinois, area to identify opportunities and requirements for these positions for the purpose of advising changes in the business education curriculum so that students could be better prepared. A high school education was required in all cases, and the following were rated as being most beneficial: courses in English pertaining to grammar, composition, and related expressions; courses in mathematics, particularly algebra; courses in bookkeeping and accounting; courses in beginning and advanced typewriting; and courses in office machine operation. Also, the employees were expected to have the kind of personality

traits enabling them to work well with others and demonstrating resourceful methods of approach to new problems.

She found employers were in general agreement that a need existed for training of data processing workers prior to placement on the job. They felt the following agencies, in the order listed, should provide the training: high schools, equipment companies, business colleges, employers, colleges or universities, and adult education programs operated by the local public school system.\(^\text{18}\)

Manning polled business educators who were members of the Chicago Area Business Education Department Chairmen Association and businessmen who were members of the Data Processing Management Association, Chicago Branch, concerning subject matter content for a one-semester introductory course in data processing in high school with these results:

1. All indicated that an introductory course in data processing should be offered at the secondary school level.

2. Businessmen are willing to hire high school students to work in their data processing departments.

3. A basic understanding of the punched card and the functions and capabilities of the keypunch, sorter, and collator is necessary.

4. COBOL was the first choice of a specific computer language for an introductory course, and AUTOCODER was the second choice.

5. Both groups would prefer students to have hands-on experience with the data processing equipment. According to Clair Parsh, many entry-level jobs in data processing are available to high school graduates. In his article he lists minimum requirements set forth by the United States Employment Service for some of the typical jobs in business data processing as:

1. Key punch or card punch trainee: high school education, skill in typing, ability to do simple clerical work, and an aptitude for machine work. From the trainee position, the only requirements for promotion to supervisor are experience requirements.

2. Tabulating machine and equipment operator trainee: high school education, aptitude for this type of occupation, may be required to have a background in bookkeeping or accounting, and ability to wire control boards. In many cases, tabulating equipment wiring courses are provided as on-the-job training.

3. Programmer: high school graduate with an aptitude for programming may be hired with no experience and trained by the equipment manufacturer.

The following information was included in a summary of James F. Wenner's study to determine the minimum employment requirements for positions in EDP in selected businesses in the state of Iowa:


The results of the questionnaire to business firms in Iowa clearly show that twelve years of education is a must for persons entering the field of data processing. It also shows that in almost all cases these persons should be high school graduates. Fifty percent of the firms required keypunch and verifier operators to have typewriting in high school. This was the only job classification in which fifty percent or more of the firms surveyed require a specific high school course or courses in business. A college degree was a minimum requirement in eight to forty percent of the firms for only four job categories—electronic data processing analyst, punched-card methods analyst, systems analyst, and tab equipment supervisor. Nine to sixty-two percent of the firms require from one to sixty months of electronic data processing experience for new employees. General business, secretarial, clerical, and accounting experience are required by few firms. Eleven to forty-two percent of the firms require tab equipment experience of three to six months. Fifteen to forty-six percent of the firms require new employees to attend their company school for one to twenty-four months, and nineteen to seventy percent of the firms require new employees to attend an equipment manufacturer's school from one to twelve months. Vocational schools were not considered an important source for training employees.

A part of the comprehensive report by Bangs and Hillestad concerning their study of the common body of knowledge needed for entry into selected office occupations in data processing lists the following findings:

1. High school graduates from data processing programs may enter the following data processing jobs: Keypunch operator, unit record operator, tape librarian, and computer operator.

2. Graduates of two-year post high school institutions may enter the same jobs as those who graduate from high school data processing programs, but in addition, the following jobs are available to them: programmer, systems analyst (with some further experience and training), and supervisor of data processing (with experience and possibly further training).

3. Generally, the jobs in data processing will become more complex rather than proliferate.

4. Computer manufacturers indicated that little change would take place in computers in the next three to ten years except for miniaturization and greater memory unit capacity; thus, many of the jobs now available will continue to be prevalent for several years to come.

5. With the relative decrease in use of punched cards as input, the proportion of key punch and verifier operators will decrease.

6. Advances in the software will be extensive in the next three to ten years; consequently, opportunities will expand for persons trained in the use of the new software as it is developed and accepted.

7. Programmers will not need to be as technically trained as is presently true. Graduates of two-year post high school programs will be adequately trained for programming positions. However, the programmer as he is known today will become important to the business organization if he is prepared to move into a systems analysis position. Businesses will want their programmers to have the necessary background training to move into the position of systems analyst, or expect the programmer to continue his training on the job so that he may move into the higher level position.

8. Unit record equipment is being phased out with the installation of smaller computers. The position of unit record equipment operator will not be as prevalent in the near future as it has been in the past.

9. Opportunities for persons to program software equipment as it is developed will increase greatly.

10. Persons who will be classified as Applications Specialists will be increasingly in demand. These people will advise businesses on how to use automated systems.

11. An administrative level position possibly will emerge, a person known as an Automated Data Management Specialist, who will be responsible for deciding what to do with the data from the computer. His job will be to teach management through application.

12. As the use of time sharing increases, more and more business employees will need to understand automatic data processing. In a time-sharing installation many of the regular clerks will be responsible for originating
and putting data into the automated data processing system. They will be required to be a part of the total system but will not necessarily hold a job classified as a data processing position.22

EDP FOR THE COLLEGE-BOUND STUDENT

The opinions of data processing managers, personnel directors, management consultants and employment agents concerning the teaching of data processing in public schools were reported in Education Age. The consensus was that some knowledge of data processing was a minimum requirement for the majority of jobs; and because practically every college discipline used computers in one way or another, previous data processing instruction for the student going on to college was of equal importance.23

Willard Korn advocates teaching the fundamental concepts of business data processing in high school to provide a basis for further education, either in the form of on-the-job training in business or for taking further course work at the post-secondary level.24

Caroline Beckner suggests that high schools present background courses in data processing to interest the


23"Should U. S. Schools Teach DP?" Education Age, (September-October, 1967), pp. 43-45.

college-bound student in pursuing this career in college. Systems Analysts and Managers in all technological areas of business are in demand and highly educated and creative personnel are needed to staff these positions.\textsuperscript{25}

A different reason for data processing courses for the college-bound student is advanced by Merle W. Wood when he suggests taking a more realistic appraisal of the many "college-bound" students who never get to college.\textsuperscript{26}

Less than two out of every ten students now in grade school will finish four years of college.\textsuperscript{27} Yet, the high school curriculums are largely based on the assumption that college graduation is the goal of most students. Typical academic or college-preparatory programs make little provision for occupational training.\textsuperscript{28}

The question of values within education and society is summed up by Grant Venn:

\begin{quote}
The B.A. or B.S. is held out as the goal to almost all students from the day they enter school; thus, the student of average or above intelligence interested in electricity is always encouraged to go to college and become an
\end{quote}

\textsuperscript{25}Caroline Beckner, "Who Should Study Data Processing?" Business Education World, XLVIII (April, 1968), 10-11.


engineer rather than take a technical program and become an electronics technician. The average student in the tenth grade is encouraged to remain in a general or college-preparatory track in the vague hope that he may later want to go to college and some college may admit him. When the first student ends up an engineering dropout statistic and the second a high school graduate without a skill, and when the nation ends up short of electronics technicians and auto mechanics, we still, seemingly, fail to see anything wrong.

Though there is widespread feeling for college-bound students to have courses in data processing in high school, the institutions of higher learning as yet have no specific guidelines on what credit will be allowed for previous study.

Community and four-year college catalogs from institutions in the state of Washington were reviewed to determine what entry level courses in EDP were being offered and to obtain general information on the courses. There were no definite high school courses listed as prerequisites for entry into a course of study in data processing; however, in each case, an introductory course offered by the institution was a prerequisite to all other courses in the field. In some instances, the introductory course was a requirement for all business education and business administration majors and was a requirement for other majors such as Engineering, Secretarial-Home Arts Career Plan, and Commercial Service Representative in some colleges.

Results of a questionnaire compiled by Dr. Gibson in 1969 indicated that high schools were covering data processing

on an introductory basis and some of the schools were developing courses beyond a general knowledge instructional phase, including some basic job entry training. Community colleges had heavy concentrations in data processing courses which showed what appeared to be a heavy overlap with the four-year colleges teaching the same material.

He states there are three levels of work in data processing: professional, usually requiring a four-year collegiate education or its equivalent; technical, usually requiring six months to two years of post-high school education or its equivalent; and clerical, requiring a high school education or its equivalent. However, a problem of articulation exists because there appears to be no clear line of demarcation between terminal and transfer students. He says, "Many terminal students continue their education part-time in a four-year college, while employed full-time in data processing. Conversely, many transfer students obtain part-time employment in data processing while carrying full-time study loads."  

A student taking units of data processing at one level might be getting excellent job training or background for further study in the field but might find himself unable to transfer the majority of his units if he desired further education from that level.

---

Dr. Gibson concluded that the need for planned articulation was apparent so that students could progress smoothly from high school through community college and on to a four-year college with a minimum of wasted time and effort.

The following are articulation problems revealed by this study.

1. There has been a lack of communication among the various levels regarding courses offered, credit allowed, and the number of students who have problems in articulation.

2. Counselors on the high school level were not fully informed about the data processing programs available at the community college and four-year college. They were not fully familiar with the job opportunities in data processing and the ability and educational preparation necessary for the various levels, especially the math necessary for the higher level jobs.

3. The high school teachers indicated the need for some system whereby course work done on the high school level would be recognized by the community college, and the students would not have to repeat the work.

4. Many catalogs and brochures do not emphasize what courses are acceptable for transfer to the four-year institutions as part of a major in data processing.

5. A basic problem on all levels is getting administrators, counselors, and teachers in other areas to realize the general education value of data processing.31

While Dr. Gibson's study was limited to an area in California, it may be indicative of a national trend. Richard S. Greene obtained similar results in a nation-wide survey in 1969. He investigated the number and length of data processing courses at the high school, vocational-technical school, and junior college level by contacting the supervisor or director

31Ibid.
of business and office occupations in each state. His conclusions were that more and more schools are teaching data processing at all levels of education; the offerings range from an introductory course to job preparation; and there is a great need for closer cooperation among the institutions providing training and study in this area.\(^{32}\)

Dael Wolfle has also commented on the problem of articulation of high school and college programs. His thoughts on the subject in 1954 were:

When most high school graduates continued their education in college it was comparatively easy to develop high school curricula which led quite directly to college work. Now that most high school graduates do not enter college, much of the earlier articulation of the two levels has been lost.\(^{33}\)

EDP FOR GENERAL KNOWLEDGE

Because technology has become the common mode of human life, everyone will be users of or workers in some form of automation. Data processing and computers are forms of automation that have or will change procedures in mathematics, science, medicine, industry, and private homes, as well as in the business office. This makes it imperative for every individual, regardless of his ambition, to have some knowledge and understanding in this field. The course of study should not


be limited to the business oriented student; "all students need exposure to automation and data processing."\(^\text{34}\)

Others, who are knowledgeable in the field of data processing and education, concur with the above.

Goodlad et al hold the view that no student should leave school without some knowledge and understanding of automation and information processing. They warn against leaving this instruction to institutions of higher learning:

Computer training in higher education, however, does not reach enough students. Roughly one out of every three high school students does not graduate; a second does not continue his education beyond a high school diploma; and so only the third, the college-bound student, will benefit from EDP courses offered in higher education.\(^\text{35}\)

S. J. Wanous reports that many responsible groups, including the President's Science Advisory Committee, believe that all students need to know how to use a computer.\(^\text{36}\)

Janet Baulch, urging an EDP course for all high school students, says:

It is a generally accepted fact that economic education is a necessary part of the general education of high school students today. Since much of our lives will be touched by data processing now, and even more so in the future, isn't


it a logical follow-up that all high school students should be given some understanding of this subject as a preparation for their adult lives?

The mystery of the big complicated thinking machine can be dispelled. The fear of dealing with it can be overcome. There is no mystery to EDP; computers are not awesome monsters to overpower the little man. Such a general education course could teach this to students and help them all—the future doctors, lawyers, merchants, housewives, or artists—deal with something that will be more and more a part of each man's daily existence in the future.37

EDP COURSE OUTLINES FOR SECONDARY SCHOOLS

Willard Korn interviewed business data processing managers, employees, and business data processing teachers to elicit their opinions on the content of a high school course in EDP. As a result of his study, he felt there was a need for a course that would provide a broad understanding of the subject. The outline which resulted from his work is presented here:

Unit I
GENERAL INTRODUCTION

A. What is Data Processing?
B. Job descriptions and opportunities within the area of data processing
C. History of data processing—a brief discussion of the historical highlights for each of the following methods of processing data
1. Manual
2. Mechanical
3. Electromechanical
4. Electronic

UNIT II
PURPOSE AND FUNCTION OF UNIT-RECORD EQUIPMENT
A. Does not include technical board wiring
B. Card coding, layout, and design
C. Cardpunch and verifier
D. Sorter, interpreter, reproducer, collator
E. Accounting machine (tabulator) and calculator

UNIT III
INPUT/OUTPUT MEDIA AND DEVICES
A. Media—punched card, punched paper tape, magnetic tape, discs, drum, microfilm and others.
B. Devices—printers, card/punch, plotter, display devices, data converters, data collection and transmission devices, optical scanning equipment such as OCR (Optical Character Recognition) and MICR (Magnetic Ink Character Recognition), machines, and test-scoring machines.

UNIT IV
PRIMARY STORAGE AND RETRIEVAL
A. Types of internal storage—core
B. New development and characteristics of memory systems (Mass memory, random access)

UNIT V
ARITHMETIC-LOGIC FUNCTION OF THE COMPUTER
A. Numeration systems and data representation
B. Registers—function of

UNIT VI
CONTROL UNIT
A. Function of the computer control unit
B. Registers and instruction formats and method of operation upon a program

UNIT VII
INTRODUCTION TO PROGRAMMING
A. I/O data in conjunction with programming
B. Block diagrams and decision tables as tools used in the problem-solving process
C. Seeing a program processed on the computer—if possible the students could attempt to process one written by themselves
D. Survey of the different programming languages—not a technical study but an overview of what they are
UNIT VIII
INTRODUCTION TO SYSTEMS DESIGN, ANALYSIS AND DEVELOPMENT

A. The total systems concept
B. The place of systems within the data processing department
C. The place of the data processing department within the company structure
D. The flowchart as a tool of the systems analyst

The length of the course should be at least one semester or perhaps a year—depending on the competency of the teacher, hardware available, and basic objective(s) of the course. For a general education course one semester is sufficient. For a vocational course in a school with the necessary hardware, it could be one year.

An outline for a course designed to attract both business students and college-bound science students is suggested by Merle W. Wood. If scheduling could be arranged, an excellent procedure would be to offer the course as a "team"—one business teacher and one math or science teacher—taught course. All students would be together during the first half of the semester for basic theory of data processing. For the second half of the semester, the class could be broken into two sections: business students would progress with the business teacher into topics of business data processing and the other group would go on to scientific applications of computer technology. Mr. Wood's suggested outline follows:

I. Development of Record Systems
   A. Ancient record systems
   B. Early manual systems (1500-1900)

---

38Korn, loc. cit.
C. Mechanical accounting systems
D. Growth and development of electro-mechanical systems

II. The Need for Automated Data Processing Systems
A. Expanding demand for services
B. Uses in decision making

III. Major Uses of Data Processing
A. Business
B. Government
C. Military
D. Scientific

IV. Data Handling
A. Collection of data
B. Conversion to input media
C. Processing
D. Storage
E. Output
F. Uses of output

V. Electro-Mechanical Data Processing
A. Key punch
B. Verifier
C. Sorter
D. Reproducing punch
E. Collator
F. Interpreter
G. Tabulator
H. Calculator
I. Types of Applications
J. Integrated systems

VI. Computer systems
A. Computer types
   1. Digital
   2. Analog
B. The computer configuration
   1. Input equipment
   2. Processing
   3. Storage systems
   4. Output
C. Computer flow charting
   1. General
   2. Detail
D. Computer language
E. Numbering systems
F. Programming
G. Computer capability
H. Applications
VII. The Data Processing Department  
A. Equipment  
B. People  
C. Problems  
D. Functions  

VIII. Advanced Training in Data Processing  
A. Junior college  
B. College programs  
C. Company in-service  
D. Machine manufacturers' schools  
E. Library and home study  

SUMMARY  

Studies have been made city-wide, state-wide, and nation-wide concerning employment opportunities and knowledge and skills required for high school graduates for entry into data processing occupations. Conclusions of the studies reviewed are in general agreement that a number of entry-level jobs exist for the high school graduate and that training is needed at the high school level.  

The subjects mentioned most frequently as being beneficial to a student for job entry were: typewriting, English, mathematics, bookkeeping, EDP concepts, and office machine operation.  

In addition to these specific courses, certain traits were mentioned as being important to attain any degree of success beyond the entry jobs: ability to work well with

---

others, flexibility, dependability, honesty, initiative, ability to follow directions, and problem-solving and logical-thinking skills.

In the area of EDP for the college-bound student, all writers agreed that knowledge in this field was important to the student. According to several of the writers, there is a need for planned articulation between the various levels of education for smoother progression through the stages of formal schooling.

Most writers comment on the vast changes that are being wrought by automation and advocate EDP for general knowledge for all students so they will be better prepared to live in a computerized world.
CHAPTER III

RESULTS AND INTERPRETATION OF DATA

METHOD OF PROCEDURE

Two questionnaires were designed to obtain information on which to base content of a high school course in EDP. Copies of the questionnaires and cover letters appear in the appendix as Exhibits A, B, C, and D.

One questionnaire (Exhibit A), sent to community and four-year colleges in the area, requested information on the degree of training in listed subjects deemed desirable for students whose college major would be data processing or computer science. Questionnaires were sent to nine colleges; six community colleges and three 4-year colleges. Replies were received from five community and two 4-year colleges.

Another questionnaire (Exhibit C), sent to selected commercial users of EDP equipment in the area, was for the purpose of obtaining information on job opportunities in EDP for high school graduates as well as positions open to those who pursue this course of study in post-secondary schools. The selected firms were two banks, two insurance companies, and two manufacturing firms. Large firms of this type were chosen because it was thought they would provide more opportunities for employment at the beginning level. Usually,
smaller firms with small staffs, want employees who are capable of handling varied assignments. High school graduates do not generally possess the maturity or experience required for such jobs.

Replies were received from all six of the commercial users of EDP equipment. The firms were assigned numbers and these were used for the compilation and reporting of information received.

COLLEGE SURVEY

Table I, page 35, shows the number of colleges checking each degree of preparation considered desirable for entering students. Data Processing and Computer Science were both used on the questionnaire because a course of study in this field is frequently referred to by either title. The designation "Data Processing" is most often used for undergraduate or two-year college courses in business, and "Computer Science" is most often used for graduate work and scientific studies. This was apparently the way the designations were interpreted by the respondents.

The high school student who is planning further study in the field of data processing needs to have studied business math, algebra, bookkeeping, EDP concepts, and programming. With the exception of business math and bookkeeping, the preparatory courses needed are basically the same for a computer science major.
COBOL and FORTRAN were the programming languages checked most frequently for "heavy preparation for both data processing and computer science.

One respondent did not check any subjects under "Computer Science" and did not check languages under "Data Processing." The reasons stated were that high schools could not work in these areas.
### TABLE I

**DEGREE OF PREPARATION DESIRABLE FOR COLLEGE-BOUND STUDENTS MAJORING IN EDP**

<table>
<thead>
<tr>
<th>SUBJECT</th>
<th>DATA PROCESSING</th>
<th></th>
<th>COMPUTER SCIENCE</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>HEAVY</td>
<td>MEDIUM</td>
<td>LIGHT</td>
<td>HEAVY</td>
</tr>
<tr>
<td>Typing</td>
<td>1</td>
<td>2</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Business Math</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Algebra</td>
<td>4</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Math:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Linear Algebra</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advanced Algebra</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trignometry</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Logic</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bookkeeping</td>
<td>4</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Data Flow in Computer</td>
<td>4</td>
<td>3</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Computer Operation</td>
<td>3</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Block Diagramming</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Flow Charting</td>
<td>4</td>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Keypunching</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Programming</td>
<td>5</td>
<td>1</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>Languages:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>COBOL</td>
<td>4</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>FORTRAN</td>
<td>3</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>AUTOCODEER</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RPG</td>
<td>1</td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>BASIC</td>
<td>1</td>
<td>1</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>MACHINE</td>
<td>1</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
</tbody>
</table>
BUSINESS SURVEY

The first part of the questionnaire sent to commercial users of EDP equipment was for the purpose of finding out to what extent unit record equipment and computer equipment are being used. The results, shown in Table II, below, and Table III, page 37, bear out the opinions of many writers in the field that third generation computers are becoming more prevalent with the result that unit record equipment is being phased out. This suggests that courses in EDP should be designed to teach concepts and theory rather than familiarization and skills on particular equipment.

TABLE II
UNIT RECORD EQUIPMENT

<table>
<thead>
<tr>
<th>TYPE</th>
<th>COMPANY</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Banking</td>
<td>Insurance</td>
<td>Mfg'ing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>1  2</td>
<td>3  4</td>
<td>5  6</td>
</tr>
<tr>
<td>Accounting Machine</td>
<td></td>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reproducer</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Collator</td>
<td></td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Interpreter</td>
<td></td>
<td>3</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Calculating Machine</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sorter</td>
<td></td>
<td>3</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Instead of listing number of units of equipment in each category, respondents 1, 3, and 5 stated "Very Few" for all.
**TABLE III**

**COMPUTER EQUIPMENT**

<table>
<thead>
<tr>
<th>TYPE</th>
<th>COMPANY</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>Banking</td>
<td>Insurance</td>
<td>Mfg'ing</td>
<td></td>
</tr>
<tr>
<td>CPU</td>
<td>10</td>
<td>4</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>Magnetic Tape Drives</td>
<td>32</td>
<td>13</td>
<td>*</td>
<td>4</td>
</tr>
<tr>
<td>Paper Tape Reader Punch</td>
<td>*</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Disk Storage</td>
<td>2</td>
<td></td>
<td>*</td>
<td></td>
</tr>
<tr>
<td>Card Reader Punch</td>
<td>47</td>
<td>4</td>
<td>*</td>
<td>1</td>
</tr>
<tr>
<td>Optical Scanner</td>
<td>*</td>
<td></td>
<td>1</td>
<td>*</td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drum Storage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cathode Ray Tube</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Printer</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Indicated this type of equipment was available but did not give number of units.

Table IV, page 38, gives the results of questions one through four under Programming Methods. The figures pertaining to the number of programmers employed would be more meaningful if the total number of data processing employees was known. However, it is safe to assume that programmers will be needed whether programs are purchased from outside or written in-house. COBOL was the most commonly used language; the others mentioned were used with equal frequency.
## TABLE IV

### PROGRAMMING METHODS

<table>
<thead>
<tr>
<th>QUESTION</th>
<th>COMPANY</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Banking</td>
</tr>
<tr>
<td></td>
<td>1  2</td>
</tr>
<tr>
<td>Number of Programmers: Systems</td>
<td></td>
</tr>
<tr>
<td>Application Maintenance</td>
<td>24 24</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Are Programs Purchased from Outside?</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>***</td>
</tr>
<tr>
<td></td>
<td>Yes</td>
</tr>
<tr>
<td>Languages Used</td>
<td>COBOL</td>
</tr>
<tr>
<td></td>
<td>PL1</td>
</tr>
<tr>
<td></td>
<td>BAL</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Documentation: Type</td>
<td>Run Book</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Extent</td>
<td>Extensive</td>
</tr>
</tbody>
</table>

*Programmers rotate and work in all programming areas.

**No programmers are employed at this branch.

***No answer
<table>
<thead>
<tr>
<th>JOB TITLE</th>
<th>REQUIREMENTS</th>
<th>Academic Background</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Aptitude Tests</td>
<td>High School</td>
<td>Post-Secondary</td>
</tr>
<tr>
<td>Programmer</td>
<td>4</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer Operator</td>
<td>5</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tab Operator*</td>
<td>3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Systems Analyst</td>
<td>4</td>
<td></td>
<td>2</td>
</tr>
<tr>
<td>Keypunch Operator</td>
<td>5</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>Other:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reader</td>
<td>1</td>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Sorter Operator</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Three firms do not have this position

Note: The numbers represent total number of firms seeking specific qualifications for positions listed.

Table V, above, gives the results of question one under Qualifications. A majority of firms use the IBM Aptitude Test for computer and keypunch operators, as well as programmers.
Only one company stated they would hire a high school graduate as a programmer, however, this answer was qualified when they added "experience" under "Other."

Computer operator, keypunch operator, and tab operator are the jobs shown to be available to high school graduates. In most cases, experience was desired for these jobs. A cooperative program, where a student could spend part of each day working in a data processing department, could provide the experience qualification.

All six companies responded "yes" to the question concerning hiring high school graduates in the data processing department. The jobs named in this connection were: keypunch, computer, and tab operators; reconcilement clerk; and one company stated, "for all jobs in the department." This last statement possibly means a high school graduate of some years ago who has accumulated some years of experience working in the field of EDP. This assumption is made because the firm listed "experience" for all jobs.

The question regarding salaries was included to provide a realistic picture of local conditions. So much has been written about the shortage of EDP personnel and the high wages paid to EDP employees. The beginning salary for the three categories of operators ranges from $350 to $550 a month. The range after three years is $400 to $700 a month. For the positions of programmer and systems analyst, the beginning salary ranges are $560 to $680 and $600 to $900
monthly, respectively. After three years the range increases from $825 to $1,000 for programmers and $840 to $1,700 for systems analysts.

Seattle is known to be a strong union city with a high cost-of-living index so it is doubtful these salaries would be appreciably different from others requiring similar qualifications.

Merit was given most often as the basis for advancement. Other traits listed were: desire, service, ability, and performance.

The weakness most frequently detected in data processing employees was lack of experience. Others noted were: attitude, depth of training, will not accept responsibility, and inability.

Opinions were requested as to whether experience or formal training was most desirable in prospective data processing employees. Table VI, below, shows the results.

**TABLE VI**

<table>
<thead>
<tr>
<th>BACKGROUND</th>
<th>OPINIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>One who has two years' experience with little or no formal training</td>
<td>5*</td>
</tr>
<tr>
<td>One who has formal training with little or no experience</td>
<td>2*</td>
</tr>
<tr>
<td>One who has no experience or training in the field</td>
<td>0</td>
</tr>
</tbody>
</table>

*One company prefers experience for operators of the equipment and formal training for systems analysts and programmers.
Table VII, below, shows the results of question eight pertaining to where data processing employees received their initial training. It is interesting to note that while all firms stated they employ high school graduates, only two list high school for initial training. This seeming discrepancy could be caused by the fact that so few high schools offer data processing courses. If this is true, then it is apparent that data processing instruction is needed in the high schools and that jobs would be available to graduates.

### TABLE VII

**INITIAL TRAINING**

<table>
<thead>
<tr>
<th>COMPANY</th>
<th>On the Job</th>
<th>Mfg'ers' Schools</th>
<th>Private Business Schools</th>
<th>High School</th>
<th>Comm. College</th>
<th>4-year College</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>4</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>5</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Four companies are planning expansion of their data processing facilities and two are undecided. None are planning to add unit record equipment. All those planning expansion checked magnetic tape, magnetic disk, and on-line facilities.
This is further indication that planned expansions are in the direction of third generation computer equipment.

SUMMARY

The results of the college survey show that knowledge in the following areas would be beneficial to the high school student planning to major in data processing in college: business math, algebra, bookkeeping, EDP concepts, and programming. With the exception of business math and bookkeeping, a high school student planning to major in computer science in college needs basically the same preparatory courses.

The results of the business survey indicate third generation computers are becoming more prevalent, and unit record equipment is being phased out.

All companies hire high school graduates in their data processing departments for the following jobs: tab operator, keypunch operator, and computer operator.

The weakness most frequently noted in data processing employees was lack of experience.
CHAPTER IV

OUTLINE FOR A ONE-SEMESTER DATA PROCESSING COURSE AT THE SECONDARY SCHOOL LEVEL

It is generally accepted among educators and businessmen that studies in EDP should be offered at the high school level. Of the many reasons advanced for including study in this area in secondary schools, the predominant one is to provide general knowledge and understanding of this important field. Limiting courses to training in specific skills at this level is advised against because many skills become obsolete before they are mastered.

A rapidly changing business technology, with subsequent changing occupational patterns, has made education an essential key to this country's growth. However, not only is education necessary to provide an individual with the means to earn a livelihood, it is equally important to his self-fulfillment as a citizen who will live in a computerized world.

The traditional curriculum, which separates those in the college preparatory program from those who will terminate their formal education at the end of high school, penalizes both. The college-bound student frequently finds it necessary to enter the labor market earlier than anticipated and is not equipped to make this transition. A concentration of vocational training often leads to a narrow range of skills.
without the ability to adapt to the changing labor market. Providing students with job entry skills only is no longer adequate preparation. In our present mobile society, this is usually only the first step in a series of job changes.

The literature reviewed as well as the survey findings indicate that almost all the jobs available to high school graduates are equipment operator jobs. Without a much more comprehensive survey, it is not possible to estimate accurately the demand for equipment operators in the Seattle area. However, since all firms in this study indicated they have relatively few pieces of unit record equipment in operation, and no plans to expand in the future, it appears that job opportunities would not be substantial enough to warrant installing the various pieces of equipment necessary for job training.

Many state the opinion that persons with a general knowledge of fundamental EDP concepts can be trained in a short time to be equipment operators. This training could either be gotten on the job or in an intensified post-secondary course. The majority of firms surveyed checked "on the job" for initial training for data processing employees. There are several community colleges in the area offering courses in the operation of equipment which can be completed in one quarter.

This indicates that a course in data processing best suited to Seattle-area secondary schools should provide a
broad insight into the many techniques and applications of EDP for general knowledge and a strong foundation for further study in the field.

Following is a suggested outline for a one-semester course in data processing, open to all students, to be taught in the eleventh or twelfth grade of high school. While the course can be taught without equipment, the use of a keypunch machine and a computer to process programs would add appreciably to the understanding of certain concepts. There are presently a variety of textbooks and workbooks available; (See Appendix E) however, since EDP is such a rapidly changing field, no specific one is suggested. Films, fieldtrips, speakers from industry, current periodicals, and other instructional materials should be used to supplement a chosen textbook. This is necessary to provide a meaningful and relevant course in this constantly changing field.

COURSE OUTLINE

General Objectives:

To provide a broad insight into the objectives, techniques, and applications of data processing.

To provide a background for future study of the technical aspects of data processing.

To provide information concerning personal and professional characteristics, education, and training necessary to enter the field of data processing.
Objective - Section I

To provide a basic understanding of the history and development of data processing equipment and technology.

I. General Introduction (1 week)
   A. Definition of EDP
   B. Evolution of methods of processing data
      1. Manual
      2. Mechanical
      3. Electro-mechanical
      4. Electronic
   C. Need for EDP systems
      1. Business
      2. Government
      3. Scientific

Objective - Section II

To provide an acquaintanceship with the most commonly used machines in information handling.

II. Tabulating Card Equipment (3 weeks)
   A. Functions
      1. Origination of data
      2. Processing of data
      3. Output of data
   B. The tabulating card
      1. Present use of punched cards
         a. Checks
         b. Coupons
         c. Payment notices
         d. Student registration cards
         e. Miscellaneous
      2. Basic types of punched cards
         a. 80-column
         b. 90-column
      3. Card fields
      4. Card design
   C. Tabulating card equipment
      1. Keypunch
      2. Verifier
      3. Interpreter
      4. Sorter
      5. Reproducing punch
      6. Collator
      7. Accounting machine
      8. Calculator
   D. Simulated problem
F. Software
   1. Definition and purpose
   2. Developments and trends

Objective - Section V

To provide information concerning systems and procedures in automatic data processing.

V. Systems Analysis and Design (2 weeks)
   A. The total systems concept
      1. Analyze present system
      2. Define system requirements
      3. Designing the new system
         a. Determining input, operational, and output methods
         b. Selecting equipment
         c. Selecting codes
         d. Designing forms
      4. New system proposal
   B. Use of flow chart by systems analyst

Objectives - Section VI

To provide information concerning opportunities for positions in the field of data processing.

To provide basic information needed by those who wish to take advanced courses in data processing and computer science.

VI. Social and Economic Aspects of Data Processing (1 week)
   A. Job opportunities
      1. High school graduates
      2. Post-secondary training
      3. College graduate
   B. Advanced training in data processing
      1. Community college
      2. Four-year colleges and universities
         a. Data processing
         b. Computer science
      3. Manufacturers' schools
      4. On the job
   C. Review of current literature
1. Design of cards
2. Procedure for machine use
E. Reports on current periodicals

Objective - Section III

To provide an understanding of the basic operation of the electronic computer system of automatic data processing.

III. Electronic Computers (3 weeks)
   A. Types of computers
      1. Digital
      2. Analog
   B. Classification of computers by use and size
      1. Scientific versus business
      2. Special-purpose versus general-purpose
      3. Desk size computers
      4. Small computers
      5. Large computers
   C. Functions of the computer
      1. Methods of input
      2. Types of memory
      3. Arithmetic-logic
      4. Control
      5. Methods of output
   D. Reports on current periodicals

Objective - Section IV

To provide an understanding of the concepts of programming and coding.

IV. Computer Programming (8 weeks)
   A. Definition
   B. Procedure
      1. Defining problem
      2. Devising procedures
      3. Coding
      4. Debugging
      5. Conversion
   C. Flow charting or block diagramming
      1. Purpose
      2. Types
      a. General
      b. Detail
   D. Survey of computer languages
      1. COBOL
      2. FORTRAN
   E. Simple program construction
CHAPTER V

CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

Data processing should be offered to all high school students. Study in this field is equally important to the college-bound and terminal student.

The results of the survey taken in the Seattle area are in agreement with surveys taken city-wide, state-wide, and nation-wide concerning employment opportunities in data processing for high school graduates. The jobs open to them are usually entry level jobs such as operators of equipment.

An individual with a basic knowledge of EDP concepts makes a good candidate for equipment operation training and this can be accomplished in intensified post-secondary courses or on the job.

While a college degree is not mandatory for programmers and systems analysts, some post-secondary education and training are required for these positions.

Experience was the most frequently mentioned qualification for EDP employees.

Relatively little unit record equipment is being used in the companies surveyed. All plans for expansion are toward third generation computers.
There is an articulation problem between the high schools and post-secondary educational institutions with regard to courses in EDP.

**RECOMMENDATIONS**

All high schools in the Seattle area should offer a general education one-semester data processing course open to all students.

All high schools in the Seattle area should offer a one-semester computer programming course for college-bound students and those interested in pursuing a career in data processing.

COBOL and/or FORTRAN should be the computer language(s) offered.

Those schools having computers in use for administrative purposes should also be using them for instructional purposes.

Those schools without computers on the premises should give thought to the use of a time-sharing system for the purpose of offering computer programming instruction.

A cooperative work-study program should be set up to provide experience for students interested in obtaining employment in EDP upon high school graduation.

An articulation committee, composed of representatives from all levels of educational institutions and businessmen,
should be organized for the purpose of evaluating EDP courses taken at each level to prevent credit loss and duplication of effort.

Teachers of data processing courses should constantly keep up-to-date in this fast developing field by reading current periodicals, attending professional meetings and summer sessions at colleges and universities, and working in data processing departments in business.
BIBLIOGRAPHY

BOOKS


PERIODICALS


"Should U. S. Schools Teach DP?" Education Age, (September-October, 1967), pp. 43-45.


MONOGRAPHS AND REPORTS


**UNPUBLISHED WORKS**


Brenholt, JoAnne M. "A Study to Determine the Educational Preparation and Teaching Experience of Montana Business Education Teachers in Areas of Bookkeeping and/or Accounting and in Data Processing." Unpublished Master's dissertation, University of Montana, 1968.


APPENDIXES
Dear

I am a high school teacher on leave of absence from the Edmonds School District, studying computer science at the University of Montana. The program I am in has been designed to equip business teachers with the necessary skills and knowledge to teach electronic data processing.

I am designing a curriculum for a course of study in electronic data processing in high school and in order to make it more meaningful and worthwhile to the students, I would like to receive information from data processing department chairmen in colleges and universities concerning high school training desired for college entry.

Information from you will help in developing better training programs for our young people who are interested in entering this field. Will you please complete the enclosed questionnaire and return it to me in the stamped, addressed envelope. Your cooperation is extremely important to the gathering of this data.

Thank you for your assistance.

Yours very truly,

Mrs. Edyth W. Henderson

Enclosure
This questionnaire was prepared for the purpose of acquiring information to be used in developing an instructional program in electronic data processing at the secondary school level.

Please indicate the amount of training in the listed subjects you think would be desirable for high school students whose college major would be either data processing or computer science by marking as follows: H for heavy, M for medium, and L for light.

<table>
<thead>
<tr>
<th>SUBJECT</th>
<th>DATA PROCESSING</th>
<th>COMPUTER SCIENCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Business Math</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Algebra</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Math (please name)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bookkeeping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Data Flow in Computer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Computer Operation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block Diagramming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flow Charting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Keypunching</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Programming</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Languages:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COBOL</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FORTRAN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AUTOCODER</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other (please name)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

College: ____________________________________________

Completed by: ____________________________________________

Name ____________________________________________ Title ____________________________
April 14, 1970

Dear

I am a high school teacher on leave of absence from the Edmonds School District, studying computer science at the University of Montana. The program I am in has been designed to equip business teachers with the necessary skills and knowledge to teach electronic data processing.

I am designing a curriculum for a course of study in electronic data processing in high school and in order to make it more meaningful and worthwhile to the students, I would like to receive information from data processing department heads concerning their needs for personnel in this field.

Information from you, as an employer of data processing personnel, will help in developing better training programs for our young people who are interested in entering this field. Will you please complete the enclosed questionnaire and return it to me in the stamped, addressed envelope. Your cooperation is extremely important to the gathering of this data.

Your answers will be confidential and your company name will not be used in any of the summary statements.

Thank you for your assistance.

Yours very truly,

Mrs. Edyth W. Henderson

Enclosures
The purpose of this questionnaire is to acquire information to be used in developing an instructional program in electronic data processing at the secondary school level.

In order to protect the privacy of your opinions, company names will not be used in any of the summary statements.

COMPANY: __________________________________________

EQUIPMENT:

Unit Record Equipment:

<table>
<thead>
<tr>
<th>Number</th>
<th>Equipment</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Accounting Machine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Reproducer</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Collator</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Interpreter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Calculating Machine</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Sorter</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other</td>
<td></td>
</tr>
</tbody>
</table>

Computer:

<table>
<thead>
<tr>
<th>Number</th>
<th>Equipment</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Central Processing Unit</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Magnetic Tape Drives</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Paper Tape Reader Punch</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Disk Storage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Card Reader Punch</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Optical Scanner</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other:</td>
<td></td>
</tr>
</tbody>
</table>


PROGRAMMING METHODS:

1. Number of Programmers employed:

   Systems _____________________ Application _____________________
   Maintenance _____________________

2. Are programs purchased from outside sources? _____________________

3. Program languages used:

   COBOL ___________ RPG ___________ OTHER _____________
   FORTRAN ___________ PLI ___________

4. Documentation:

   Type _____________________ Extent _____________________

QUALIFICATIONS:

1. What qualifications do you look for in data processing employees?

   Programmers _____________________
   Computer Operators _____________________
   Tab Operators _____________________
   Systems Analysts _____________________
   Key Punch Operators _____________________
   Other _____________________

2. Do you employ high school graduates in your data processing department?

   Yes ___________ No ___________.

3. If answer is yes, for what jobs? _____________________

4. What is approximate beginning salary for:

   Programmers ___________ Systems Analyst ___________
   Tab Operators ___________ Key Punch Operator ___________
   Computer Operator ___________ Other ___________
5. What is potential salary after three years?

Programmers _______________ Systems Analyst _______________
Tab Operators _______________ Key Punch Operator _______________
Computer Operator _______________ Other _______________

6. What is basis of advancement?


7. Which of the following, in your opinion, would make the best prospective data processing employees?

_____ One who has two years' experience with little or no formal training.
_____ One who has formal training with little or no experience.
_____ One who has no training or experience in the field.

8. Where have your employees usually received their initial training?

_____ On the job
_____ Schools sponsored by manufacturers of equipment
_____ Private business schools

Post high schools:
_____ Community College
_____ Four-year College
_____ High school

9. What weaknesses are most frequently detected in new employees?


10. Are you planning future expansion of your data processing facilities?

_____ Yes    _____ No    _____ Undecided

11. If yes to the previous, what type of equipment do you plan to use?

a. Unit record equipment. What kind?

b. Computer equipment. In which of the following areas?

_____ Magnetic tape
_____ Magnetic drum

_____ Larger than 8K in size

_____ Magnetic disk
_____ On-line facilities
_____ Other

A comprehensive introductory textbook with major emphasis on electronic data processing. Manual, mechanical, and punched card systems are covered to acquaint the student with the variety of methods and devices available.


An introduction to the field of business data processing that may be used as a one- or two-semester course. Using the course for a two-semester course would allow for a more detailed study of unit record equipment operation and/or computer programming; however, supplementary operating and/or programming manuals would be needed for this application.


An introductory course, designed for college level, with emphasis on examining the way in which computers may be applied to improve usage and effectiveness of information required by management.


A one-semester introductory course covering concepts and equipment; systems and procedures; and business organization and data processing. Major emphasis is on the systems approach of understanding the flow of work. Student's workbook is available for use with the text.


A one-semester introductory course in computer information processing designed for college level business students. The major emphasis is general orientation to the computer's impact on managers and the environment in which they work.

A one-semester course designed for secondary school students as an introduction to various phases of data processing with emphasis on electro-mechanical equipment and methods. The course covers equipment that operates with punched cards, both "unit record" machines and small card system computers. Students' manuals are available for use with the text.