

ANALYSIS OF SOME PURPOSED MONTANA PRACTICES
WITH REGARD TO DATA PROCESSING IN EDUCATION

BY

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ABSTRACT

The purpose of this study was to determine if it would be possible for school systems in Montana to obtain access to data processing techniques. An effort was made to determine whether mechanical data processing practices would provide relief from much of the clerical work now part of school life. An attempt was also made to determine if there was any implication for curriculum change, because of mechanical data processing practices.

Methods used in this study involved a review of literature which revealed that mechanical data processing means might reduce clerical work in the school system. Interviews were held for the purpose of finding what mechanical data processes would become available to school systems in Montana in the near future. The question of how school systems could develop their own data processing programs in both the administrative and instructional phases was answered in the affirmative.

Interviews indicated that it might be possible for school systems in Montana to have access to mechanical data processes by the fall of 1969 through the State Department of Public Instruction. Incorporating data processes with curriculum might be possible through the Vocational Education Act of 1963.

The survey of literature seemed to indicate general agreement that mechanical data processing was a faster means to schedule classes and perform other clerical tasks. The most important recommendation from the results of this study was the fact that if these practices are becoming available, educators should avail themselves of these services.

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CHAPTER I

Increased enrollments and the shortage of teachers has caused concern among school administrators for a more effective system of record maintenance and control. The success of data processing in the fields of industry and science alerted educators to the possibility of employing data processing systems in education. This writer contends that education may best be served by that which facilitates it, and the data processing seems to be a reasonable approach to solving many of the problems of both administrators and teachers in the clerical aspects of pupil personnel management.

Changes in educational methods have placed more strain on administrators that still use manual scheduling methods. The development of new courses and the resulting expansion of the curriculum has made it difficult to track or locate students for various purposes. Construction of new and different educational facilities such as new vocational education centers and reading laboratories all compound this scheduling problem.

Frequently, this overload resulted in lost vacations for some administrators or required before-school assembly of the faculty to prepare student programs, correct records, or perform other clerical functions, not to mention the turmoil and embarrassment that manual errors in records created after school opened.

THE PROBLEM

The purpose of this study was to answer several questions relevant to mechanical data processing in public school systems. First, was an attempt to generalize a method of machine data processing which could be applicable to all sizes of school systems. Second, an effort was made to determine whether or not mechanical data processing practices would provide relief from clerical work that is now part of everyday school life. Third, an attempt was made to determine if there was any implication for curriculum change, because of mechanical data processing practices.

PROCEDURE

A review of related literature was conducted to assess what has been accomplished in the area of data processing as it relates to the field of education. The review of related literature involved tracing the history of data processing in education from 1950 through May, 1967.

Personal interviews were held with representatives from the State Department of Public Instruction and the State Highway Department in Helena, Montana, which are presently employing mechanical data processing equipment and practices. The interviews attempted to assess the types of machines these departments used for specific purposes and if it were possible to obtain help from them in setting up data processing practices for the public schools of Montana.

Personal interviews were held with representatives from IBM Corporation's branch office in Helena. The interviews were an attempt to gather informational literature on the types of data processing machines now available and the initial cost of ownership and operation of these machines. A third objective of the interviews was to determine what IBM's thinking was in the area of educational data processing.

Mr. Homer Loucks, principal of Helena Senior High School, was interviewed because of the possibility of a computer center being established in the Helena Vocational Education Center during the 1967-1968 school year. Also, Mr. Howard Loftesnes, a representative of Standard Register, Spokane, Washington, was interviewed to determine the types of paper products available for use in educational data processing machines.

LIMITATIONS

There were several limitations placed on this study. The review of literature was confined to material which could be found in the Montana State University Library and that which could be gathered from the State Department of Public Instruction and the IBM Company of Helena, Montana. The interviews held were limited in that they reflected the subjective opinions of the persons interviewed.

The accuracy of the information reported in this study about the Montana State Department of Public Instruction's Data Processing Assistance Program was contingent upon federal funding of the program. The Department of Public Instruction, in anticipation of federal

funding under Title X of the National Defense Education Act, planned to make data processing assistance available to Montana school districts by the fall of 1969. In the event that financial assistance through Title X was not forthcoming, the assistance would necessarily be postponed.

DEFINITION OF TERMS

A source document is any document containing information to be transcribed into machine language (key punched).

A key punch is a machine with a typewriter keyboard, or adding machine key board which is used to punch holes in a card to record information.

To verify means to check that the information key punched into a card was recorded correctly.

Mark sense is the conduction of electricity through a mark. Electrographic pencil marks on a card can be translated into holes in the same card entirely by machine, for information that can be recorded by means of a pencil stroke. This is preferable to key punching.

Mark sense treatment is a special coating applied to cards so a mark sense pencil will make more readily conductive marks.

Simple optical scanners do the same thing that mark sensing does, except that reflected or blocked light is used.

Machine language is the actual patterns of holes in a card or electronic stops in a computer that represent characters, either

letters or numbers.

Software is paper products used in mechanical data processing.

Hardware are machines used in data processing.

Sorters are mechanical devices used to arrange cards in order determined by the data punched on them.

Collators are a specialized type of machine used to feed and compare two sets of punched cards simultaneously in order to match or merge either numerical or alphabetical information.

Printing Units are used for tabulating and accounting purposes. They obtain printed reports of data that are punched into the cards. The more simple IBM tabulators will add and subtract one hundred twelve digits and up to one hundred twenty characters on a single line.

Tracking is the locating of any student or group of students in any class at any time during the school day.

CHAPTER II

REVIEW OF LITERATURE

Data processing in education is a relatively new innovation.. The idea began to develop in the early 1950's, that it might be possible to do school registration and grade reporting by mechanical means. Davis (5:125) reported that Sterling Morton High School; Cicero, Illinois, began data processing for student registration by first having the student select the subjects he wished to take during the following year. This was accomplished in the homeroom with assistance from the homeroom advisor.

A master card was filled out with the student's name, address, telephone number, semester in school, sex, date of birth and parents' first names. Sterling Morton High School also coded a file number on the master card. This number was actually a disguised and modified intelligence quotient which was used in placing the pupil at a learning level more suitable to his scholastic ability. A serial number was also incorporated on the master card to place the pupil in strict alphabetical order with the rest of the students in the school.

A student election and registration card was filled out with the help of the advisor. The cards were then turned over to the principal who took them to the key punch operators to have the information punched into them.

The school found it advisable to purchase two pieces of IBM equipment, a key punch machine and an IBM card sorting machine. No

extra personnel were hired to operate these machines. The business education department gave class credit to the students who were interested in learning the techniques involved in key punch operation. The punched cards were placed in the sorter and classes were very quickly set up subject by subject, starting with departments to which registration was limited.

The final machine operation concerned the production of attendance information and the printing of the grade cards. The information necessary for these processes had to be sent directly to the IBM Company for tabulation since Sterling Morton did not have the required computer or printing unit to carry out this operation.

The cost to Sterling Morton High School for the services provided by IBM amount to eight thousand dollars per year or one dollar per pupil per semester. Actual clerical costs had been reduced by two thousand dollars. There was an added benefit, however, with the savings of some three thousand hours of teacher clerical time during the school year.

Data processing in scheduling and grade reporting was found to be a necessity in some school systems, especially those schools having large enrollments. Feader (7:4), a school accountant, found that due to increased enrollments in Tousey, Maryland, his particular school system would either have to hire more people to do the clerical work or go to some sort of machine processing. The school purchased equipment for accounting, teacher payroll, personnel reports, and item analysis of textbooks and supplies. Where formerly it took the work

of seven clerks a total of five days to fill out the payroll reports, the complete operation after the installation was done in six hours.

In 1955 Smith (9:4) offered some good advice to school systems thinking about beginning machine operations for their schools. He reported that school systems should decide what operations they wanted to perform and get representatives from the various data processing firms to advise them. He also stated that the school system should not try to do everything at once, but rather should start with one or two operations such as class lists and grade reporting. As competency developed in these areas, Smith recommended the cautious addition of various machines used to post records and facilitate scheduling. Another important consideration mentioned was that of machine paper or "software". The school must try to think through all possible card operations before ordering to avoid waste or duplication. He also stated that a school district should not buy the machines outright, because new improved machines are always being developed, and in this regard it would be better to lease or rent.

Wahlquist (11:17) found how machine processes saved counselor time in El Monte Union High School, El Monte, California. The complete registration procedure was set up on a punch card basis, and it was found that this method facilitated a greater flexibility in checking on total subject requests and determining class conflicts. This, in turn, made it easier and faster to set up a comprehensive and workable master schedule.

Driscoll (6:8) has shown that machine data processes were used in Messina, California's schools to speed student record compiling and to keep records; thereby, freeing the teachers from tedious clerical work. Driscoll stated:

In the field of class scheduling alone the machines saved two thousand hours of teacher time by registering, printing class lists, report cards and other cumulative record information.

Driscoll also made the point that in keeping records, both academic and fiscal, the machine process was accurate. Human error in this area seemed almost non-existent.

Services that mechanical data processing procedures might provide for school systems as suggested by Brickman (3:275) were such things as class registration, class scheduling, class loading, locker assignment, assembly seating, homeroom sectioning, ability sectioning, inventory control of textbooks and libraries, purchase ordering, fiscal reporting, enrollment projections, financial projections, grade cards, attendance reports, honor and eligibility lists, pupil progress reports, guidance reports, staff certification, teacher assignment, activity fund records, preparation of budgets, bus routing and building utilization analysis.

Rolens (8:71) reported on what data processing meant to different school systems. He reported that a large metropolitan school system may need an extremely complex high storage computer used to run myriads of operations. In contrast, he felt that a small rural system might

use what he called the "horse and buggy" approach to constructing schedules and student registration. In this approach, he recommended that the principal gather all the specialized information such as teacher assignment information, facility information, students' request of courses, frequency of course selection and conflicts of students. When this information was gathered it was hand punched into appropriate cards with a very inexpensive and simple hand operated card punch. When this was completed, and it was pointed out that hand punching takes a good deal more time than automatic card punches, the principal sent the packets of cards out, (he bought some computer time), to be processed. The cards were sent back along with printed lists of all the information wanted.

The costs for this type of data processing may be very low if the school maintains only its own card punch system. One example cited the total cost for two school districts that went together on a process with a total of two thousand students. The cost was two hundred sixty dollars for both districts, and for this money they each received complete lists of student programs, the actual registration of all students, class loading analysis lists, a packet of completed class cards and a complete set of grade cards. All of this labor saving work was done at a total cost for each school system of one hundred thirty dollars.

According to Carter (4:47), cost has been one of the major deterrents to the adoption of data processing by school systems. To reduce costs, he suggested that a number of school systems might pool

their resources and rent or buy machines that singly they could not afford. Carter stated that Duke University, University of North Carolina, and North Carolina State University have combined efforts and resources to make machine services available to all colleges in North Carolina. They have received a 1.5 million dollar grant from the National Science Foundation to introduce this program, with the long range goals to extend their services to all schools in the state of North Carolina.

There have been other problems involved in the implementation of data processing in schools. Slatter and Ray (10:12) stated that machines were initially oriented toward scientific and business applications. As a result, educators have had a difficult time communicating their needs to people who manufactured these machines. Personnel shortage was another problem cited by Slatter and Ray. Persons familiar with processing machine operation were not available to help schools begin data processing programs. Further, data processing personnel were not familiar with the scope and sequence of educational operations. A direct consequence of this was the fact that many school systems, after a very costly experience, abandoned electronic data processing.

The worry about doing too much too fast and becoming immersed in something which would be unusable has caused Anderson (1:7) to ask:

How can we learn enough about the new technology to evaluate what will be available in the future? Can we learn enough to resist poorly developed materials while accepting what is good and usable? How can we learn to use the new technology in our work when proven benefits are available?

The conceptual design for implementation of data processing by all schools of the several states was brought out by Bean (2:10). He stated that funds have now become available for data processing in the State Departments of Education in the several states through Section 1009, Title X of the National Defense Education Act. Title X authorizes federal funds to assist the states, "to improve and strengthen the adequacy and reliability of educational statistics".

Title X grants may be used to:

1. Improve the collection, analysis and reporting manuals to guide local educational units.
2. Develop accounting and reporting manuals to guide local educational units.
3. Conduct conferences and training programs in data processing for employees of local educational units.
4. Improve methods of obtaining educational data.
5. Expedite the matter of processing and reporting statistical data through installation of data processing equipment in the local educational units.

With money made available through Title X, Bean made the point that every state department of education should have a data processing center with clearly defined lines of access and responsibility.

SUMMARY

The review of literature pointed out that the cost of mechanical data processing might not be unreasonable and that mechanical data processing appeared to save teacher, administrative and clerical time and effort. Mechanical data processing, as reported by the authors,

was more efficient than manual means because it minimized the possibility of human error.

It was also found that mechanical data processing, due to the standardization of data reporting, seemed to present data in an easily interpreted fashion. Administrative time was also saved in the tracking of students by the use of mechanical data processing. The process also seemed to lend itself to becoming part of the curriculum in that students might be trained in machine operation.

CHAPTER III

INTERVIEWS

In an attempt to assess the types of data processing practices, either currently available or proposed, and the services planned by the Montana State Department of Public Instruction, interviews of key personnel were held. To obtain a degree of latitude in points of view concerning data processing for Montana schools, interviews were set up with private enterprise, state agencies and a public school system. The entity interviewed and its representatives were: 1) State Department of Public Instruction, Mr. Bill Woods; 2) State Highway Department, Mr. Ed Miller; 3) International Business Machines Corporation, Mr. Bill Miller; 4) Standard Register Company, Mr. Howard Loftesnes; and 5) School District Number 1, Mr. Homer Loucks.

Interview with Bill Woods, State Department of Public Instruction, Data Processing Coordinator, Helena, Montana, June 8, 1967.

Mr. Woods reported that the State Department of Public Instruction was presently working on a data processing system which would become available for all public schools in Montana by the fall of 1969. This system was designed to incorporate the use of the Honeywell 200 computer. (See Appendix A, page 29, for a detailed description of Honeywell 200 scheduling methods.) The state proposal paralleled the pupil personnel services system recently employed by the state of California.

The State Department of Public Instruction tentatively planned to deal with student master file maintenance attendance accounting and mark reporting. Plans called for mailing a special forms package to each school district wishing to avail themselves of the state's services. The particular school district would then select the forms most applicable for the operations they wished to perform and supply the State Department of Public Instruction with the information necessary to do the desired job. The state proposed to run the program on their computer and send the schedule, conflict chart, attendance lists, etc. back to the school district. (See Appendix B, page 33 for some of the various types of forms available.)

Mr. Wood reported that the cost of the program to the school district would be dependent on the size of the district and the amount of machine operations to be performed. He pointed out, however, that the cost would be very reasonable and that a great amount of administrative time would be saved the school district.

The possibility of human error would be cut down to a great degree, the only possibility that of not sending the correct information to the state by the administrator of the school district. Mr. Wood stated, however, that this would be kept to a minimum by making the forms packets as foolproof as possible. Mr. Wood also noted that the Honeywell 200 system was used because it was already in operation in California. The Montana State Department of Public Instruction did not feel it needed to expend money on researching a

system if one was currently in operation in northern California, an area which has much the same topography as parts of Montana.

Interview with Ed Miller, State Highway Department, Data Processing Supervisor, Helena, Montana, June 8, 1967.

Mr. Miller stated that he was an advisory committee member to the Helena Public Schools system for the purpose of assisting the school system to begin a program of teaching data processing in their new vocational education building. He had made an offer to the Helena school system to aid teachers in the instruction of data processing techniques to students from the Highway Department's point of view. He stated that the Highway Department would in no way attempt to determine the type of machines to be purchased by the school system, but would make suggestions and advise any school system that came to him for advice and consultation.

It was his belief that a school district beginning this type of instruction should hire a full time program director not connected with the teaching profession to be concerned with the business operation. The reasons he gave for not having a professional teacher to do this were: 1) a teacher's job is to educate and not perform clerical tasks for the district, and 2) teachers are usually not hired on a twelve month basis and would not be around to run the schedule preparatory to opening of the school in the fall.

Mr. Miller also stated that the Montana State Highway Department would attempt to help school districts in the state of Montana to begin

practices in data processing for scheduling, grade reporting and any other function they wished to perform. The Highway Department might use their computer to assist schools in this respect.

At the time of the interview the computer cost to the Highway Department was quoted at one hundred twenty dollars per hour of operation, but Mr. Miller reported that the cost to the particular school district would not be equivalent because the department would run the schools' programs after ordinary Highway Department working hours. Mr. Miller informed this writer that the State Department of Public Instruction was the agent to consult first. If they could not perform the services requested by the schools, the State Highway Department would attempt to assist the schools.

Mr. Miller pointed out several ways of eliminating human error in transcription of data by placing decimal points in proper places in computer forms and writing instructions on the forms above each column to be filled in. He also showed how certain types of forms might be made up to use both sides and thereby conserving forms and consequently saving money.

Interview with Homer Loucks, Principal, Helena Senior High School, Helena, Montana, June 8, 1967.

Mr. Loucks stated that in the fall of 1967 his school would introduce a vocational training program, with money from the Vocational Education Act of 1963 to train programmers in key punch operation. The school's program was tentatively planned to take from six to nine

months to complete and would attempt to train students for jobs in key punch operation. The machines for this program would be furnished by International Business Machines Corporation and were to be housed in Helena's new Vocational Education Center. Help in organizing the program was obtained from a lay advisory group of prospective employers and interested businessmen who used data processing in the community.

Mr. Loucks projected that this was the way to begin computer operations. The school system was to start on a limited scale, however, the first computer was planned for installation by the summer of 1968. With the installation of the computer the school's first computerized schedule would be printed by the fall of 1968. Mr. Loucks felt that at that time the school system would go over to complete modular scheduling.

Even more important to Mr. Loucks than scheduling was the fact that the computer could assist the counselor with the testing program and enable the school system to obtain class lists and grade reports by the use of computer printed data mailers. The principal stated further that this type of instruction and implementation of the computer assisted data processing was here to stay and would be an asset to school systems in the future, as more money became available for data process implementation.

Interview with Bill Miller, International Business Machines Corporation, Education Representative, Helena, Montana, June 8, 1967.

IBM Corporation was interested primarily in the educational aspect of the computer. (For a detailed description of IBM's curriculum in data processes, see Appendix C, page 39). The representative from IBM stated that Helena Senior High School, Helena, Montana was attempting to place a vocational course in key punching and computer training in their new vocational education center at Helena.

He explained that school systems should start with this vocational education and later move toward scheduling, reporting and other machine operations. The reasons for this were many but mostly by teaching these courses the school system would then know how to go about the various data operations they might wish to use and would also know what pitfalls to avoid.

The Helena school system approached IBM about teaching key punching and computer training in their vocational program and were advised to form an advisory committee of lay citizens who used computer assistance and data processing. IBM felt that these people would be better able to advise the school on what and how much to teach the student so that when he completed the course he would be better trained for a particular job. Another reason for using the lay advisory committee is the relationship that would be built up between the prospective employee and the school.

IBM's representative stated that the Helena school would teach only key punching beginning in the fall of 1967. Helena Senior High School vocational education was to receive four key punch machines and two verifiers from IBM for a total cost of four hundred and twenty dollars per month, installed and serviced.

SUMMARY

By the fall of 1969 it may be possible for public school systems in the state of Montana to acquire mechanical data processing for student master file maintenance, attendance accounting, and mark reporting. This service was tentatively to be provided by the State Department of Public Instruction, Helena, Montana. The department had purchased a Honeywell 200 computer and planned to initiate a program of services for public schools in Montana, much the same as one now available to the public schools in California.

The Honeywell 200 computer which the State Department of Public Instruction planned for use in data processing for public school systems, was a smaller scale computer than was formerly available. Since the computer was smaller, it cost less to own and operate. The Honeywell 200 would perform all of the functions of a large scale computer, however, the time of operation would be longer. In student scheduling, for example, the average number of students per minute scheduled was fifty as compared to five hundred for some larger machines.

The Honeywell 200 was programmed to accept seven phases of educational data processing. They were: preparing student request cards, the tally and pairing of student requests, creating of master schedule and master cards, priority sequencing of student request cards, scheduling, assigning study halls and printing of schedules.

The State Department of Public Instruction planned to make available sample packets of forms which would be sent to the public school systems wishing to take part in the data processing program being set up. These forms would be standardized to the state department's computer. The types of forms or software would have to be adapted to the State Department of Public Instruction's specifications. Standard Register Company prints many types of machine paper which may be tailored to a particular school system's needs. Some types of software currently available to schools are items such as: machine scored test devices, attendance gathering documents, permanent records and data mailer grade reports. The cost of the services to be provided by the State Department of Public Instruction had not been determined, however, the department reported that it would be well within the means of school districts in Montana.

Data processing for public school systems might also be possible through the Montana State Highway Department. This department might assist school districts interested in beginning data processing by providing technical assistance and computer services. The department stated that public schools in the state of Montana might obtain computer services after the department's regular working day to perform

data processing operations. The department also reported that it might be possible for their representatives to help train teachers in the instructional phase of data processing, should the school wish to introduce a course in data processing practices into the curriculum.

The possibility of incorporating data processing for scheduling and grade reporting with the curriculum of the school might be possible through help from the Vocational Education Act of 1963. Helena Senior High School, with money from the National Vocational Education Act, planned to offer a program to train key punch operators beginning in the fall of 1967. This program was to begin with the installation of key punch machines and verifiers to be used in teaching high school students. Later the school planned to obtain its own computer and begin a program for training computer operators. Along with the curriculum innovation, they planned to schedule classes, report grades and track students. Their first computerized scheduling was to begin by the fall of 1968.

Helena had obtained technical assistance and hardware from IBM Corporation. Four key punch machines and two verifiers were rented for a cost of four hundred twenty dollars per month. It was IBM's contention that a school system should begin with data processing from the aspect of curriculum and later enter into the scheduling and school business application of data processing.

IBM might assist school systems in Montana that wished to begin a curriculum in data processing. The purposes of the IBM curriculum in data processing are to acquaint the student with data processing and

to introduce the student to computer processes and programming. The IBM curriculum is divided into eight different phases and include: an introduction to electronic data processing, the functional units of a computer, the peripheral unit record equipment, stored programming concepts, the steps in computer analysis, operation of a computer, machine language programming and the use of symbolic language.

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

It has been the purpose of this investigation to study the feasibility of schools in Montana having access to data processing techniques and if it would be possible to incorporate data processing with the curriculum of the school. It was also hoped that the study would reveal evidence, in the form of reviews and opinions, as to the effectiveness of data processing in relieving school personnel of the tedious clerical tasks associated with school administration.

Conclusions

From this study the writer concluded that it may be possible for schools in Montana to acquire data processing for schedule making and pupil personnel accounting by the fall of 1969. These services may be provided through the State Department of Public Instruction, Helena, Montana.

From sources consulted in the review of literature and the interviews, the writer concluded further, that mechanical data processing might reduce clerical work and eliminate much human error in record keeping and student scheduling. The cost of acquiring and operating mechanical data processing equipment might not be unreasonable if several schools pooled their resources for this purpose. Software may be designed specifically for performing educational data processing and may be purchased from several firms.

It might be possible, with money available through the Vocational Education Act of 1963, to begin an instructional program in data processing. Therefore, it seems reasonable that a school system could incorporate the instructional phase of data processing with the administrative phase and perform both teaching and school business activities.

The writer determined that the key personnel interviewed in this study were extremely interested in the future of data processing in education. The field of data processing in education, while still in its early stages in Montana, seems to be moving toward becoming one of the innovations that in the future might be readily accessible to public schools in the state. With its proven benefits in reducing menial chores and its possibilities for use as part of the curriculum, data processing might well prove to be used extensively in school systems in Montana.

Recommendations

The results of this study have revealed evidence which could lead to further studies in depth and scope in the area of data processing in education. The writer suggests follow-up studies to prove the effectiveness of lay advisory committees on educational data processing. Further study is also indicated to determine if a curriculum in data processing is advisable in the light of the many advances technology has made in perfecting data processing machines. For example, if money were spent by a school system to train key punch operators and technology found a way to eliminate key punch machines, could this expenditure be

justified? Studies might be made to assess actual time and money saved by installation of data processing equipment over the use of manual means.

Much has been written about the fact that administrators do not fully understand the implications data processing may have for their schools. A study might be made to determine the best method for disseminating information to these people about data processing. Perhaps it would be possible to provide for a section in the Montana Education Association Journal on data processing in education.

The computer is becoming recognized as a valuable asset by educators across the country. Research could be conducted to determine the best way of utilizing this new tool with regard to curriculum and data processing.

A study might be performed to discover if computers might be used effectively in programs of individualized instruction for the schools. This study might be concerned with the cost of computer assisted individualized instruction and whether this instruction was effective.

More research might be completed to discover methods of designing software to meet a particular school's needs. Educators in conjunction with personnel in software production might find means of reducing human error to a greater degree than was formerly possible. This study seemed to reveal a need for mechanical data processing in Montana schools and the writer recommends further study to update obsolete systems in the state.

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APPENDIX

APPENDIX A
ABSTRACT OF:
STUDENT SCHEDULING FOR THE
HONEYWELL 200 COMPUTER
JOHN F. HUNTER, JR.
CLEVELAND SCHOOL SYSTEMS

I. Introduction

The scheduling of classes in educational institutions is more and more frequently being accomplished by computers. Many systems of scheduling have been initiated. Some systems have been practical and some have been experimental.

With the initiation of this new system of scheduling the user not only has a complete and practical system, but also a system that costs only a fraction of the previous one. This cost reduction has been accomplished by the use of a smaller scale computer and the use of advanced systems techniques. It might be possible for the administration of educational institutions to turn to computers for the solution of scheduling of classes and thus further efforts for producing a better education.

II. Description of System

To present a general picture of the system for student scheduling a phase description will be presented in this section. The brief comments here will be supplemented in later sections with complete working detail.

Phase I - Preparing Student Request Cards

Phase II - Tally and Pairing of Student Requests

Phase III - Creating of Master Schedule and Master Cards

Phase IV - Priority Sequencing of Student Request Cards

Phase V - Scheduling

Phase VI - Assign Study Halls

Phase VII - Print Schedules

Phase I - Preparing Student Request Cards

The selection of courses by the student provides the information to be used in scheduling. The student's name, grade, school, student number, and course requested are keypunched into a card for input into the computer.

Phase II - Tally and Pairing of Student Requests

In order to prepare the Master Schedule of courses it is first necessary to determine the number of requests for each particular course. These tallies are helpful in determining seating and section requirements for each course. The pairing of all courses and the tallies of each pair are helpful in determining the timing relationship required for all sections. This timing relationship must allow the scheduling of all students without conflicts. This tally and pairing is completely produced by the computer.

Phase III - Creating of Master Schedule and Master Cards

The master schedule may contain up to and including ten periods. Courses may be (1) single semester or double semester (2) single day or multi-day (3) single period or multi-period (4) concurrent or non-concurrent or partially concurrent (5) split period or consecutive period (6) priority course or non-priority course (7) or any combination of the above.

The master schedule is based on tallies and tallies of pairs from the tally and pairing listing. The better your master schedule, the better job of scheduling the computer can do. A poor master schedule will result in poor class balances and more conflicts than will a good master schedule.

The course number, section number, period, days met, semester, number of seats, course description, teacher, room number, credit and priority are keypunched into a card for input into the computer.

Phase IV - Priority Sequencing of Student Request Cards

Grade twelve is to be scheduled first, then grade eleven, and then grade ten. Within each grade students are placed in sequence by difficulty of scheduling. Students requesting more single section courses are more difficult to schedule than students requesting fewer single section courses, students requesting double section courses are more difficult to schedule than students requesting fewer double section courses, etc. Tallies are made of each type of course and thus students are placed in a priority sequence depending on the degree of scheduling difficulty. This gives the system three advantages 1) reduces the number of conflicts or students that cannot be scheduled, 2) reduces the number of study hall conflicts and 3) allows the computer to schedule more students per minute.

Phase V - Scheduling

The average number of students per minute that might be scheduled is fifty. Although the number of conflicts is dependent upon the master schedule, it is not unusual to obtain less than one per cent conflicts.

To build a good master schedule it is possible to use this program as a simulator. Building a master schedule by this procedure has heretofore been too costly.

Scheduling consists of assigning periods of time to each course requested by the student. Assignment of courses must meet the following requirements: 1) no conflict in period, day or semester, 2) only a predetermined number of study halls may be scheduled in consecutive periods, and 3) all sections of a course must be balanced.

There are thousands of ways to schedule a single student. There is no limit to the checking of each possible way to schedule a student until the above requirements are met. The method for finding more than one schedule is called backtracking.

Phase VI - Assign Study Halls

Study halls are assigned in the absense of course assignments. A student will be assigned to a study hall so that for any one period, regardless of days of the week, the student will be in the same section. Tallies are established for each section and for each day within that section. These tallies are then printed as a Study Hall Summary Report. This allows the administration to make the most efficient use of study hall facilities.

Phase VII - Print Schedules

Schedules are printed including student name, grade, school name, school number, year, course description, teacher, period, room number, semester, days met and credit.

APPENDIX B

SOME OF THE VARIOUS TYPES
OF SOFTWARE AVAILABLE FOR USE
BY THE PUBLIC SCHOOLS
THROUGH STANDARD REGISTER COMPANY

WILLOUGHBY - EASTLAKE CITY SCHOOLS

**STUDENT
PERMANENT
RECORD
GRADES 9-12**

STUDENT		BIRTHDATE		DATE OF ENTRY		DATE WITHDRAWAL		HOUSE NUMBER	STREET NAME	CODE		
NAME	FIRST NAME	MO.	DAY	YE.	MO.	DAY	YE.	MO.	DAY	YE.		
STUDENT	INST. INITIALS	HOM. NO.	CREDIT EARNED	GRADE	YEAR ENDING	SCHOOL	HOME ROOM TEACHER	TOTAL DAYS ABSENT	TOTAL DAYS TARDY			
				FIRST YEAR								
				TOTAL CREDITS EARNED THIS YEAR	TOTAL CREDITS EARNED TO DATE	ACCUMULATED POINT AVERAGE	POINT AVERAGE THIS YEAR					
STUDENT	INST. INITIALS	HOM. NO.	CREDIT EARNED	GRADE	YEAR ENDING	SCHOOL	HOME ROOM TEACHER	TOTAL DAYS ABSENT	TOTAL DAYS TARDY			
				SECOND YEAR								
				TOTAL CREDITS EARNED THIS YEAR	TOTAL CREDITS EARNED TO DATE	ACCUMULATED POINT AVERAGE	POINT AVERAGE THIS YEAR					
STUDENT	INST. INITIALS	HOM. NO.	CREDIT EARNED	GRADE	YEAR ENDING	SCHOOL	HOME ROOM TEACHER	TOTAL DAYS ABSENT	TOTAL DAYS TARDY			
				THIRD YEAR								
				TOTAL CREDITS EARNED THIS YEAR	TOTAL CREDITS EARNED TO DATE	ACCUMULATED POINT AVERAGE	POINT AVERAGE THIS YEAR					
STUDENT	INST. INITIALS	HOM. NO.	CREDIT EARNED	GRADE	YEAR ENDING	SCHOOL	HOME ROOM TEACHER	TOTAL DAYS ABSENT	TOTAL DAYS TARDY			
				FOURTH YEAR								
				TOTAL CREDITS EARNED THIS YEAR	TOTAL CREDITS EARNED TO DATE	ACCUMULATED POINT AVERAGE	POINT AVERAGE THIS YEAR	NO. IN CLASS	CLASS RANK	GRADUATED		
STUDENT	INST. INITIALS	HOM. NO.	CREDIT EARNED	GRADE	YEAR ENDING	SCHOOL	HOME ROOM TEACHER	TOTAL DAYS ABSENT	TOTAL DAYS TARDY			
				TOTAL CREDITS EARNED THIS YEAR	TOTAL CREDITS EARNED TO DATE	ACCUMULATED POINT AVERAGE	POINT AVERAGE THIS YEAR	NO. IN CLASS	CLASS RANK	GRADUATED		

GRADE KEY

- A - Excellent
- B - Good
- C - Average
- D - Below Average
- E - Unsatisfactory
- W - Dropped
- * - Course Taken In Summer School

SCHOOL CODES

- 11 - North High School
- 12 - South High School
- 21 - Eastlake Jr High School
- 22 - Willoughby Jr High School
- 23 - Willawick Jr High School
- 24 - Kennedy Jr High School

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00041

TITLE _____ DATE _____

REPORT PERIOD

NO.

ATTENDANCE SHEET

PROCESSED BY HAMILTON COUNTY SCHOOLS D.P. CENTER

YEAR				ATTENDANCE SHEET												PROCESSED BY HAMILTON COUNTY SCHOOLS D.P. CENTER											
4	3	1	0	3	1	2	1	0	3	4	2	1	0	3	4	2	1	0									
==	==	==	==	==	==	==	==	==	==	==	==	==	==	==	==	==	==	==									
PRESENT				ABSENT								TARDY															
10	20	40	11	2	3	0	10	20	40	11	2	3	0	10	20	11	2	3									
5	6	7	8	9	12	4	5	6	7	8	9	12	4	5	6	7	8	9									
10	20	40	11	2	3	0	10	20	40	11	2	3	0	10	20	11	2	3									
5	6	7	8	9	12	4	5	6	7	8	9	12	4	5	6	7	8	9									
10	20	40	11	2	3	0	10	20	40	11	2	3	0	10	20	11	2	3									
5	6	7	8	9	12	4	5	6	7	8	9	12	4	5	6	7	8	9									
10	20	40	11	2	3	0	10	20	40	11	2	3	0	10	20	11	2	3									
5	6	7	8	9	12	4	5	6	7	8	9	12	4	5	6	7	8	9									
10	20	40	11	2	3	0	10	20	40	11	2	3	0	10	20	11	2	3									
5	6	7	8	9	12	4	5	6	7	8	9	12	4	5	6	7	8	9									
10	20	40	11	2	3	0	10	20	40	11	2	3	0	10	20	11	2	3									
5	6	7	8	9	12	4	5	6	7	8	9	12	4	5	6	7	8	9									
10	20	40	11	2	3	0	10	20	40	11	2	3	0	10	20	11	2	3									
5	6	7	8	9	12	4	5	6	7	8	9	12	4	5	6	7	8	9									
10	20	40	11	2	3	0	10	20	40	11	2	3	0	10	20	11	2	3									
5	6	7	8	9	12	4	5	6	7	8	9	12	4	5	6	7	8	9									
10	20	40	11	2	3	0	10	20	40	11	2	3	0	10	20	11	2	3									
5	6	7	8	9	12	4	5	6	7	8	9	12	4	5	6	7	8	9									
10	20	40	11	2	3	0	10	20	40	11	2	3	0	10	20	11	2	3									
5	6	7	8	9	12	4	5	6	7	8	9	12	4	5	6	7	8	9									
10	20	40	11	2	3	0	10	20	40	11	2	3	0	10	20	11	2	3									
5	6	7	8	9	12	4	5	6	7	8	9	12	4	5	6	7	8	9									
10	20	40	11	2	3	0	10	20	40	11	2	3	0	10	20	11	2	3									
5	6	7	8	9	12	4	5	6	7	8	9	12	4	5	6	7	8	9									
10	20	40	11	2	3	0	10	20	40	11	2	3	0	10	20	11	2	3									
5	6	7	8	9	12	4	5	6	7	8	9	12	4	5	6	7	8	9									
10	20	40	11	2	3	0	10	20	40	11	2	3	0	10	20	11	2	3									
5	6	7	8	9	12	4	5	6	7	8	9	12	4	5	6	7	8	9									
10	20	40	11	2	3	0	10	20	40	11	2	3	0	10	20	11	2	3									
5	6	7	8	9	12	4	5	6	7	8	9	12	4														

STUDENT RECORD SYSTEM • 3910-12 LINDBELL BLVD. • ST. LOUIS, MO. 63106

STUDENT NAME: _____ STUDENT NUMBER: _____

TEACHER: _____

DATE: _____

ROOM: _____

DATE: _____

ROOM: _____

PLEASE DETACH THIS STUB
CAREFULLY ALONG PERFORATION

USE ORDINARY PENCIL - NOT BALL POINT PEN. BE SURE MARK IS BLACK AND COMPLETELY FILLS
SPACE. ERASE COMPLETELY WHEN MAKING ANY CHANGES OR CORRECTIONS.

PAGE: _____

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

TO OPEN TEAR ALONG THIS PERFORATION
 • USE THUMB NOTCH TO REMOVE CONTENTS •

PENFIELD SENIOR HIGH SCHOOL
 HIGH SCHOOL DRIVE
 PENFIELD, NEW YORK 14526

TO PARENT OR GUARDIAN OF

TO PARENT OR GUARDIAN OF

GUIDANCE COMMISSION

FILE NO. 1
 DATE
 ATTEN

PUPIL REPORT CARD

SEE REVERSE SIDE



FIRST CLASS MAIL
 U S POSTAGE
 PAID 5 CENTS
 PERMIT NO. 6

APPENDIX C

CURRICULUM IN DATA PROCESSING
COMPILED BY IBMFUNDAMENTALS OF DATA PROCESSING AND AN INTRODUCTION TO COMPUTER
PROGRAMMING

Hours Required

Class, 5; Laboratory, 2

Description

The purposes of this course are to acquaint the student with data processing concepts and to serve as an introduction to electronic digital computers. The operation of essential peripheral unit record equipment is explained. The student becomes acquainted with a specific machine and learns how to program the machine using machine language. Symbolic language is used to program exercises for the computer.

Major Divisions

- I. Introduction to Electronic Data Processing
- II. Functional Units of a Computer
- III. Peripheral Unit Record Equipment
- IV. Stored Programming Concepts
- V. Steps in Computer Analysis
- VI. Operation of Computer
- VII. Machine-Language Programming
- VIII. Use of Symbolic Language

Division I. Introduction to Electronic Data Processing

A. Definition

B. History and growth of computers

1. Mechanical aids

- a. Napier's bones
- b. Desk calculators
- c. Babbage machines

2. Early computers

- a. Mark I - Harvard
- b. ENIAC

C. Current Uses

1. Business

2. Scientific

3. Military

D. Future trends

E. Types

1. General purpose

2. Special purpose

3. Analog

4. Digital

F. Data representation

1. Recording media

- a. Cards
- b. Paper tape
- c. Magnetic tape
- d. Magnetic ink

2. Methods of representing data

- a. Binary code
- b. Binary coded decimal
- c. Biquinary
- d. Six-bit numeric code

Division II. Functional Units of a Computer

A. Storage Devices

1. Primary
 - a. Core
 - b. Drum
 - c. Disk
2. Secondary
3. Random access

B. Arithmetic logical unit

1. Registers
2. Parallel and serial operations
3. Fixed and floating decimal points

C. Control

1. Instruction cycle
2. Execution cycle
3. Fixed vs. variable word length

D. Input and output devices

1. Card reader and punch
2. Magnetic tape unit
3. Paper tape reader and punch
4. Magnetic character sensing
5. Counters
6. Cathode ray tubes
7. Data buffers
8. Optical scanners

Division III. Peripheral Unit Record Equipment

A. Keypunch

1. Operation
2. Reading the card
- 3.. Preparing a program card

B. Sorter

1. Principle of operation
2. Numeric and alphabetic sorting

C. Control panel machines

1. Use in data processing
2. Simple wiring principles

Division IV. Stored Programming Concepts

A. Definition of stored program

B. Computer address system

1. Types
 - a. One address
 - b. Two address
2. Word format
 - a. Data word
 - b. Instruction word

C. Flowcharts

1. Purpose
2. Types
3. Notation
4. Techniques

- D. Logical operations
 - 1. Program loop
 - 2. Branching
- E. Instruction modification
- F. Address modification
- G. Indexing
 - 1. Concept of iterative process
 - 2. Index registers
- H. Indirect addressing
- I. Compilers and assemblers
- J. Subroutines
 - 1. Open subroutine
 - 2. Macro instructions
- K. Programming an imaginary computer

Division V. Steps in Computer Analysis

- A. Analysis of problem
 - 1. How to devise an algorithm
 - 2. What constitutes a good algorithm
- B. Formulation of problems in mathematical statements
- C. Programming
 - 1. Flowcharting
 - 2. Coding
 - 3. Compiling
 - 4. Checkout
 - 5. Documentation

- D. Input preparation
- E. Program run
- F. Checking results
- G. Interpretation

Division VI. Operation of Computer

- A. Console panel
 - 1. Registers
 - 2. Console lights
 - 3. Control keys and lights
 - 4. Switches
- B. Operating procedures
 - 1. Input
 - 2. Output
 - 3. Clearing storage
 - 4. Program alteration
- C. Addition and multiplication by reference tables

Division VII. Machine-Language Programming

- A. Arithmetic instructions
- B. Transfer of data
- C. Branching instructions
 - 1. Conditional
 - 2. Unconditional
- D. Input/output instructions
- E. Address modification
- F. Divide feature

- . Debugging
- . Problems
 - 1. Arithmetic
 - 2. Linear and quadratic equations
 - a. Incrementing
 - b. Looping

Division VIII. Use of Symbolic Language

- . Language representation
 - 1. Data
 - 2. Instructions
- . Operational procedures
- . Fixed and floating decimal point numbers
- . Writing a fixed program in symbolic programming system language
 - 1. Flowchart
 - 2. Code
 - 3. Run program
 - 4. Check with machine-language instructions
 - 5. Debug

Books and References

- Wans, G., and C. Perry. Programming and Coding for Automatic Digital Computers. New York: McGraw-Hill, 1961.
- Wormain, C. Programming the 1620. Englewood Cliffs, N. J.: Prentice-Hall, 1960.
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- Wrubel, M. A. A Primer of Programming Digital Computers. New York: McGraw-Hill, 1959.

IBM Manuals

- "Flowcharting Techniques" (C20-8152)
- "Introduction to IBM Data Processing Systems" (F22-6517)
- "Program Writing and Testing" (J26-5547)
- "IBM 1620 Central Processing Unit, Model 1" (A26-5706)
- "1620/1710 Symbolic Programming System" (C26-5600)