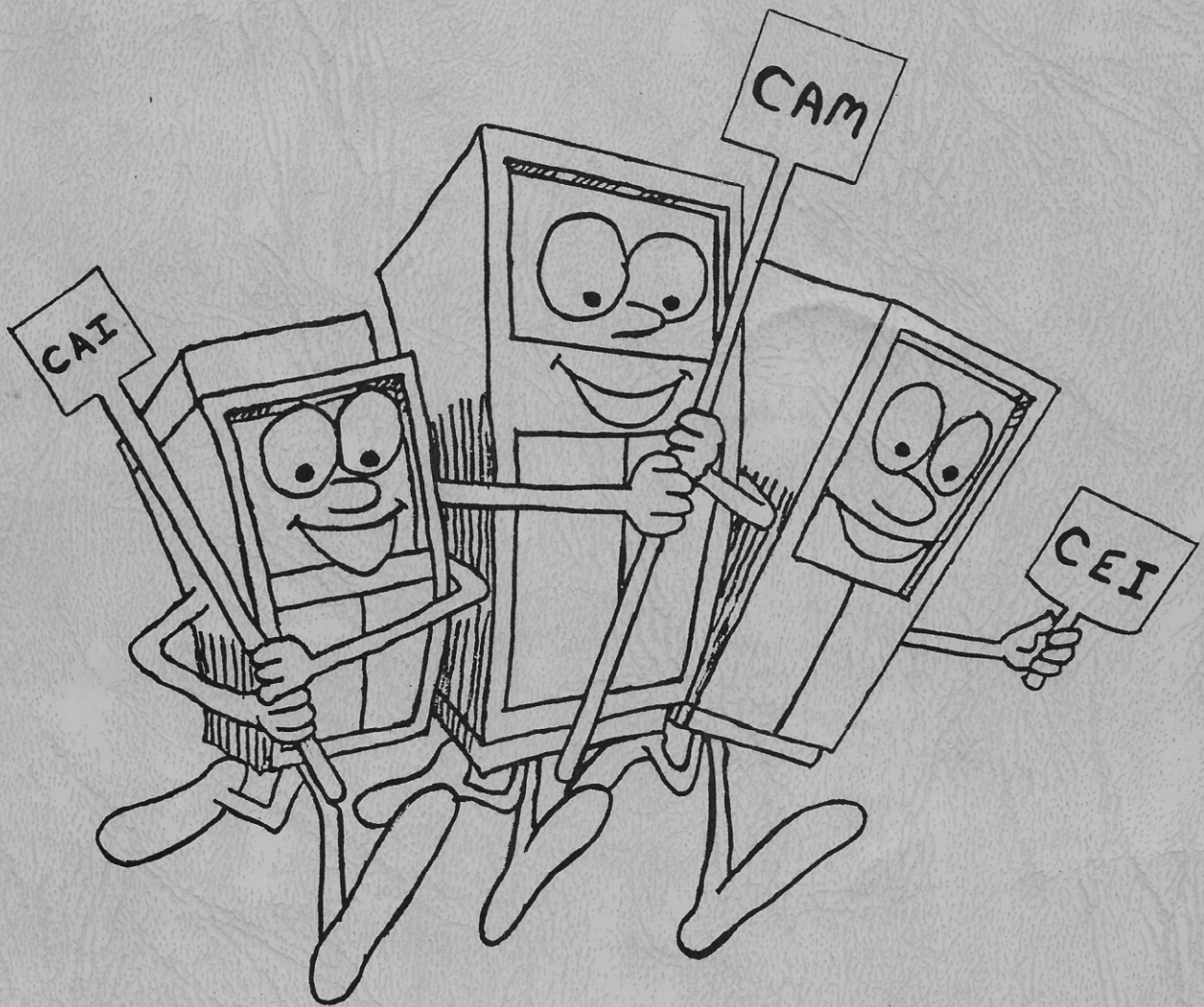# ACADEMIC COMPUTING ANNUAL STATUS REPORT

PHOENIX UNION HIGH SCHOOL SYSTEM

June 30, 1977

ACADEMIC COMPUTING - ANNUAL STATUS REPORT

NUMBER ONE

PHOENIX UNION HIGH SCHOOL SYSTEM

JUNE 30, 1977

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PREFACE

The purpose of this status report is three-fold.

FIRST: It provides historical information
                on the background of academic
                computing in the Phoenix Union High
                School System.

SECOND: It furnishes a summary of the current
                utilization of the Educational
                Computer.

THIRD: It states goals for the future and
                suggests the budgetary implications
                of these goals.

The Hewlett-Packard computer was purchased by the Phoenix Union High School
System during the 1969-70 school year. Since that time, reports have been
written which provide information on numerous aspects of the computer's use.
This report is the first attempt to write an "all inclusive" report. It
will be updated on an annual basis hereafter.

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HISTORY

On November 6, 1969, the Board of Education of the Phoenix Union High School System approved the NDEA-ESEA Title III Computer Assisted Instruction Proposal and on April 16, 1970, authorized purchase of a Hewlett-Packard 2000A time-sharing system with matching district funds. This computer had the ability of communicating with 16 users simultaneously and cost a total of $101,232.

It was emphasized in the April 16, 1970, Board Agenda that this acquisition could not achieve all the purposes that were outlined in the Computer Assisted Instruction Proposal which had been approved by the Superintendent's Staff, Curriculum Council, Division of General Education, Computer Assisted Instruction Committee, and the Director of Federal Programs. But it was documented that this project was a start which could be expanded to accommodate future needs for development of individualized instruction.

During the 1970-71 school year the Hewlett-Packard was upgraded to a 2000B model which had the capability of communicating with 32 users simultaneously. This upgrade was again purchased with matching NDEA funds. The total cost was $34,802.40.

Another upgrade took place in the 1972-73 school year when the Hewlett-Packard became a 2000C'. This upgrade provided additional storage memory on the computer at the cost of $38,075.00. This purchase was made entirely with district money.

The final upgrade* took place in the 1973-74 school year when the Hewlett-Packard was transformed into a 2000F. This upgrade improved the performance of the computer but did not involve the acquisition of additional components. There was no charge for this upgrade which was performed by the Hewlett-Packard Company.

Currently, our Hewlett-Packard 2000F has fifty-two terminals** tied to it over telephone lines. However, it only communicates with 32 terminals simultaneously. Users are serviced on a first come, first served, basis.

The major problem which has been facing the Educational Computer Center for several years now is not being able to supply computer assistance to academic departments in our schools which request this service. During the 1974-75 school year, the district released a request for proposals (RFP) for a new computer system. Proposals were received from six vendors as a result of this RFP. On May 29, 1975, the Board of Education rejected all six. The problem still exists. The solution is up to the Board of Education.

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* The card reader for the Educational Computer was replaced with a newer model during the 1973-74 school year at a cost of $2,782.00

** The district owns 60 terminals; 52 are "on-line" with the computer; 5 are "off-line"; and 3 are assigned to the Educational Computer Center.

EFFECTIVENESS OF COMPUTER ASSISTED INSTRUCTION

Numerous research studies have been conducted around the country which substantiate the effectiveness of academic computing. Included here is a summary of two studies conducted in the Phoenix Union High School System which involved experimental and control classes.

CAI in Math, Carl Hayden High School - Fall, 1972

The findings of this study indicated there were significant differences in the students who used the computer assisted instruction compared to those students who did not use the computer assisted instruction at Carl Hayden High School.

RESULTS: Both groups gained from pre to progress. The experimental group (+1.86) gained more compared to the control group (+1.04) from pre to progress testing.

RESULTS: At the end of 28 school days the experimental group had a relatively higher percentage for the class average than that of the control group.

RESULTS: Based on these data, it was concluded that there is a difference in the effectiveness of the computer assisted instruction on the students' arithmetic achievement to that of the arithmetic achievement of those not influenced by the computer assisted instruction. The experimental group gained relatively more than the control group from pre to progress.

The findings also supported the hypothesis that students who utilize the computer will have a decrease in their absence rate when compared with those students who do not use the computer.

The findings of the Mathematics Attitude Scale indicate that the experimental group improved their attitude towards math more than the control group did. Analysis on the attitude scale (Likert Scale) was accomplished by computing average scores and by using a chi-square 2 x K contingency table.

CAI in Reading, Carl Hayden High School - Spring, 1974

The findings of this study indicated significant differences between students who completed the CAI drill and practice skill program and those who did not receive the computer assisted instruction on the skill program.

The experimental group that was pretested scored lower on the pretest (17,5 mean), than did the control group (19.9). The difference was not great enough to be called significant.

The groups that were pretested scored higher on the post-test than did their unpretested counterparts. However, this difference was not significant either.

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Significant differences occurred wherever the experimental group was compared to the control group. In comparing total groups, the difference was significant at the .001 level, indicating that the experimental group had achieved more as a result of the computer assisted instruction.

EQUIPMENT

The components of the Educational Computer, the terminals, terminal covers, and the keypunches are owned by the district. The communications equipment is rented from the telephone company. Section V of this report shows the placement of this equipment and Section VI shows the cost by year, starting with the initial purchase. The following is a list of the equipment.

A. Computer Components:

```
    1 - 2100A Central Processor
    1 - 2116B Communications Processor
    2 - 7900A Disc Drives
    1 - 7970A Magnetic Tape Drive
    1 - 2748A Paper Tape Reader
    1 - 2767A Line Printer
    1 - ASR-35 Teletype Console
    1 - 7261A Card Reader
```

B. Terminals:

```
    56   Teletypes (ASR-33)
     1   Digilog Telecomputer Terminal
     3   Infoton Cathode Ray Tube (CRT) Terminals
    ‾‾
    60
```

C. Terminal Covers

```
    32   Van San Sound-Off Dampeners, Model 1026
```

D. Keypunches:

```
    12   026 Keypunches
     1   029 (Equivalent) Keypunch
    ‾‾
    13
```

E. Communications Network:

```
    32   Local Datrex Lines
    20   Remote Datrex Lines
    ‾‾
    52
```

APPLICATIONS

A. Current Applications: Description

The four main applications for which the Educational Computer is utilized are (1) Computer Mathematics, (2) Comprehensive Achievement Monitoring, (3) Computer Extended Instruction, and (4) Computer Assisted Instruction. A short description of these four categories follows:

(1) Computer Mathematics

Computer Mathematics is the instruction of programming languages and programming techniques. Computer Math is taught utilizing both the Time-Shared mode and the BATCH mode. During the 1976-77 school year five schools are offering courses in Computer Mathematics.

(2) Comprehensive Achievement Monitoring

Comprehensive Achievement Monitoring (CAM) is a test grading system which keeps extensive records on the students' progress. It is designed to give teachers and students information for classroom decision making. Data provided by CAM indicates to teachers what course material their students already know and what material they have forgotten; which students need special help; and which educational techniques are most effective. CAM benefits the students by telling them what they have learned and what they need to study more.

During the 1975-76 school year, CAM was utilized in five schools. Currently, CAM is utilized in eight schools. CAM is processed at night utilizing the BATCH mode of the Educational Computer.

(3) Computer Extended Instruction

Computer Extended Instruction (CEI) provides the student with the opportunity to investigate concepts by utilizing a computer which otherwise would go beyond the content of the course. Computer Extended Instruction utilizes both the Time-Sharing mode and the BATCH mode of the Educational Computer. During the present school year, math and science classes in all of our 13 schools (including C. E. C. and Transition) have the opportunity to utilize Computer Extended Instruction. One home economics and one social studies department have utilized the Educational Computer for Computer Extended Instruction.

(4) Computer Assisted Instruction

Computer Assisted Instruction (CAI) is defined as drill, practice and instruction, presented by a computer terminal, which assists the teacher with the presentation of material covered in his/her course. A student interacting with a CAI program can have a choice of the skill he/she wishes to study.

Additional capabilities of the computer relating to Computer Assisted Instruction are no longer available to our teachers/ students due to the increase in the number of users of CAI versus the lack of increase in computer memory. These capabilities include allowing the instructor to prescribe specific skills individually for each student. With this feature, the computer keeps track of each student's progress and automatically presents the student's next appropriate lesson. In addition, if the student leaves the terminal in the middle of a skill presentation, when he/she returns, the computer resumes the study where the student left off.

The computer is capable of producing, upon request, a summary report which can include the following for each student: (1) the original prescription; (2) the skills completed; (3) the skills yet to be studied; (4) which activity of which skill is currently being studied; (5) an indication as to whether the computer told the student to get help from the instructor on the last activity studied; and (6) the total number of minutes the student has used the CAI program. Another feature available when students follow a prescribed course of study is grouping. Upon request, the computer can produce a list of students who need study on any particular skill. The features mentioned in this paragraph are not available to our teachers/students due to the current shortage of computer memory.

Computer Assisted Instruction is provided to assist the teacher with the teaching process and to assist the student with his/her learning. It does more than just present material through the medium of the computer; it provides a degree of individualization otherwise unattainable.

During the 1975-76 school year CAI was utilized in four subject areas: math (6 schools), reading (2 schools), English (1 school) and foreign language (4 schools). Two additional reading departments are using CAI this school year. CAI utilizes the Time-Sharing mode of the Educational Computer.

In addition to these four main applications, there are a number of additional applications which use the Educational Computer on a limited basis. The usage is limited due to the shortage of academic computer power. These include the following:

(5) Material Retrieval Program

The material retrieval program is a set of computer programs used in the South Mountain High School Reading Department. At the onset of this project, a set of reading skills was defined. Currently, there are 112 skills defined in 8 reading areas. After each skill was defined, the reading department at South examined every piece of instructional material available to their students (books, filmstrips, slide-tapes, magazines, films, periodicals, etc.). Page by page, it was determined which skill was presented in each piece. In addition, the reading level of each piece was determined.

At this point in time, the instructional staff at South tells the computer the skill(s) a particular student needs to study and the student's reading level. In turn, the computer prints a list of all instructional material (by page) available to that student at his/her reading level which teaches the prescribed skill(s). The material retrieval program utilizes the Time-Sharing mode of the Educational Computer.

(6) Business Applications

Currently, the Business Education Department at Carl Hayden High School is utilizing the Educational Computer in the Data Processing classes taught by Mr. Bruce Moore. Mr. Moore uses the Educational Computer to introduce the BASIC language to his students using the Time-Sharing mode of the Educational Computer. In addition, Mr. Moore uses "on-line" facilities of Maricopa County Community College District and "BATCH" facilities of the Phoenix Union High School System administrative computer.

(7) Social Studies Simulations

There are a number of simulations in the Educational Computer which will allow social studies departments to become involved with Computer Extended Instruction. These simulations allow the students to investigate concepts in just seconds, which would take days or years to investigate in actual life. To date, Computer Extended Instruction has been accessed by only one social studies department. The social studies simulations utilize the Time-Sharing mode of the Educational Computer.

(8) Computer Accounting

The Pillsbury Accounting Package is available on the Educational Computer. This package enables students to investigate computerized accounting principles. The package is currently used by two business departments. This package utilizes the BATCH mode of the Educational Computer.

(9) Psychological Services

Currently, the Exceptional Student Departments at three schools are making use of the Educational Computer. Once a student has been tested (not using the computer) and his/her weakness identified, the computer is used to print an individualized list of remediation techniques. At the school, the department's secretary types on a computer terminal. The student's name and code numbers which relate to specific skills are entered into the computer. The list of remediation techniques is then printed on the high speed printer at the Educational Computer Center and sent to the department via interschool mail. This application utilizes the Time-Sharing mode of the Educational Computer.

(10) Home Economics

Home economics classes in some schools have made use of the Educational Computer. In particular, a Huntington II simulation called DIET has been of interest. With this program, the food value of a person's meals is analyzed using the Time-Sharing mode of the Educational Computer.

(11) COMPUTE

COMPUTE is a work-sheet-generating set of programs for basic skills mathematics. Each major area of arithmetic has been subdivided into very specific sub-objectives. A different work sheet can be printed for each student in a class. These work sheets are tailored to the student's individualized needs. Even if two students are studying the same objectives, the work sheets will be different because the problems are randomly generated. This application utilizes the Time-Sharing mode of the Educational Computer.

B. Current Applications: Computer Languages

This section discusses which computer languages are used for each of the applications listed in Section IV A. In addition, the sources of particular programs are indicated.

(1) Computer Mathematics

In Computer Mathematics, BASIC and FORTRAN are emphasized. The BASIC is Hewlett-Packard's 2000F version of standard Dartmouth BASIC and the FORTRAN is standard FORTRAN IV. In addition, ALGOL and Hewlett-Packard ASSEMBLER are available. The BASIC is available in both Time-Sharing and BATCH while the other three languages are only available in BATCH.

(2) Comprehensive Achievement Monitoring (CAM)

CAM is a set of programs written in FORTRAN. We lease the programs from National Evaluation Systems, Inc.

(3) Computer Extended Instruction

To utilize the Educational Computer for Computer Extended Instruction, the student either writes his/her own programs or uses a pre-written program. Pre-written programs are available from several sources. The student may use a program written by the instructor or by another student. Hundreds of programs are available from the Hewlett-Packard Users Group's contributed library. In addition, several projects have written programs. Projects from which we incorporate programs include Huntington I, Huntington II, Project SOLO, Project NOCOST, the Hewlett-Packard Computer Curriculum Series, and Digital Equipment Corporation's BASIC Applications Program. All of the above programs are written in the BASIC language.

(4) Computer Assisted Instruction

The main MATHEMATICS CAI programs in use in the Phoenix Union
High School System are those which are supplied by the Hewlett-
Packard Company. These programs belong to H-P and are written
in H-P BASIC. In addition, teachers and students have written
a number of math CAI programs in BASIC which are in use through-
out the system.

The READING CAI programs currently in use are all written by
our teachers. They are written in BASIC and in the Hewlett-
Packard Instructional Dialogue Facility (IDF). IDF is an
author language owned by Hewlett-Packard which enables
instructors to create CAI lessons without acquiring computer
related skills. The instructor merely sits at a terminal and
carries on a dialogue with the computer in English--the computer
programs itself after asking the instructor to supply such
information as:

        Text
        Question
        Correct Answer(s)
        Replies to Each Correct Answer
        Anticipated Incorrect Answer(s)
        Replies to Each Incorrect Answer
        Reply to Unanticipated Answer
        Failure Message
        Hints

No knowledge of computers or computer programming is required
for a teacher to use the Instructional Dialogue Facility to
create CAI lessons.

The ENGLISH CAI programs in use in our district come from two
sources. One series was written by Shirley Lowe, English
Department Chair at North High. These are written in IDF.
Another series comes to us from Maricopa County Community
College District and was written by their instructors. These
are written in BASIC.

The FOREIGN LANGUAGE CAI programs come to us from three sources.
A set of Spanish lessons named CARLOS is from Dartmouth College
and is written in BASIC. The first CAI lessons in foreign
language which were written by one of our teachers are a set of
French lessons called AVOUS, written by Phyllis Durnin (North
High) in IDF. Another set of French lessons, AVOUSP, was written
in IDF by Mary Harthun of Trevor Browne High School. In addition,
Ms. Durnin has written a set of Spanish lessons in IDF called TUYO.
Our third set of foreign language CAI lessons comes to us from
the Maricopa County Community College District and is written in
BASIC.

(5) Material Retrieval Programs

The material retrieval programs were designed by Lynda Johnson and
Sonja Bell, formerly of South Mountain High School. The programming
was done by Rick Meyer of the Phoenix Union High School System
Educational Computer Center in the BASIC language.

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USE BY STUDENTS

This section contains statistics on the number of students who utilized the Educational Computer and the amount of processing accomplished, as follows:

Table One lists the number of students who used the BATCH mode of the computer and the number of programs which were processed for them. The table covers the years 1974-77.

Table Two lists the number of CAM tests processed for students during the years 1974-77. For the school year 1976-77 it also lists the number of students involved with CAM.

Table Three lists the number of students who used the Time-Sharing mode of the computer during the years 1974-77. For the 1976-77 school year it also lists the number of hours that each department was logged onto the computer.

Table Four lists the distribution of computer terminals and related datrex (phone) lines for 1976-77 and the proposed distribution for 1977-78.

CAM PROCESSING OF STUDENT TESTS

School	Course	1974-75 No. of Tests	1975-76 No. of Tests	1976-77 No. of Tests	1976-77 No. of Students
Browne	Algebra			585	95
	Science			2,934	253
C. E. C.	Reading		517	1,177	209
	Math		183	852	222
	Science		594	649	166
	American History		546	957	170
	Free Enterprise			102	17
Central	Biology			686	131
	Chemistry			1,067	147
Hayden	Math		607	1,315	202
	Reading			965	306
North	Math	1,414	2,077	2,116	326
	Reading	588	178	1,448	353
South	Math		210	136	130
	Reading		609	412	297
Transition	Science			196	76
Union	Math		588	422	253
	Reading		13	1,836	175
	TOTALS	2,002	6,122	17,855	3,528

TERMINAL AND DATREX (PHONE LINES) DISTRIBUTION

School	Department	1976-1977		1977-1978 - PROPOSED	
		Number of Terminals	No. of Datrex Lines	Number of Terminals	No. of Datrex Lines
Alhambra	Foreign Language	1	1	1	1
	Math	2	2	2	2
	Science	1	1	1	1
Browne	English	0	0	1	1
	Foreign Language	1	1	1	1
	Math	3	2	3	2
	Science	2	1	2	1
Camelback	Math	3	3	3	3
	Science	2	2	2	2
Central	Math	4	3	4	3
	Science	3	2	3	3
Cyesis	Math et al.	0	0	1	1
East	Math	1	1	1	1
	Science	1	1	1	1
Hayden	Business	1	1	1	1
	Math	4	4	4	4
	Reading	1	1	1	1
Maryvale	Math	2	2	3	2
North	English	3	3	2	2
	Foreign Language	1	1	1	1
	Math	3	3	2	2
South	Math	5	5	2	2
	Reading	2	2	2	2
	Science	1	1	1	1
Transition	Math	1	1	1	1
Union	Math	2	2	2	2
	Reading	2	2	2	2
West	Math	3	2	3	2
	Reading	1	1	3	3
	Science	1	1	1	1
	TOTALS	57	52	57	52

SECTION VI

COSTS

A. Capital Costs:

Tables Five and Six itemize the capital expenditures relating to the Educational Computer. Table Seven is a summary of Tables Five and Six.

TABLE FIVE

HARDWARE COSTS: COMPUTER/PERIPHERALS/CARTRIDGES

YEAR	COMPUTER AND PERIPHERAL EQUIPMENT			DISC CARTRIDGES		
	Item	District Budget	NDEA	Item	District Budget	NDEA
1969-70	H-P 2000A	$ 50,616.00	$ 50,616.00			
1970-71	Peripherals	28,719.80	.00			
	Upgrade to 2000B	17,401.20	17,401.20			
1971-72		.00	.00			
1972-73	Upgrade to 2000C'	38,075.00	.00			
1973-74	Peripherals	2,782.00	.00			
	Upgrade to 2000F	.00	.00	4 cartridges	$ 520.00	.00
1974-75		.00	.00	4 cartridges	525.00	.00
1975-76	Upgrade card reader	288.75	.00	15 cartridges	1,968.75	.00
1976-77				5 cartridges	656.25	.00
Subtotals		$137,882.75	$ 68,017.20		$ 3,670.00	.00
TOTAL		$ 205,899.95			$ 3,670.00	

TABLE SIX

HARDWARE COST: TERMINALS AND MISCELLANEOUS EQUIPMENT

Year	Item	District Budget	NDEA
1969-70		.00	.00
1970-71	17 teletypes	$ 13,445.40	$ 3,182.40
	6 couplers*	1,854.00	
1971-72	16 teletypes	12,868.54	6,410.14
1972-73	10 teletypes and	11,336.00	.00
	1 Digilog terminal		
1973-74	10 teletypes	12,334.40	.00
1974-75	3 teletypes**	3,732.75	.00
	2 print punches	1,103.60	.00
	1 Omega 264 keypunch***	1,797.00	.00
1975-76	3 Infoton terminals	3,810.00	.00
1976-77		.00	.00
Subtotal		$ 62,281.69	$ 9,592.54
TOTAL		$ 71,874.23	

TABLE SEVEN

SUMMARY OF HARDWARE COSTS

Computer and peripheral equipment	$ 205,899.95
Disc cartridges	3,670.00
Terminals and miscellaneous equipment	71,874.23
TOTAL	$ 281,444.18

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* During the 1973-74 school year, these couplers were no longer in use and they were traded for one teletype.

** One teletype was beyond repair and was traded in on these new ones.

*** The remaining twelve keypunches in the math pool were purchased prior to the purchase of the Hewlett-Packard 2000A.

B. Operational Costs:

Table Eight is the 1974-77 operational expenditures for the Educational
Computer Center:

TABLE EIGHT

1974-77 OPERATIONAL EXPENDITURES

District M & O

Codes	Description	1974-75	1975-76	1976-77
156	Computer Operators	$ 2,182.77	$ 953.67	$ 1,498.60
160	Certificated Personnel	18,095.79	20,064.00	21,647.00
438 & 492	Datrex (phone)	26,861.62	33,846.50	36,144.26
440	Software Rental	3,553.00	1,630.00	1,510.00
450	Equipment Repair	24,784.05	24,744.00	27,623.93
454 & 864	Printing & Duplicating	378.85	896.57	737.32
520	Mileage	433.65	453.15	467.10
530	Supplies	313.87	339.02	168.45
532	Supplies, Instructional	1,510.97	2,038.70	1,208.80
538	Instructional Materials, Print	429.18	754.14	706.75
801	Dues and Fees	55.00	50.00	75.00
	SUBTOTAL	$78,598.75	$85,769.75	$ 91,787.21

Title I

Codes	Description	1974-75	1975-76	1976-77
056	Keypunch Operator			2,539.78
156	Computer Operators			2,594.28
442	Software Rental			3,000.00
532	CAM Supplies			1,084.53
	SUBTOTAL			$ 9,218.59
	GRAND TOTAL			$101,005.80

Code 450 is for the maintenance contract on the Hewlett-Packard computer
and keypunch and terminal repair.

Table Nine shows a breakdown on datrex costs (codes 438 and 492).

TABLE NINE

COST OF PHONE SERVICE TO EDUCATIONAL COMPUTER
(DATREX SYSTEM)

SCHOOL	NUMBER OF LINES	COST PER MONTH EACH	TOTAL COST PER MONTH	ANNUAL COST
Alhambra	4	$ 45.25	$ 181.00	$ 2,172.00
Camelback	5	22.50	112.50	1,350.00
Carl Hayden	6	22.50	135.00	1,620.00
C. E. C.	0	22.50	.00	.00
Central	5	22.50	112.50	1,350.00
Cyesis	0	22.50	.00	.00
East	2	78.85	157.70	1,892.40
Maryvale	2	56.45	112.90	1,354.80
North	7	22.50	157.50	1,890.00
Phoenix Union	4	22.50	90.00	1,080.00
South Mountain	8	71.85	574.80	6,897.60
Transition School	1	22.50	22.50	270.00
Trevor Browne	4	67.65	270.60	3,247.20
West	4	22.50	90.00	1,080.00
Subtotal				$ 24,204.00
Computer Center (Common Equipment)			592.70	7,112.40
Subtotal				$ 31,316.40
Tax (6.7%)				2,098.20
TOTAL				$ 33,414.60

GOALS

A. Student Related Goals:

The following is a list of student related goals for academic computing as identified by the Phoenix Union High School System's Educational Computer Specialist. The list is in priority order.

(1) To make available to every high school student the fundamentals of computer literacy which are encountered in daily living.

(2) To make the computer available for problem solving in all Math and Science classes.

(3) To make the computer available for simulations in all Math and Science classes.

(4) To make the computer available for simulations in other subject areas such as Business, Social Studies, Home Economics, etc.

(5) To make the computer available for the in-depth learning of the programming languages BASIC, FORTRAN, and ASSEMBLER to students enrolled in Computer Mathematics classes.

(6) To make the computer available for the in-depth learning of the programming language COBAL and to introduce the BASIC programming language in Business classes.

(7) To make the computer available for student achievement monitoring so that the data resulting will be available for making daily instructional decisions. This service is to be available to all subject areas.

(8) To make the computer available to run test item analysis on materials used with the student achievement monitoring programs.

(9) To make the computer available for computer assisted instruction in basic skills mathematics in all math departments.

(10) To make the computer available for computer assisted instruction in basic skills reading in all reading departments.

(11) To make the computer available for computer assisted instruction in basic skills English in all English departments.

(12) To make the computer available for computer assisted instruction in foreign language in all foreign language departments.

(13) To make the computer available to instructors who write computer assisted instruction lessons in a computer author language.

(14) To make the computer available as a manager of instruction for the work students do with computer assisted instruction lessons.

(15) To make the computer available as a device to prescribe instructional materials for students needing work on specific skills at specific levels of difficulty. This service is to be available to all subject areas.

(16) To make the computer available in all business departments for computer augmented accounting.

(17) To make the computer available in Exceptional Student Departments for prescribing remediation techniques for students.

(18) To make the computer available in counseling departments to provide guidance to students seeking information on careers, colleges, and scholarships.

(19) To make the computer available in counseling departments to provide guidance to students seeking information on vocations and vocational training.

(20) To make the computer available in counseling departments to provide guidance to students seeking information on specific jobs and information on the current local job bank.

(21) To make the computer available for test generating for classroom teachers of all subject areas.

(22) To make the computer available as a manager of instruction to coordinate and maintain the effective integration of the use of technology in the classroom in all subject areas.

(23) To make the computer available in the evening for Adult Basic Education classes.

(24) To make the records available from the student achievement monitoring programs to update the student data base maintained by administrative computing.

(25) To make the student data base maintained by administrative computing available to the student achievement monitoring programs and to the computer assisted instruction programs.

B.. Computer Acquisition Related Goals:

Some of the above are being accomplished on our Hewlett-Packard Educational Computer. However, the majority of these goals require additional computer resources including computer hardware, the associated peripherals, terminals, and communications equipment. The following is a set of goals relating to the acquisition of additional computer resources:

Major Goals:

(1) To make academic computing services available to all instructional departments instead of to the limited ones now being served. In these regards: To increase the number of terminals which concurrently communicate with the computer without increasing the phone company costs.

(2) To regain the features available in computer assisted instruction which our growth has forced us to give up, as mentioned in Section IV A (4).

(3) To increase computer storage memory beyond the current level to accommodate additional courseware in the areas already being served.

(4) To achieve the goals listed in this status report without degrading the current level of computer performance in such areas as computer response time.

(5) To make the change over to the new computer hardware without losing the CAI courseware that has been written by our instructional staff.

(6) To acquire new computer hardware that supports the same computer programming languages which are used on the Educational Computer currently.

(7) To be able to cost-effectively utilize our existing 60 terminals with any new computer hardware.

Secondary Goals:

(8) To provide computer power to support academic uses of computers which our instructional staff currently acquires from other sources, such as the Guidance Information System, acquired from the Maricopa County Community College District Hewlett-Packard computer; and on-line COBOL programming which Carl Hayden High School Business Department has acquired from the Maricopa County Community College District UNIVAC computer.

(9) To put academic achievement monitoring on-line to the computer, so as to provide immediate data to teachers/students for classroom decision making. This would replace the CAM system currently being operated in a BATCH mode at night.

(10) To be able to share common data bases with the administrative computing division to decrease duplication of effort and redundancy.

(11) To become involved in new applications such as those mentioned in Section VIII.

(12) To extend our use of the computer by having available additional programming languages.

(13) To have modern technological features such as re-entrant programs available which will augment future expansion of computer assisted instruction.

SECTION VIII

NEEDS ASSESSMENT

The Phoenix Union High School System established a computer acquisition committee which was chaired by Carolyn Scott, Assistant Superintendent for Instruction. This committee consisted of three sub-groups. The first sub-group was a steering committee. The second sub-group dealt with administrative computing and the third dealt with academic computing. The membership of these groups was as follows:

Steering Committee	Administrative Committee	Academic Committee
Carolyn Scott, Chair	Lanny Kope, Chair	Jack Comstock, Chair
Jack Comstock	Earl Barrett	Earl Barrett
Don Covey	Bob Blackman	John Black
Jeff Gadd	Larry Casillas	Don Covey
Lanny Kope	Gary Estes	Bob Dye
John Schoolland	Carl Hurlburt	Dick Froese
J. G. Thompson	H. J. Jones	Wes Goodwin
	Patsy Kakucsi	Milt Jones
	Jack Maddux	Bert Konzal
	George Miller	Ed Long
	Chuck Morehouse	Dan Mangelsdorf
	John Schoolland	Rick Meyer
	Ray Wisniewski	John Miller
		Doris Moten

The findings of the administrative group may be found in a status report dated May, 1977. The findings of the academic group are included in the following memo.

Memorandum

DATE: February 2, 1977

TO: Computer Acquisition Steering Committee, Dr. Carolyn Scott, Chair

FROM: Jack Comstock/Rick Meyer

SUBJECT: Possible Computer Applications for Instruction

The Instructional Applications Committee has developed a partial list of applications for an expanded computer system. The expanded system would provide additional on-line capacity for students as well as instructional batch operations at each school.

The Instructional Applications may be divided into categories. Four main categories are included here:

(1) Computer Based Instruction
(2) Computer Assisted Instruction
(3) Computer Extended Instruction
(4) Guidance Services

The committee discussed several specific applications for a new computer system as follows:

(1) Comprehensive Achievement Monitoring (CAM) currently in use in the district
(2) University level courses available to high school students for credit
(3) Tutorial programs for the homebound, courses with low demand at specific campuses, and independent in-depth study
(4) Library of Congress collection now available in both video and printed format
(5) Prescription teaching assisted by test and record analysis for the drop-out prone and/or students with specific instructional needs
(6) Employment Preference Programs which could match occupational choices with current and future job markets
(7) Educational research services such as that used by the Arizona State University Arizona Education Information System (AEIS)
(8) Instructional developments based on system analysis of student needs
(9) Search and Inventory programs for district instructional equipment
(10) Test item banks for specific courses and/or subject areas
(11) Computerized lesson plans
(12) Instructional Activity Banks
(13) Assistance for registration, attendance, and scheduling

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Computer Acquisition Steering Committee
Possible Computer Applications for Instruction

Many of these applications overlap each other and overlap
administrative applications. A new computer system would make it
possible to allow these activities to share data bases and reduce
redundancy.

These are but a handful of possibilities for applying both present
and potential computer technology to instruction. The problem
will not be identification of possible uses, but rather one of
selecting the most appropriate and feasible.

JC/RM:ds

cc: Robert Goodrich
      John Black
      Don Covey
      Bob Dye
      Dick Froese
      Wes Goodwin
      Milt Jones
      Bert Konzal
      Ed Long
      Dan Mangelsdorf
      John Miller
      Doris Moten

MISCELLANEOUS REQUIREMENTS PERTAINING TO A NEW COMPUTER

In addition to those requirements already mentioned, there are a number of other considerations which include the following:

A. Personnel:

   (1) The Educational Computer Center currently has the services of one-third of a ten-month secretary. This is not sufficient for the current operation. If academic computing is to increase, then secretarial services will also need to be increased.

   (2) For putting current programs on a new computer, for maintaining these programs and for initiating new programs, a programmer will have to be included as a member of the Educational Computer staff.

   (3) It would be cost effective to have an equipment technician as a member of the Educational Computer staff. This person's primary duties would be with the district's card handling equipment used by the Educational Computer Center and the business education departments. The repair and maintenance of this equipment is currently covered by a contract from an outside vendor which is bid each year. The secondary duties of this technician would be to do trouble-shooting and minor maintenance on terminals and communications equipment. This person would transport terminals with serious mechanical/electrical problems to a vendor for repair. The money saved by not having a contract for repair of card handling equipment and the money saved which is currently spent in sending a vendor to schools for minor terminal repair will offset this person's salary and the cost of the repair parts. In addition, this person will relieve terminal and communications equipment trouble-shooting duties of the district's Educational Computer Specialist, which in turn will increase this person's productivity.

B. Facilities and Equipment:

   (4) Computer room floor space, refrigeration and electrical power will need to be analyzed. The current location of the Hewlett-Packard Educational Computer will not accommodate additional hardware, even by removing walls and remodeling.

   (5) Currently, the Educational Computer Center is seriously limited on shelving and storage. With this consideration, thought should be given to purchasing a storage cabinet which is fireproof for the back-up storage of software and courseware.

   (6) A work station for the academic programmer mentioned in Section IX A (2) will need to be provided.

   (7) Currently, each of the on-line academic terminals at our schools is hooked up to the Educational Computer over a separate telephone line. By purchasing communications equipment, when a new computer is purchased, several terminals may be hooked up to the computer

over just one phone line. This will allow us to greatly increase the number of terminals concurrently on line with the computer without increasing our phone company costs. One consideration regarding obtaining our own communications equipment is that it will be placed in a central location at each school and we will need to run wiring from this location to the classrooms where terminals are to be used. The cost of this wire and its installation should be included in the total planning for a new computer system.

C. Structured Growth of Computer Assisted Instruction:

With the purchase of a new computer will come the desire to make CAI more widely available to our students (see Section VII, Goals). Even though a large amount of CAI courseware has been developed by our instructional staff, for the most part it lacks continuity. That is, teachers write CAI lessons to satisfy specific needs with little consideration to the availability of CAI lessons which could precede or follow. To get top utilization, a more structured approach to writing CAI lessons needs to be considered. This will involve professional growth money to pay teachers for workshops and/or performance contracts.

SECTION X

ALTERNATIVES REGARDING ADDITIONAL COMPUTER RESOURCES

There are a number of alternatives regarding the immediate future of academic computing in the Phoenix Union High School System. The alternatives include the following:

(1) We can keep what we have and not grow to meet the current and future needs of our teachers and students. This is not recommended. It was said by a past Board member, Steve Jenkins, that it's not a question of IF we purchase new computer hardware, the question is WHEN to purchase it.

(2) Communications equipment could be purchased and installed now which could be used on a new computer in the future. This equipment would save phone line costs for the Hewlett-Packard in the meantime.

(3) One huge computer could be purchased for the purpose of meeting the needs of both administrative and academic computing.

(4) Two medium sized, large scale computers could be purchased. One would be devoted to administrative computing and the other to academic computing. Each computer could serve as a back-up to the other.

(5) One medium sized, large scale computer could be purchased for administrative computing and two minicomputers could be purchased for academic computing. The administrative and academic computer systems could communicate with each other but would not provide back-up for each other.

(6) Three large minicomputers (each several times bigger than either of our current systems) could be purchased. One would be primarily for administrative computing and two would be primarily for academic computing, but overlapping could take place. Each computer would provide back-up for the other two.

NOTE: Upgrading the current Hewlett-Packard computer and using it in place of one of the minicomputers mentioned in (4) or (5) above is a possibility assuming the new minicomputer(s) had compatible software and all machines could communicate with each other.

SECTION XI

RECOMMENDATIONS REGARDING ADDITIONAL COMPUTER RESOURCES

The following recommendations are made regarding the acquisition of new computer hardware. The recommendation is made that:

(1) Computer hardware be purchased that will give us additional capabilities without loss of any of the performance which we now have available through use of the Hewlett-Packard.

(2) Computer hardware be purchased to meet as many of the goals as possible as stated in Section VII of this report.

(3) Communications hardware be acquired as part of the new computer purchase which will allow growth without increasing phone company costs.

(4) No commitment be made on either selling or keeping the Hewlett-Packard until we see what is bid by all vendors. The Hewlett-Packard may or may not cost-effectively fit into the new computer configuration.

(5) A Request for Proposal (RFP) be written which details our administrative and academic computing needs but is not written in such a way as to single out any one hardware configuration as being most desirable. In this manner, it will be possible for each vendor to submit a proposal representing that company's best solution to meeting our needs.

(6) An RFP be released that will allow a vendor to bid on one or more of our five separate considerations, namely (1) administrative computer hardware; (2) academic computer hardware; (3) communications equipment; (4) terminals; and (5) card readers.

FUTURE COST

The biggest cost inherent in purchasing a new computer is that of the hardware itself. This includes the computer, peripherals, terminals and communications equipment. In addition, this report has made reference to considerations which involve expense in the following areas:

CAPITAL EXPENSE

        Facilities (floor space)
        Electrical service
        Refrigeration
        Storage (ordinary and fireproof)
        Work station - programmer
        Hook-up of communications equipment (material)

OPERATIONAL EXPENSE

        Two-thirds additional secretary
        Academic programmer
        Professional growth - workshop/contracts
        Hook-up of communications equipment (labor)

The actual capital and operational projected cost could be identified, but to do so, specific vendors' equipment would be used as examples. This could be misinterpreted as an endorsement and consequently is not included in this report.

It should be noted that the purchase of communications equipment will allow continual growth without the need for additional telephone lines. This means that future growth will be possible without increased phone line expense.

TABLE ONE

BATCH PROCESSING OF STUDENT PROGRAMS

School	Course	1974-75		1975-76		1976-77	
		Number of Students*	Number of Programs**	Number of Students*	Number of Programs**	Number of Students*	Number of Programs**
Alhambra	Math	111	626	93	591	70	382
Browne	Math	85	1,070	233	1,737	190	1,022
	Science	20	20	495	1,101	642	1,049
Camelback	Math	930	6,171	579	4,109	405	2,835
Central	Math	330	2,521	440	2,742	287	3,610
East	Math	15	432	375	1,349	245	331
	Science	64	131	68	176		
Hayden	Math	46	202	12	327	18	227
Maryvale	Math	113	811	60	819	88	975
North	Math	90	440	140	456		
South	Math	329	1,944	485	2,027	274	1,292
Union	Math			38	38	100	100
West	Math	175	1,244			22	165
	TOTALS	2,308	15,612	3,018	15,472	2,341	11,988

* The number of students who used the BATCH mode of the computer was reported by the department chairs at the end of each school year.

** The number of programs ran is logged by the night computer operators.

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TABLE THREE

TIME-SHARED BASIC USAGE BY STUDENTS

School	Department	1974-75 Number of Students*	1975-76 Number of Students*	1976-77 Number of Students*	Number of Hours**
Alhambra	Foreign Language			50	30.1
	Math	450	308	225	1,218.1
	Science	220	190	165	466.0
	Other	878	900	900	72.0
Browne	Foreign Language	27	95	120	390.9
	Math	54	110	148	1,165.0
	Science	22	34	92	475.9
Camelback	Math	363	320	280	1,400.0
	Science	239	295	447	398.8
C. E. C.	Math	30	25		
Central	Math	120	71	183	1,419.0
	Science	515	505	550	1,158.0
East	Math	65	315	245	410.1
	Science	168	128	281	370.7
Hayden	Business		84	121	220.4
	Math	313	301	370	2,779.5
	Reading	30	100	220	657.2
	Science	6	6		
	Other			217	77.0
Maryvale	Math	114	24	582	1,257.7
	Science	7		1	7.7
North	English	87	135	139	232.9
	Foreign Language	50	61	150	341.1
	Math	115	320	353	337.3
	Reading	50			
	Science	8	3		
South	Math	274	230	30	397.6
	Reading		800	159	673.4
	Science	490	417	522	171.0
Transition	Math			175	131.6
	Science			30	18.8
Union	Math	171	286	257	302.2
	Reading			285	1,119.3
West	Math	100	90	290	733.7
	Reading			631	413.7
	Science	254	117	300	364.5
	TOTALS	5,220	6,270	8,518	19,211.2

* The number of students who used the Time-Sharing mode of the computer was reported by the department chairs at the end of each school year.
** The number of hours that a department is logged onto the computer is automatically accumulated by the computer.

ORGANIZATION

The operation and use of the Educational Computer is supervised by the district Educational Computer Specialist. This individual has the services of one-third ten-month secretary (this secretary also works for the Supervisor of Communication Arts and the Social Studies Supervisor).

The Educational Computer has two modes of operation. During the day (7:00 a.m. to 6:00 p.m.) the computer operates in a time-sharing mode during which time it communicates with 32 users simultaneously. There are 52 terminals* attached to the computer over telephone lines from our 11 high schools and Transition School. In addition to the specialist and the secretary mentioned above, the daytime operation staff also includes a part-time (four hours per day) keypunch operator.

During the evening, starting at 6:00 p.m., the Educational Computer is operated in the BATCH mode of operation. In this mode of operation, the computer processes one program at a time by reading cards which have been either punched or marked at some previous time. The Computer Center has the services of two operators during these hours. One operator comes in at 6:00 p.m., and the second one comes in after the first one has left. Each works two to four hours per night depending upon the work load.

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* The district owns 60 terminals; 52 are "on-line" with the computer; 5 are "off-line"; and 3 are assigned to the Educational Computer Center.

(6) Business Applications

One primary use of the Educational Computer is to introduce
students to the BASIC language and to give them the opportunity
to program in this language. In addition to the Educational
Computer, the Phoenix Union High School System Administrative
Computer and the Maricopa County Community College District UNIVAC
Computer are used by one business department to teach COBOL
programming. In this regard, the Phoenix Union High School System
Administrative Computer is used in the BATCH mode and the
Maricopa County Community College District computer is used in
the Time-Sharing mode.

(7) Social Studies

The Huntington I and Huntington II programs mentioned in
Section IV B (3), "Computer Extended Instruction," are the primary
programs used in social studies. These programs are written in
BASIC.

(8) Pillsbury Accounting Package

The Pillsbury Accounting Package correlates with a book,
COMPUTER ORIENTED ACCOUNTING (South-Western Publishing Co.),
written by Wilbur F. Pillsbury, DBA. The programs are written in
FORTRAN.

(9) Psychological Services

The remediation techniques programs were designed by Martha Tanner
of Alhambra High School. The programs, which are written in BASIC,
were adapted for the Hewlett-Packard computer by Rick Meyer of
the Educational Computer Center.

(10) Home Economics

The primary programs used by the home economics departments are
from the Huntington project and are written in BASIC. In addition,
special purpose programs have been written by Rick Meyer of the
Educational Computer Center.

(11) COMPUTE

The COMPUTE programs are written in BASIC and are the property of
the Minnesota Council on Quality Education.

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