72-18,338

MIKESELL, Jerald Louis, 1935-
ASPECTS OF COMPUTER SCIENCE THAT WOULD PROVIDE
VALID CURRICULA IN COMPUTER SCIENCE FOR EDUCATORS.

University of Wyoming, Ed.D., 1971
Education, curriculum development

University Microfilms, A XEROX Company, Ann Arbor, Michigan

ASPECTS OF COMPUTER SCIENCE THAT WOULD PROVIDE VALID CURRICULA IN COMPUTER SCIENCE FOR EDUCATORS

by

Jerald Louis Mikesell

A Project Report
Submitted to the Department
of Curriculum and Instruction and
The Graduate School of the University of Wyoming
in Partial Fulfillment of Requirements for the
Degree of Doctor of Education

University of Wyoming
Laramie, Wyoming
November, 1971

This thesis, having been approved by the special Faculty Committee, is accepted by the Graduate School of the University of Wyoming, in partial fulfillment of the requirements for the degree of Doctor of Education

[signature]

Dean of the Graduate School

Date November 19, 1971

ACKNOWLEDGEMENTS

This study was made possible only with the assistance and cooperation of many persons. The author is grateful to Dr. Bill W. Tillery for his patience and guidance during the writing of the study. The reading committee deserve a special thanks for their efforts.

The author is also grateful for the advice and cooperation of Dr. Al Suvak and Dr. Eric Strohmeyer. Their willingness to listen and act as a sounding board for ideas was most helpful.

The patience, encouragement and willingness to help exhibited by my dear wife, Jeannette, have earned for her an eternal thanks.

CONTENTS

TABLES

CHAPTER I

INTRODUCTION

Statement of the Problem

The purpose of this study is to identify those aspects of computer science that would provide valid curricula in computer science for educators.

Definition of Terms

To provide a common meaning for some of the terms used in this study the following words are defined:

1. APL - A scientific language that permits great compression of algorithmic statements into a few lines of coding.

2. BASIC - A user language developed specifically for use with remote terminals.

3. COBOL - A business data-processing language.

4. Coding - The method used to represent (symbolize) data for the computer. It gives successive computer operations required to solve a given problem.

5. Coefficient - The product being regarded as a distinct entity with respect to the excluded factor and to a designated operation.

6. Computer - A machine which is able to perform sequences of arithmetic and logical operations upon information.

7. Computer-Assisted-Instruction - Computers linked directly to teaching devices and television which aid in the instruction of students.

8. Debug - To find and remove errors in a computer routine.

9. Electronic Data Processing - A range of machines and processes which includes tabulating, punched card, or integrated data processing, computers, and systems and procedures work.

10. Factor Loading - A coefficient, ranging between -1.00 through 0 to +1.00, that expresses the relations between the tests and the underlying factors.

11. Flow Chart - A graphical representation of a sequence of programming operations, using symbols to represent operations such as compute, substitute, compare, jump, copy, read, write, etc.

12. FORTRAN - One of the most popular computer languages developed for mathematicians and scientists. FORTRAN is derived from FORmula TRANslation.

13. Gaming - A situation where participants compete with the computer in training situations.

14. Hardware - The mechanical, magnetic, electronic and electrical devices from which a computer is fabricated.

15. Information System - All of the electronic data processing hardware and software that are needed to provide comprehensive services to a business, industry or educational system.

16. Programming - The process of producing from a given problem a computer program to solve the problem. It consists of problem analysis, selection of the method, and coding.

17. Remote Terminal - A teletype, electric typewriter or other device which can supply input to the computer and can accept output from the computer by using telephone or other types of wire connections. Can be many miles removed from the computer center.

18. Software - A collection of standard programs and operational procedures needed for the efficient use of a digital computer.

19. User - A person who through some type of input device communicates with a computer.

20. User Language - A special language which enables a person to communicate with the computer without using machine language. Machine language translates everything to a base two representation.

Limitations of the Study

This study is limited to determining content, approach and topic emphasis for a computer science course for educators. A determination of the relative emphasis that should be given to each topic is accomplished by statistical procedures described in detail later in this paper.

The panel of experts was selected from a listing of people trained in both computer science and education. This listing was obtained while reviewing the literature in the field of computer technology as it relates to education and people known personally by the author as having background and/or experience in both computer science and education.

There was no evidence to show that the sample used in this study is representative of the total population of people qualified in both computer science and education. There will be no attempt to make generalizations to the population as a whole as a result of this study.

There will be no attempt to organize the topics determined to be worthwhile into a sequence for teaching purposes.

Importance and need for the Study

According to Haga the utilization of computer technology in education is a must. The business of education has grown until it consumes more than forty billion dollars of the nation's wealth each year. It is not defensible to guide the operation and direction of such a vast enterprise without the use of the best tools that technology can provide.[1]

Educational institutions are feeling the impact of having to absorb and live with computer technology, and they have the additional responsibility of educating the citizens of today and tomorrow so that they can utilize the services of computer technology. Loughary indicates that there is need to acquaint the prospective teacher with the hardware and software of a technical age. Yet, many colleges and schools of education are doing little or nothing to provide the prospective teacher with information about today's role of computers in his teaching career.[2]

The computer has become so common and so inexpensive that computer terminals are now being installed in homes at a cost of only $110 a

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[1]Enoch Haga, Understanding Automation, Elmhurst, Illinois: The Business Press, p. 79, 1965.

[2]John W. Loughary, "Can Teachers Survive the Educational Revolution?" Phi Delta Kappan, 48:204-07, January, 1967.

month for rent, plus $7.50 per hour of use. Through a time-sharing system up to 200 remote terminals are connected to a central computer and operated simultaneously. This is possible because the actual time needed to service each terminal is just a fraction of a second.[1]

The modern computer is suited for many of the clerical tasks and even more sophisticated problems that face educators. Illinois school districts utilize the computer to perform one hundred twenty nine different tasks for them.[2]

Asbell reports that what appears to be a wave of the future, the Texarkana experiment, utilizes computer type equipment to "individualize" instruction for students. This commercial company is a competing school system that is utilizing scientific equipment to successfully do a job that the school systems are often failing to do.[3]

Leadership in the use of computer science is coming from outside the education profession and is being impressed on the schools by educationally oriented data processors rather than by data-processing oriented educators.

The colleges and universities have a tremendous responsibility in training people who can be the leaders and also in assuming a great deal

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[1]--------, "The Handy Uses of a Home Computer," Life, 68:49 January 30, 1970.

[2]--------, Survey: Educational Electronic Data Processing, Illinois Public Schools, Circular Series A, Number 205, 1967.

[3]Bernard Asbell, "Schools Hire Out the Job of Teaching." Think, 36:6-7, September-October, 1967.

of the leadership role themselves. It is the teacher training institutions who are presently training the teachers of the year 2000. Are these teachers being adequately trained to meet the increased involvement they will have with computer technology? Bushnell reports that the teachers on the firing line want to know: "What is my responsibility?" "How do I fit in?" "How and when do I actually use the computer in the classroom?"[1]

These questions, according to Stollar, could be answered in the methodology courses taught by the college of education. Many colleges and universities with a teacher education program already have the facilities to draw upon for the laboratory experiences and for technical assistance. It would be relatively easy to add a data-processing course for educators during their first year of the professional education sequence. He continues:

> This should be a general survey course aimed at discussing the way in which educational data-processing systems are developed, the typical application of data processing and computer science to education. No attempt should be made to make programmers out of potential teachers.[2]

The intent of the course would be to make the student a knowledgeable consumer.[3]

The determination of the content deemed most appropriate to the type of course described above is the intent of this paper.

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[1] Don D. Bushnell and Dwight W. Allen, The Computer in American Education, New York: John Wiley and Sons, Inc., p. 149, 1967.

[2] Dewey H. Stollar and John R. Ray, "DATE - Datamation Applications for Teacher Education," The Journal of Teacher Education, 20:192, Summer, 1969.

[3] Ibid.

CHAPTER II

METHOD OF STUDY

There were four major areas contained in the design of this study. They were (1) the construction of the opinionnaire, (2) the administration of that opinionnaire to a control group and a panel of "experts" (3) the analysis of the data from the returns obtained and (4) a descriptive comparison of the findings of this study and the programs described in Chapter III.

Development of the Opinionnaire

The original opinionnaire was based on topics suggested for inclusion in a course of study for educators relating to computer science. These topics were derived from a careful study of the literature related to computer science in education, including topics found in existing programs described in Chapter III and from the writer's experience in developing and teaching a course of this type. A preliminary instrument was prepared and submitted for criticism to the director of the test scoring service at Montana State University. This person has a Doctor of Education degree, has taught data processing courses, and has had over ten years experience working with computers in education.

The revised instrument was then administered to a group of graduate students at Montana State University, some of which had had some computer experience. As a result of this pilot study the opinionnaire was revised and the control group and the panel of experts were asked to

rate each item as follows: (1) of very little value
(2) of some value
(3) worthwhile
(4) of great value
(5) vital

Topics designed to determine possible inclusions for a course in computer science for educators were listed. Items designed to determine the most effective way to train the educator to utilize computer technology (formal computer science courses taught by computer science departments, self education, computer manufacturer's courses, etc.), the best type of user language, the type of educator it should be geared toward and the duration of the course were also included. A copy of the opinionnaire is found in Appendix B.

Selection of the Respondents

For some of the statistical procedures used and for testing and validating the opinionnaire a control group was selected. Those asked to respond to the opinionnaire as a control group included twelve College of Education faculty at Montana State University, forty-five computer science students who had had at least one previous course in computer science and eight students taking senior level courses in computer science. It was felt that the faculty members would have expertise in education and a layman's knowledge of computers with some definite opinions concerning it. The students of computer science have some expertise in their field and a layman knowledge of education with some definite opinions concerning it. They were encouraged to respond to only those items about which they had some knowledge or some definite opinion.

A "panel of experts"[1] was selected from a listing of people trained in both computer science and education. This list was compiled as a result of reviewing the literature in the field of computer technology in education and of people known personally by the author as having background and/or experience in both computer science and education.

Administration of the Opinionnaire

The College of Education faculty were given the opinionnaire for their responses, and were given oral instructions concerning its use and how to fill it out. The author met with the computer science classes and administered the opinionnaire during a class session.

The revised opinionnaire, together with a stamped, self-addressed envelope, a mark sense sheet, and a letter of explanation were mailed to thirty people trained in both education and computer science. A second mailing was made to those people who had not responded to the first mailing within two weeks.

Analysis of the Data

The data obtained were analyzed by a series of statistical procedures. The returns on items twenty-nine through forty-seven, which dealt with course procedures rather than course inclusions, were tabulated, a mean and a standard deviation was computed for each item. Significant differences between the various response items in each

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[1]See Appendix A for complete listing of those who responded to the opinionnaire.

category were determined by a single-factor, repeated measures analysis of variance type design. The analysis of variance table using a single-factor, repeated measures design is as follows:[1]

$(1) = G^2/kn$ $(2) = \Sigma\Sigma X^2$ $(3) = (\Sigma T_j^2)/n$ $(4) = (\Sigma P_i^2)/k$

Source of variation	SS	d.f.	MS	F
Between people	$SS_a = (4) - (1)$	n-1		
Within people	$SS_w = (2) - (4)$	n(k-1		
Treatments	$SS_t = (3) - (1)$	k-1	$SS_t/k-1$	$\frac{MS_t}{MS_r}$
Residual	$SS_r = (2)-(3)-(4)+(1)$	(n-1)(k-1)	$SS_r/(n-1)\ (k-1)$	
Total	$SS_T = (2) - (1)$	kn-1		

The result of the single-factor, repeated measures analysis of variance design is an F ratio. The significance of the obtained F ratio was determined by use of the F table which is found in the appendix of the book by Winer.[2]

If the overall hypothesis of equal means is rejected by the analysis of variance, it is reasonable to assume that at least one sample mean differs significantly from one other sample mean. A number of methods exist for making selected a posteriori and complete sets of comparisons of the sample means. If a comparison is suggested by inspection of the data Winer says, "The procedure given by Scheffé would be used to obtain the critical value."[3]

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[1] B. J. Winer, Statistical Principles in Experimental Design, New York: McGraw-Hill Book Company, pp. 110-113, 1962.

[2] Ibid., pp. 642-647.

[3] Ibid., p. 113.

Roscoe in talking about the Scheffé test of multiple comparisons says:[1]

> The Scheffé procedure for testing any and all possible comparisons between means has the important property that the probability of a Type I error for any comparison does not exceed the level of significance specified in the analysis of variance for the over-all hypothesis. However, the probability of a Type I error for a given comparison may be considerably smaller than the level of significance set by the investigator. Like the analysis of variance, the Scheffé procedure is quite insensitive to departures from normality and homogeneity of the variances. The test statistic is quite simply calculated for any pair of means, and it is referred to the same region of rejection as that specified for the test of the over-all hypothesis of equal means. The formula is as follows:

$$F = \frac{(M_1 - M_2)^2}{MS_w\left(\frac{1}{n_1} + \frac{1}{n_2}\right)(k - 1)} \qquad \text{with df} = k - 1,\ N - k$$

There are times when the overall hypothesis of equal means is rejected by the analysis of variance procedures and the Scheffé test finds that no two means differ significantly. This is due to the fact that the analysis of variance procedure is a more powerful test of the hypothesis of equal means. When this happens it is reasonable to conclude that the largest mean is significantly larger than the smallest.[2]

It was felt that in some instances several of the items 1-28, which dealt with topics suggested for inclusion in the course, related to a particular factor or generalization concerning content and/or approach

[1]John T. Roscoe, Fundamental Research Statistics, Holt, Rinehart and Winston, Inc., pp. 239-240, 1969.

[2]Ibid., p. 241.

in a course of this type. Since not every possible topic could be listed in the opinionnaire, topics that someone may want to consider for inclusion in the curricula for a computer science course for educators can be compared to one of the identified factors and thus rated. To determine if such factors did exist, the results obtained from the control group were subjected to a factor analysis procedure.

The first step in the factor analysis is to develop an intercorrelation matrix. This is a matrix which shows the correlation of each variable to every other variable being tested. The next step is to extract factors from the matrix of intercorrelations.[1] After factoring the matrix, the next step in the procedure is to rotate the frame of reference axes into a meaningful position. This is accomplished by utilizing a varimax rotation with the computation done by a high speed digital computer. A factor matrix of coefficients that expresses the relations between the variables and the underlying factors is formed.[2] These coefficients, entitled factor loadings, range between -1.00 and +1.00. They are interpreted in the same manner as correlation coefficients in that they express the correlations between the variables and the factors. Kerlinger states that:

> Factor analysis has two basic purposes: (1) to explore variable areas in order to identify factors presumably underlying the variables as well as the variables, and as

[1]Harold Borko, Computer Applications in the Behavioral Sciences, Englewood Cliffs: Prentice-Hall Inc., p. 241, 1962.

[2]Fred N. Kerlinger, Foundations of Behavioral Research, New York: Holt, Rinehart and Winston, Inc., p. 653, 1964.

in all scientific work, (2) to test hypotheses about the relation among variables.[1]

Labeling of the factors identified was determined as a result of the nature of the items receiving large factor loadings.[2] The responses of the panel of experts were compared on the factors determined from the control group and for the panel of experts on each of the factors identified.

A determination of significant differences between the means of the control group and the experts was accomplished by utilizing the t test. A calculation of the mean for each factor was accomplished by finding the mean of all items that received a factor loading greater than .30 for each respondent, then averaging the factor mean for all respondents. If an item received a negative factor loading, the rating given by each of the respondents was inverted. The Case I formula given by Ostle was used to compute the t value between the means. The ratio obtained by the formula:

$$\frac{\bar{X}_1 - \bar{X}_2}{S_{\bar{X}_1 - \bar{X}_2}} = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{S^2}{n_1} + \frac{S^2}{n_2}}} = \left(\frac{\bar{X}_1 - \bar{X}_2}{S}\right)\left(\frac{n_1 n_2}{n_1 + n_2}\right)^{1/2}$$

is distributed as Student's t with $n_1 + n_2 - 2$ degrees of freedom.[3]

The specific null hypotheses to be tested as a means of determining the most effective course inclusions and procedures include:

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[1] Ibid., p. 680.

[2] Harry H. Harmon, Modern Factor Analysis, The University of Chicago Press: Chicago, pp. 310-311, 1967.

[3] Bernard Ostle, Statistics in Research, The Iowa State University Press: Ames, Iowa, p. 95, 1963.

1. There is no significant difference between the mean ratings given by the control group and by the experts for each of the factors identified.
2. There is no significant difference between the mean ratings for each of the factors identified as rated by the panel of experts.
3. There is no significant difference in the mean ratings of the experts for the type of course which will most effectively train the educator to utilize computer technology.
4. There is no significant difference in the mean ratings of the experts as to the computer language that can be taught most effectively to educators.
5. There is no significant difference in the mean ratings of the experts as to the type of educator the course should be oriented toward.
6. There is no significant difference in the mean ratings of the experts as to the number of hours needed for a computer course for educators including instruction and lab activities.

Once the results had been analyzed, a descriptive comparison was made between the items listed in some of the courses described in Chapter III and the rating those items were given by the panel of experts.

CHAPTER III

SOME RELATED LITERATURE

Introduction

The author was unable to locate any research studies dealing directly with evaluation of the approaches, method or content used in computer science courses for education. Literature relating to: (1) course content, (2) approaches, and (3) pedagogy of computer science courses for educators is presented in this chapter.

Computer Courses for Educators

The Northwest Regional Educational Laboratory, through a program entitled REACT (Relevant Educational Applications of Computer Technology) is being designed so that teachers and administrators will have the opportunity to increase their understanding of how computers can be used in instruction and administration. This program is still in the development and revision stage. A letter, found in Appendix C, from the Northwest Regional Educational Laboratory details the extent of incorporation and the extent and type of validation procedures REACT had undergone as of the Spring of 1971.

> A series of training packages are being developed to demonstrate ways the computer can be used in school administration and instruction. As a result, school personnel increase their understanding of the problems and potentials in using computers. They are able to select intelligently from the growing number of possible uses of the computer in education.
>
> These training packages are organized into separate courses for school administrators and teachers.

Course I is designed to provide 30 hours of instruction for both administrators and teachers. Instructional units provide a general introduction to computers and survey the use of computers in education.

Course II for administrators, also providing 30 hours of instruction, thoroughly examines the concept of data management systems. A miniature system is constructed for an imaginary school. Then, several administrative applications are explored through manipulating this information. The applications range from the routine (preparation of report cards) to the imaginative (a program planning budgeting system).

Course III is designed for administrators who wish to implement computer based applications. It delves deeply into problems of hardware options, software needs, costs, personnel and computer power options.

Course II for teachers is composed of application units from various subject areas.[1]

Course I is composed of ten units which deal with: (1) Orientation, (2) Introduction to Computers, (3) Algorithms and Flow Charts, (4) Introduction to Programming, (5) Teletype Procedures, (6) Programming in Basic, (7) Impact of Computer on Society, (8) Computers in Instruction, (9) Computers in Educational Administration, and (10) Computers in Guidance, Testing and Libraries.[2]

Course II for administrators is based on units in the areas of Pupil Accounting, Personnel Accounting, Financial Operations, Facilities Applications, and Curriculum Applications.[3]

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[1]Jerry Kirkpatrick, Editor, Northwest Report, Northwest Regional Educational Laboratory, Portland, Oregon, p. 3, December, 1970.

[2]Ibid., p. 3.

[3]Ibid., p. 4.

Mathematics Applications, Science Applications, Business Education Applications, English Applications and Social Science Applications are the units provided in the subject areas designed to help the teacher make use of computer technology in his area of specialization. These units are found in Course II for the teacher.[1]

Schaffer suggests that a survey course in data processing for educators should include detailed treatment of: (1) the forms of machine language, (2) the functions of unit record equipment, (3) electronic computer hardware, (4) systems study and design, (5) flow charting, (6) data processing terminology, and (7) understanding the procedures and purposes of the keypunch.

Schaffer further suggests that there be some acquaintance in: (1) the history of data processing, (2) the role of data processing in the field of education, (3) the literature of the field of data processing, (4) the speed of the various kinds and pieces of equipment, and (5) programming technique.[2]

According to Haga a feeling for learning by programmed instruction can be imparted by having the participants work their way through a programmed course on programmed instruction. Other experiences suggested are: (1) having the participants analyze a task and identify performance standards, (2) produce a course outline and convert this to computer coding sheets for punching on cards or tape, (3) have those participants

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[1]*Ibid.*, pp. 5-6.

[2]Philip M. Schaffer, "The Need for Training," *The Journal of Data Education*, 11:78, December 1970.

without experience keypunch their own cards, those with knowledge of keypunching arrange for keypunching services, (4) obtaining knowledge of computing systems through classroom instruction, (5) have participants enter and check out their instructional programs on-line at remote consoles tied by telephone lines to one or more time-sharing computers, debug off-line, manually input program corrections on-line, and iterate until an effective instructional program is developed, (6) obtaining sufficient knowledge of data communications, advanced input-output devices, etc., to enable participants to make reasonably intelligent cost and effectiveness decisions in their real-life environments, and (7) obtaining an in-depth understanding of CAI behavioral research at universities and companies; identify societies, journals, and individuals which might serve as data sources for post-course follow-up by interested participants.[1]

If the people to be trained in computer technology are in-service, Jacobson advocates that extended contracts be issued for the duration of a workshop which has representatives from IBM, Friden, NCR, Burroughs, Univac and possibly other manufacturers. These representatives could make a presentation to the group. Field trips to (1) government agencies, (2) educational institutions, (3) utility companies, and (4) banking institutions which utilize applications of data processing were taken by the in-service educators that were in the workshop she describes. Each

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[1]Enoch Haga, Understanding Automation, Elmhurst, Illinois: The Business Press, p. 285, 1965.

participant also completed a seven-tape, 15-hour introductory course for the IBM key-punch machine.[1]

Stollar feels that many of the problems encountered in education are a result of having educational applications of data-processing hardware and software being promoted by the manufacturer and his sales and technical divisions. They are being developed to promote the computer market rather than for the direct solving of educational problems.[2]

According to Cougar computer manufacturer's courses are just one of several methods employed. Special faculty seminars, courses sponsored by professional societies and other organizations, and grants to permit the individual instructor to acquire the foundation and then develop computer programs for his classes were all utilized in providing computer training needed by the educator in the eleven schools that he studied.[3]

To solve the problem of teacher education, in it's time-sharing experiment utilizing remote terminals, Dartmouth College had teachers in for training sessions where they had: (1) experienced users of the system talk to the group about likely problems, (2) six one-hour lectures on BASIC language, (3) ample teacher time at the remote terminal (at least ten hours in the first five days -- twenty before the teacher

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[1]Darlyne Jacobson, "Organize Your Own Data Processing Workshop," The Journal of Business Education, 41:151-2, January 1966.

[2]Dewey H. Stollar and John R. Ray "DATE-Datamation Applications for Teacher Education," The Journal of Teacher Education, 20:191-3, Summer, 1969.

[3]J. Daniel Couger, "Educating Faculty About Computers," The Journal of Business Education, 64:249, March, 1969.

will feel completely at ease), (4) problem sessions for extra help scheduled, and (5) quantities of printed materials placed in the hands of the teacher (for reference later if needed).[1]

Brundy recommended that areas of special emphasis and research should include: (1) pedagogical issues concerned with CAI, (2) psychological and physiological effects as well as sociological implications.[2]

A general survey course is recommended by Stollar. Typical present applications of data processing and computer science as they relate to education and future data processing and computer applications in education should be stressed. There should be no attempt to make programmers out of teachers, just knowledgeable consumers. Topics should include: (1) scope and significance of data processing for education, (2) history of data processing, (3) history of data processing in education, (4) unit record data processing, (5) the development of the electronic computer, (6) today in electronic data processing, (7) applications of electronic data processing to: (a) instruction, (b) guidance and, (c) administration, (8) systems study and design, and (9) the future of electronic data processing.[3]

The Hayward Unified School District of Hayward, California developed an in-service training program in computer technology because they

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[1]--------,"Demonstrations and Experimentation in Computer Training and Use in Secondary Schools," Interm Report, Hanover, New Hampshire: Kiewit Computation Center, p. 4, 1968.

[2]Robert F. Brundy, "Computer-Assisted Instruction--Where are We?" Phi Delta Kappan, 49:424-428, April, 1968.

[3]Dewey H. Stollar and John R. Ray, "DATE-Datamation Applications for Teacher Education," The Journal of Teacher Education, 20:192-3, Summer, 1969.

felt that teachers are in need of updating their education in the area of computer science. Their aim was to make teachers aware of the developments in and the societal implications of the computer revolution. Major topics included in the program were: (1) data processing, automation, cybernetics-historical development, (2) functions of a computer, (3) operation and capacity of a computer, (4) programming a computer, (5) impact of computers and automation, (6) size and scope of computer industry, (7) vocational opportunities - today and tomorrow, (8) impact on society.[1]

Expected outcomes of an educational media course, "Computing System Analysis and Design in Education", developed by Steffensen were that the student would be able to: (1) acquire practical skill in flow-charting techniques, (2) acquire skill in applying the method of system analysis to educational problems, (3) acquire skill in educational system design, and (4) acquire skill in preparing a system design for computer implementation.[2]

A lecture-laboratory course is more informative and productive according to Haga. It also requires that access to a computer system be provided. Computer software in the form of CAI compilers, time-sharing capability available at times convenient to the class schedules,

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[1]Mary B. Quigley, "An In-Service Program," The Journal of Data Education, 11:16-7, October, 1970.

[2]Robert G. Steffensen, "Computing System Analysis and Design in Education," A Course of Study in Educational Media from the University of Utah, Department of Educational Administration.

several student consoles, logistical support such as key punching, and a considerable degree of understanding by the university faculty are considered essential to a successful course for educators in computer technology.[1]

[1]Enoch Haga, Automated Educational Systems, Elmhurst, Illinois: The Business Press, p. 284, 1967.

CHAPTER IV

ANALYSIS OF DATA

Restatement of the Problem

The identification of those aspects of computer science that would provide valid curricula in computer science for educators was the object of this study. Statistical analysis of six null hypotheses was performed to validate the findings of an opinionnaire administered to a group of people trained in both education and computer science.

Validity of Criterion for Opinionnaire

A search of the literature concerned with computer science in education identified several course outlines suggested for training educators in computer science. An opinionnaire based on topics suggested in the course outlines and from the experiences of the author was developed. A preliminary instrument was prepared and submitted for criticism to the director of the test scoring service at Montana State University. The revised instrument was then administered to a group of graduate students at Montana State University, some of whom had had some experience working with computers. These graduate students in education suggested some changes and as a result of this pilot study the opinionnaire was again revised and administered to a control group. This group consisted of people trained in education and others trained or in the process of becoming trained in computer science.

Opinionnaire Returns

The opinionnaire, together with a stamped, self-addressed envelope, a mark sense sheet, and a letter of explanation was mailed to thirty people trained in both education and computer science. A second mailing was made to those people who had not responded to the first mailing within two weeks. Of the thirty "experts" who were sent the initial mailing, a total of twenty-four usable returns were received. One opinionnaire was returned blank.

Identification of Factors

A determination of factors relating to a general idea or topic was accomplished by having the results obtained from the control group subjected to a factor analysis procedure. A factor matrix is the final result of the factor analysis. This matrix is a table of coefficients which shows the relationships between the opinions expressed in the opinionnaire and the underlying factors. These relationships are expressed as coefficients that are interpreted in the same manner as correlation coefficients.[1]

Five factors were identified by the factor analysis procedure. Names for the factors are suggested from the nature of the items with large weights.[2] Table I shows the listing of items in each factor that

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[1]Fred N. Kerlinger, Foundations of Behavioral Research, New York: Holt, Rinehart and Winston, Inc., p. 653, 1964.

[2]Harry H. Harmon, Modern Factor Analysis, The University of Chicago Press: Chicago, pp. 310-311, 1967.

TABLE I

IDENTIFICATION OF FACTORS

Computer applications and implications as related to education		Mechanics of computer use		Knowledge of computer hardware		Knowledge of computer software		"Hands on" experience	
Item number	Factor loading	Item number	Factor loading	Item number	Factor loading	Item number	Factor loading	Item number	Factor loading
14	.74	24	.83	8	.64	12	.73	3	.63
22	.73	28	.73	7	.58	13	.41	25	.42
26	.72	25	.59	9	.55	19	.36	17	.39
27	.70	6	.50	18	.49	10	.35	15	-.37
16	.69	21	.41	11	.43	11	.33	5	.36
23	.64			23	.36			2	-.34
2	.57			1	.30				
18	.50			6	.30				
15	.44								
20	.43								

NOTE: Item (4) concerning the necessity of awarding a certificate of achievement upon successful completion of the course did not obtain a factor loading greater than the absolute value of .30 in any factor.
See Appendix B for complete listing of items included on opinionnaire.

have a factor loading in excess of .30. The name for the factor was obtained by identifying a common attribute in each factor.

The highest factor loading for any item in factor one was .74 obtained for item 14. This pointed up a high correlation between the item, requiring proficiency in utilizing computing and data processing procedures and equipment as they relate to education, and factor one. The item receiving the lowest factor loading (.43) considered in factor one related to requiring familiarity with societies, journals, and individuals which might serve as resource help for post-course follow-up. Factor one was labeled Computer Applications and Implications as they Relate to Education.

Mechanics of Computer Use was the label given to factor two. The highest factor loading for any item in factor two was .83 obtained for item 24. Item 24 stressed the ability to code directly from a flow-chart. Item 21, relating to the student being able to keypunch a program, had the lowest factor loading (.41) considered for any item in factor two.

A factor loading of .64 for item 8 was the high for factor three. Item 8 stressed requiring familiarity with input and output devices and possibilities. Item 1 which stressed the student knowing the data communications flow from the learner through the computer and return received the lowest factor loading (.30) considered for factor three. Factor three was labeled Knowledge of Computer Hardware.

Factor four, entitled Knowledge of Computer Software, had a factor loading of .72 on item 12. This was the highest factor loading for any item. Item 12 stressed students having the ability to utilize "canned" programs such as pre-programmed "t" tests. Item 11 had the lowest factor loading (.33) considered in factor four. Requiring familiarity with problems faced in the application of computers in education e.g. (a) man-machine communication; (b) cost efficiency; (c) user acceptance; etc., was the problem posed in item 11.

Providing "hands on" time at an input device, item 3, received the highest factor loading (.73) in factor five. Item 2 stressing familiarity with the applications of electronic data processing in guidance and counseling received the lowest loading (-.34) considered. Factor five was labeled "Hands on" Experience.

A sixth factor identified by the varimax rotation was disregarded since the author was unable to detect a "common attribute"[1] among the items which obtained a factor loading of .30 or greater. The items and their factor loadings are as follows: Item 4 (-.64) required the awarding of a certificate of achievement for completing the course. Item 5 (-.33) required the ability to use a remote terminal. Item 6 (-.31) stressed requiring familiarity with computer storage components. Item 20 (-.35) would provide resource help for post-course follow-up for the educator. Item 21 (.41), the only item with a positive correlation, required the ability to keypunch a program.

A complete listing of the rotated factor matrix coefficients is found in Table II.

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[1]Harry H. Harmon, Modern Factor Analysis, The University of Chicago Press: Chicago, p. 311, 1967.

TABLE II

RELATIONSHIPS BETWEEN OPINIONNAIRE ITEMS

Item	Factor Loadings					
	1	2	3	4	5*	6
1**	.27568	.28263	.29584	-.25451	.21838	-.04583
2	.56743	-.03347	-.10641	.20328	-.15847	-.33791
3	.06152	.13382	-.06059	.05292	.13556	.62631
4	-.01613	-.15836	.01795	.00570	-.64115	-.00816
5	.08847	.28529	-.17352	.00175	-.32992	.36179
6	-.15626	.50076	.30265	-.05518	-.31143	-.25338
7	.11041	.13454	.57544	.05506	.10012	-.26700
8	-.17393	.10428	.64003	.18233	.14053	.08460
9	.09382	.03893	.54782	-.05996	-.10894	-.04285
10	-.13868	-.08758	.20283	.35056	.26849	.21333
11	.24008	-.05993	.43121	.32825	-.11357	.09944
12	.06043	.04952	.03038	.72735	-.06766	.09909
13	.09449	.14984	.12335	.41132	-.03217	-.01632
14	.74386	.01185	-.01539	.25753	.00106	.09795
15	.44489	.11744	.22123	.01965	.05441	-.36620
16	.68986	-.00004	.09493	-.00480	.07866	-.05551
17	.13728	.16510	.25588	.20740	-.18876	.39368
18	.50041	-.20421	.49215	-.03550	-.03447	.23198
19	.11754	-.03327	-.13827	.36462	.22430	-.03365
20	.42777	.02856	.18805	.21496	-.35064	-.08884
21	.17965	.41450	.10599	.24972	.41275	.10530
22	.72992	.08821	.08545	-.06568	-.19992	.02680
23	.64002	-.07322	.35517	-.11298	-.09680	.21771
24	-.00664	.82732	.00090	.02526	.00962	.18502
25	-.19090	.59180	.04350	.19531	.11705	.42286
26	.72089	.13332	.04413	.03316	.19458	-.00314
27	.69568	.03829	-.16976	.16980	.12681	.11497
28	.22724	.72533	.05699	.03556	.17242	.00247

*Factor 5 was omitted by the author for lack of a common attribute among large factor loadings.

**Items are numbered consecutively from 1-28 on pages 1 and 2 of the opinionnaire.

Testing of the Hypotheses

In this section the findings of the statistical analyses of the six null hypotheses stated in Chapter II are presented. The null hypotheses were tested at the .05 level of significance.

Hypothesis 1

There is no significant difference between the mean ratings given by the control group and by the experts for each of the factors identified.

A determination of significant differences between the mean rating of the control group and the experts for each of the factors was accomplished utilizing the t test.[1] The computed values were compared to the table values found in the back of Ferguson's text.[2]

The mean, standard deviation, variance and t test are listed for each of the factors in Table III.

Factor 1 had a computed t value of 3.09. Since the computed t value of 3.09 was greater than the table value of t (1.99), the null hypothesis of no difference between the means was rejected. Since the mean for the experts was significantly higher than that for the control group, it can be concluded that they felt that Knowledge of Computer Applications and Implications as they relate to Education is a more important inclusion in a computer science course for educators than did the control group.

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[1]Bernard Ostle, Statistics in Research, The Iowa State University Press: Ames, Iowa, p. 95, 1963.

[2]George A. Ferguson, Statistical Analysis in Psychology and Education, McGraw-Hill: New York, pp. 406-411, 1966.

TABLE III

COMPARISONS OF HOW CONTROL GROUP AND EXPERTS RATED
EACH OF THE FIVE FACTORS

Factor	Group	Mean	S.D.	Variance	t-test
1	Control	3.01	.76	.58	3.09*
	Experts	3.54	.60	.36	
2	Control	3.78	.75	.57	3.72*
	Experts	3.08	.86	.75	
3	Control	3.24	.63	.39	0.04
	Experts	3.24	.63	.39	
4	Control	2.78	.69	.48	1.79
	Experts	3.07	.61	.37	
5	Control	3.88	.56	.32	2.02*
	Experts	3.62	.52	.27	

*Significant beyond the .05 level.

Factor 2 had a computed t value of 3.72. Since the computed t value of 3.72 was greater than the table value of t (1.99), the null hypothesis of no difference between the means was rejected. Since the mean for the control group was significantly higher than the mean for the group of experts, it can be concluded that the control group felt that Knowledge of the Mechanics of Computer Use was of more value than did the group of experts. This probably could have been predicted because of the background and training of the majority of the control group.

Factor 3 had a computed t value of .04. Since the computed t value of .04 was less than the table value of t (1.99), the null hypothesis of no difference between the means was not rejected. There was no significant difference noted in how the control group and the group of experts rated the importance of educators acquiring Knowledge of Computer Hardware.

Factor 4 had a computed t value of 1.79. Since the computed t value of 1.79 was less than the table value of t (1.99), the null hypothesis of no difference between the means was not rejected. There was no significant difference noted in how the control group and the group of experts rated the importance of educators acquiring Knowledge of Computer Software.

Factor 5 had a computed t value of 2.02. Since the computed t value of 2.02 was greater than the table value of t (1.99), the null hypothesis of no difference between the means was rejected. Since the mean for the control group was significantly higher than the mean for the group of experts, it can be concluded that the control group felt that the "Hands on" Experience was of more value than did the group of experts.

Hypothesis 2

There is no significant difference between the mean ratings for each of the factors identified as rated by the panel of experts.

A test of null hypothesis 2 was accomplished by means of analysis of variance procedures. Table IV gives the results of the analysis of variance calculations.

TABLE IV

SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE OF THE FACTORS IDENTIFIED AS RATED BY THE PANEL OF EXPERTS

Source of variation	Sums of Squares	d.f.	Mean Square	F ratio
Between experts	18.8	23		
Within experts	39.0	96		
Factor	6.23	4	1.56	4.33*
Residual	32.77	92	.36	
Total	57.8	119		

*Significant at the .05 level.

The computed F ratio of 4.33 is larger than the table value of 2.49 (F 4, 92; .95). Therefore, the null hypothesis of no difference in the mean rating for each of the factors identified, as rated by the panel of experts, is rejected.

Multiple comparisons of the factors to determine which factor if any, has a means significantly different than the others was accomplished by utilizing the Scheffé method for multiple comparisons. The difference necessary for a significant finding occurs when the calculated critical difference is smaller than the difference between any two means.[1]

A comparison of the difference in the means is made to determine if any exceed the calculated significant difference. Table V lists the mean rating for each of the factors identified and the differences in the mean.

TABLE V

MEANS AND DIFFERENCES FOR FACTOR RATINGS BY THE EXPERTS

Factor	Mean	Differences in Mean for factor 2	3	4	5
1. Computer Applications and Implications as related to Education	3.54	.46	.30	.47	.08
2. Mechanics of Computer Use	3.08		.16	.01	.54
3. Knowledge of Computer Hardware	3.24			.17	.38
4. Knowledge of Computer Software	3.07				.55*
5. "Hands on" Experience	3.62				

*A significant difference exists at the .05 level.

The calculated critical difference between the means for the five identified factors as rated by the panel of experts was .55. Since the greatest difference between any of the means is .55, the Scheffé method for multiple comparisons was able to detect a significant difference for

[1]John T. Roscoe, Fundamental Research Statistics, Holt, Rinehart and Winston, Inc., p. 241, 1969.

the rating of "Hands on" Experience over the factor Knowledge of Computer Software. This means that the panel of experts rated the value of "Hands on" Experience significantly higher than Knowledge of Computer Software.

The mean rating of each of the items included to determine course content was found and the standard deviation computed. From a possible high mean of 5.0, three items had a computed mean of 4.0. A full listing of all twenty-eight items, ranked from those which obtained the highest mean to the item which obtained the lowest mean is found in Table VI. Requiring familiarity with problems faced in the application of computers in education, requiring proficiency in utilizing computing and data processing procedures and equipment as they relate to education, and requiring an understanding of the psychological and sociological implications involved in computer assisted instruction received the highest mean rating. The necessity of awarding a certificate of achievement as a result of the successful completion of the course had a mean rating of 2.0, which indicated the practice to be of some value. This item received the lowest overall rating.

It is of interest to note that the mean rating dropped from 3.2 to 2.8 and lower for those items that could be classified as relating to making a programmer out of the educator.

Hypothesis 3

There is no significant difference in the mean ratings of the experts for the type of course which will most effectively train the educator to utilize computer technology. This hypothesis was tested by analysis of

TABLE VI

MEAN RATING GIVEN EACH ITEM BY THE PANEL OF EXPERTS

No.	Item	Mean	S.D.
11.	Requiring familiarity with problems faced in the application of computers in education e.g. (a) man-machine communication; (b) cost efficiency; (c) user acceptance; etc.	4.0	1.18
14.	Requiring proficiency in utilizing computing and data processing procedures and equipment as they relate to education.	4.0	1.04
22.	Requiring an understanding of the psychological and sociological implications involved in computer assisted instruction.	4.0	1.12
25.	Learning a user language well enough to communicate with the computer efficiently.	3.9	1.15
26.	Requiring familiarity with the role regional data processing centers play in providing electronic data processing services for education.	3.8	0.85
3.	Providing "hands on" time at an input device.	3.7	1.27
12.	Requiring the ability to utilize "canned" programs such as pre-programmed "t" tests in a statistical program.	3.7	0.82
18.	Requiring familiarity with the negative aspects of computer assisted instruction.	3.7	1.40
23.	Requiring an understanding of devices and procedures used in computer assisted instruction.	3.7	1.03
8.	Requiring familiarity with input and output devices and possibilities.	3.6	1.24
15.	Requiring familiarity with the scope and impact of computer science on education currently.	3.6	1.06
2.	Requiring familiarity with the applications of electronic data processing in guidance and counseling.	[illegible]	0.93
5.	Requiring the ability to submit a program to the computer via a remote terminal.	[illegible]	1.02

TABLE VI (CONTINUED)

No.	Item	Mean	S.D.
19.	Arranged field trips to see the application of data processing to different aspects of education.	3.5	1.06
20.	Requiring familiarity with societies, journals, and individuals which might serve as resource help for post-course follow-up.	3.4	0.88
27.	Requiring familiarity with electronic data processing procedure that will grade, analyze, and record test results.	3.4	1.02
1.	Requiring familiarity with the data communications flow from the learner through the computer and return.	3.3	1.23
17.	Requiring familiarity with gaming and simulation programs and techniques.	3.3	1.20
6.	Requiring familiarity with storage of data involving disks, drums, tapes and core.	3.2	1.11
13.	Requiring familiarity with unit record data processing.	2.9	1.20
21.	Requiring the ability to keypunch a program.	2.8	1.38
24.	Requiring the ability to code directly from a flowchart.	2.8	1.37
26.	Requiring a high degree of proficiency in flowcharting.	2.7	1.02
7.	Requiring familiarity with computer styles, sizes and capabilities.	2.4	1.10
10.	Requiring the ability to operate data sorting equipment.	2.3	1.17
15.	Requiring familiarity with the history of electronic data processing as it relates to education.	2.[illegible]	0.87
9.	Requiring the ability to change from a base ten numeration system to a base two system and back to base ten.	2.0	0.95
4.	A certificate of achievement awarded as a result of the successful completion of the course.	2.0	0.66

variance procedures. Table VII gives the results of the analysis of variance calculations.

TABLE VII

SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE OF THE TYPES OF COURSES WHICH WILL MOST EFFECTIVELY TRAIN THE EDUCATOR TO UTILIZE COMPUTER TECHNOLOGY

Source of variation	Sums of Squares		d.f.	Mean Square	F ratio
Between experts		18.6	23		
Within experts		200.0	96		
Type of course	74.9		4	18.73	13.77*
Residual	125.1		92	1.36	
Total		218.6	119		

*Significant at the .05 level.

The computed F ratio of 13.77 is larger than the table value of 2.49 (F 4, 92; .95). Therefore, the null hypothesis of no difference in the mean ratings of the type of course which will most effectively train the educator to utilize computer technology as rated by the panel of experts, is rejected.

Multiple comparisons of the ratings of five types of courses to determine which type if any, is significantly more effective than the others was accomplished by utilizing the Scheffé critical difference method for multiple comparisons. Table VIII lists the mean and the differences in the mean for each type of course that was rated by the panel of experts.

TABLE VIII

MEANS AND DIFFERENCES FOR TYPES OF COURSES RATED

Type of Course	Mean	Differences in the mean for types 2	3	4	5
1. Formal computer science courses taught by computer science departments	2.71	.92	.46	.17	1.79*
2. Special faculty seminars (utilizing experts for a short period of time)	3.63		1.38*	.75	.87
3. Computer manufacturer's courses	2.25			.63	2.25*
4. Self education	2.88				1.62*
5. A specific course designed for educators and taught by educators trained in computer science	4.50				

*A significant difference exists at the .05 level.

The calculated critical difference between the means of the five types of courses listed for training the educator to utilize computer technology was 1.06. The mean obtained from the rating of the panel of experts for a <u>specific course designed for educators and taught by educators trained in computer science</u> was 4.50. This value exceeded all of the other means except <u>special faculty seminars</u> by more than the 1.06 required to be significant. <u>Special faculty seminars</u> were rated as being significantly better than <u>computer manufacturer's courses</u>.

<u>Hypothesis 4</u>

There is no significant difference in the mean ratings of the experts as to the computer language that can be taught most effectively to educators. This hypothesis was also tested by analysis of variance procedures. Table IX gives the results of the analysis of variance calculations.

TABLE IX

SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE OF THE TYPES OF COMPUTER LANGUAGE THAT CAN BE TAUGHT MOST EFFECTIVELY TO EDUCATORS

Source of variation	Sums of Squares		d.f.	Mean Square	F ratio
Between experts		56.2	23		
Within experts		116.7	72		
Language	21.0		3	7.00	5.04*
Residual	95.7		69	1.39	
Total		172.9	95		

*Significant at the .05 level.

The computed F ratio of 5.04 is larger than the table value of 2.75 (F 3, 69; .95). Therefore, the null hypothesis of no difference in the ratings of the type of computer language that can be most effectively taught to educators is rejected.

Multiple comparisons of the four languages compared by the panel of experts to determine *a priori* which language is significantly more effective than some of the others was accomplished by utilizing the Scheffé method for multiple comparisons. Table X lists the mean and differences in the mean for each of the languages rated.

TABLE X

MEANS AND DIFFERENCES FOR TYPES OF COMPUTER LANGUAGES RATED

Type of Language	Mean	Differences in the mean for language 2	3	4
1. BASIC	3.67	.38	1.13*	1.04*
2. FORTRAN	3.29		.75	.66
3. COBOL	2.54			.09
4. APL	2.63			

*A significant difference exists at the .05 level.

The calculated critical difference between the means of the four computer languages was .98. The BASIC language with a mean of 3.67 was the only language that had a mean high enough to produce a critical difference. BASIC was rated significantly higher than either COBOL or APL. However, the difference between BASIC and FORTRAN was not significant, nor was the difference between FORTRAN and any of the others.

Hypothesis 5

There is no significant difference in the mean ratings of the experts as to the type of educator the course should be oriented toward. To test this hypothesis the analysis of variance procedure was utilized. Table XI gives the results of the analysis of variance calculations.

TABLE XI

SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE OF THE TYPES OF EDUCATORS THE COURSE SHOULD BE ORIENTED TOWARD

Source of variation	Sums of Squares		d.f.	Mean Square	F ratio
Between experts		25.0	23		
Within experts		184.2	120		
Type of educator	48.6		5	9.72	8.24*
Residual	135.6		115	1.18	
Total		209.2	143		

*Significant at the .05 level.

The computed F ratio of 8.24 is larger than the table value of 2.30 (F 5, 115; .95). Therefore, the null hypothesis of no difference in the ratings of the type of educator that the course should be oriented toward is rejected.

Multiple comparisons of the six types of educators compared by the panel of experts to determine *a priori* which type would be significantly most effectively trained was accomplished by utilizing the Scheffé method for multiple comparisons. Table XII lists the mean and differences in the mean for each type of educator rated.

The calculated critical difference between the means of the six types of educators that the course should be oriented toward was 1.06. The mean of 4.29 obtained for item 4, which stressed that the course should be oriented toward all educators doing graduate work, was the highest of several that rated quite high. Item 6, which would direct the course toward just those educators that are interested, was rated significantly lower than all of the other types except item 5. Item 5 would have all educators doing undergraduate work required to take the course.

TABLE XII

MEANS AND DIFFERENCES FOR THE TYPES OF EDUCATORS RATED

	Mean	Differences in the mean for types of educators 2	3	4	5	6
1. Administrators	4.13	.17	.12	.16	.59	1.39*
2. Business teachers	3.96		.29	.33	.42	1.22*
3. Math and/or science teachers	4.25			.04	.71	1.51*
4. All educators doing graduate work	4.29				.75	1.55*
5. All educators doing undergraduate work	3.54					.80
6. Just those educators that are interested	2.74					

*A significant difference exists at the .05 level.

Items listing administrators, math and/or science teachers, and all educators doing graduate work all received ratings "of great value". The mean for all of the above types was in excess of 4.00. The mean of 3.96 for business teachers was also high enough to be considered in planning such a course.

Hypothesis 6

There is no significant difference in the mean ratings of the experts as to the number of hours needed for a computer course for educators including instruction and lab activities. This hypothesis was tested by analysis of variance procedures and the results have been tabulated in Table XIII.

TABLE XIII

SUMMARY TABLE FOR THE ANALYSIS OF VARIANCE OF THE TOTAL NUMBER OF HOURS NEEDED FOR A COMPUTER SCIENCE COURSE FOR EDUCATORS INCLUDING INSTRUCTION AND LABORATORY EXPERIENCES

Source of variation	Sums of Squares		d.f.	Mean Square	F ratio
Between experts		77.6	23		
Within experts		115.0	72		
Number of hours	34		3	11.33	9.68*
Residual	81		69	1.17	
Total		192.6	95		

*Significant at the .05 level.

The computed F ratio of 9.68 is larger than the table value of 2.75 ($\underline{F}$ 3, 69; .95). Therefore, the null hypothesis of no difference in the rating of the number of hours needed for a computer science course for educators is rejected.

Multiple comparisons of the four groups of hours considered by the panel of experts was accomplished by using the Scheffé method. The computed critical difference between the means is .90. Table XIV lists the mean and the differences in the mean for each group of hours rated.

TABLE XIV

MEANS AND DIFFERENCES FOR GROUPS OF HOURS AS RATED BY THE PANEL

Number of hours	Mean	Differences in the mean for numbers of hours		
		2	3	4
1. 10-30 hours	2.29	.79	1.63*	1.17*
2. 30-50 hours	3.08		.84	.38
3. 50-70 hours	3.92			.46
4. More than 70 hours	3.46			

*A significant difference exists at the .05 level.

Items 3 and 4 each had a difference greater than the .90 needed to be considered significant when compared to item 1. Therefore, it can be concluded that providing _fifty or more hours for instructional and lab activities in a computer science course for educators_ rated significantly higher than providing less than thirty.

Comparison of Findings and Computer Course Suggestions from Literature

It should be noted here that not all of the suggestions found in the literature were included in the opinionnaire. The author in consultation with the director of the test scoring service and as a result of some revision following the pilot and control group responses deleted some of the items. They were not appropriate and/or hard to interpret.

Only those items suggested in the literature by the various authors that actually appeared in the opinionnaire will be compared. If it is apparent that one of the items would be a natural inclusion in one of the factors identified a comparison of the item with the factor rating will be made.

For a comparison to be made between the items suggested in the literature and the findings of the opinionnaire a certain amount of interpretation had to be made by the author. It is frankly admitted that sometimes assumptions of what an item related to were made; and that these assumptions may be influenced by the author's experience.

Schaffer suggests that a survey course in data processing for educators should include detailed treatment of some items and only an acquaintance of others.[1] Table XV compares the items suggested by Schaffer with the findings of the panel of experts.

Those items Schaffer suggests should receive detailed treatment rated quite low. A mean rating of three was judged as being "worthwhile" and no item received a rating as high as three. None of the factors that these items fit were in the top two rated factors. For those items with which he suggested some acquaintance, three related to factors which had a mean of 3.54. Two items, the role of data processing in the field of education and the literature of the field of data processing, received mean ratings considerably higher than "worthwhile".

Preparing educators to write computer assisted programmed instruction was the task Haga was writing about when he suggested that a person

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[1]Philip M. Schaffer, "The Need for Training," The Journal of Data Education, 11:78, December, 1970.

TABLE XV

COURSE INCLUSIONS SUGGESTED BY SCHAFFER VERSUS PANEL OF EXPERTS

SUGGESTIONS BY SCHAFFER	RATINGS OF THE PANEL OF EXPERTS		
Item	Factor	Factor Mean	Item Mean
Detailed treatment of:			
1. The forms of Machine Language	2*	3.08**	
2. Functions of Unit Record Equipment	3	3.24	2.8
3. Electronic Computer Hardware	3	3.24	2.4
4. Systems Study and Design	4	3.07	
5. Flow charting	2	3.08	2.7
6. Data Processing Terminology	2	3.08	
7. Understanding the Purposes of the Keypunch	2	3.08	
Some Acquaintance with:			
1. The History of Data Processing	1	3.54	2.3
2. The Role of Data Processing in the Field of Education	1	3.54	3.6
3. The Literature of the Field of Data Processing	1	3.54	3.4
4. The Speed of the Various Kinds and Pieces of Equipment	3	3.24	2.4
5. Programming Technique	2	3.08	2.7

*Factors were entitled: (1) Computer Applications and Implications as related to Education, (2) Mechanics of Computer Use, (3) Computer Hardware, (4) Computer Software, and (5) "Hands on" Experience.

**All means were calculated on a five point scale.

could get a feeling for learning by programmed instruction by working through a programmed course on programmed instruction.[1] Other tasks outlined by Haga are compared with the findings from the panel of experts as shown by Table XVI.

All of the items suggested by Haga are related to factors that had a fairly high factor mean. Two of the items, obtaining an in-depth understanding of CAI behavioral research and obtaining sufficient knowledge to make reasonably intelligent cost and effectiveness decisions, received a 4.0 mean rating. The 4.0 mean was the highest item mean obtained from analysis of the opinionnaire.

A suggestion that Haga makes in another writing, that a lecture-laboratory course is more informative and productive,[2] is supported by the fact that the panel rated providing thirty hours or more for a course in computer science for educators significantly higher than providing less. The fact that the factor relating to "Hands on" Experience received the highest factor mean also supports this.

The establishment of a regional computer system for secondary schools was the emphasis of a program at the Kiewit Computation Center at Dartmouth College. To solve the problem of teacher education for their time-sharing experiment they brought teachers in for training sessions. The procedures listed as recommendations for running initial training sessions

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[1] Enoch Haga, Understanding Automation, Elmhurst, Illinois: The Business Press, p. 265, 1965.

[2] Enoch Haga, Automated Educational Systems, Elmhurst, Illinois: The Business Press, p. 284, 1967.

TABLE XVI

EXPERIENCES SUGGESTED BY HAGA VERSUS FINDINGS OF PANEL OF EXPERTS

SUGGESTIONS BY HAGA	RATINGS OF THE PANEL OF EXPERTS		
Item	Factor	Factor Mean	Item Mean
1. Having the participants analyze a task and identify performance standards	5*	3.62**	
2. Produce a course outline and convert this to computer coding sheets for punching on cards or tape	2	3.24	2.8
3. Have those participants without keypunch experience learn how to use the keypunch	2	3.24	2.8
4. Obtaining knowledge of computing systems through classroom instruction	3	3.24	2.4
5. Develop and de-bug an effective instructional program on-line via a remote terminal	5	3.62	3.5
6. Obtaining sufficient knowledge to make reasonably intelligent cost and effectiveness decisions	1	3.54	4.0
7. Obtaining an in-depth understanding of CAI behavioral research	1	3.54	4.0
8. Obtaining knowledge of societies, journals, and individuals which might serve as help for post-course follow-up	1	3.54	3.4

*Factors were entitled: (1) Computer Applications and Implications as related to Education, (2) Mechanics of Computer Use, (3) Computer Hardware, (4) Computer Software, and (5) "Hands on" Experience.

**All means were calculated on a five point scale.

for school teachers are given by the Interm Report.[1] A comparison of the procedures used at Dartmouth with the findings from the opinionnaire are found in Table XVII.

TABLE XVII

DARTMOUTH COLLEGE RECOMMENDATIONS VERSUS FINDINGS OF THE OPINIONNAIRE

DARTMOUTH RECOMMENDATIONS	RATINGS OF THE PANEL OF EXPERTS		
Item	Factor	Factor Mean	Item Mean
1. Experienced users of the system talk to the group about likely problems	1*	3.54**	
2. Use of the BASIC language			3.7
3. Ample time at remote terminals	5	3.62	3.5
4. Problem sessions for extra help	1	3.54	
5. Reference material made available to the teacher	1	3.54	3.4

*Factors were entitled: (1) Computer Applications and Implications as related to Education, and (5) "Hands on" Experience.

**All means were calculated on a five point scale.

The recommendations given by the Dartmouth College project were rated very high. However, not enough material was given to provide a

[1]--------,"Demonstrations and Experimentation in Computer Training and Use in Secondary Schools," Interm Report, Hanover, New Hampshire: Kiewit Computation Center, p. 4, 1968.

basis for conducting a training session for teachers. This program has received considerable attention nationally. More information about their training activities would be helpful in course planning.

"There should be no attempt to make programmers out of teachers, just knowledgeable consumers," according to Stollar.[1] A general survey course stressing typical applications of data processing and computer science as they relate to education should be taught. Special emphasis should be given to the contributions data processing and computer science will make to education in the future. A comparison of the specific items recommended by Stollar and the findings from the opinionnaire are found in Table XVIII.

The items recommended by Stollar received quite high ratings when compared to the findings of the opinionnaire, but there was a very important gap in the recommendations. None of the items recommended by Stollar provided for "Hands on" Experience. Since this factor received the highest mean of all, a provision for letting the educator have some experience communicating with a computer would be an important addition to Stollar's recommendations. The second factor that was missing was a provision for requiring some competency in the mechanics of computer use.

A felt need to become knowledgeable about the developments in and the societal implications of the computer revolution caused the Hayward Unified School District of Hayward, California to develop an in-service

[1]Dewey H. Stollar and John R. Ray, "DATE - Datamation Applications for Teacher Education," The Journal of Teacher Education, 20:192-3, Summer, 1969.

TABLE XVIII

STOLLAR'S RECOMMENDATIONS VERSUS THE FINDINGS OF THE OPINIONNAIRE

STOLLAR'S RECOMMENDATIONS	RATINGS OF THE PANEL OF EXPERTS		
Item	Factor	Factor Mean	Item Mean
1. Scope and significance of data processing for education	1*	3.54**	3.6
2. History of data processing	3	3.24	
3. History of data processing in education	1	3.54	2.3
4. Unit record data processing	4	3.07	2.8
5. The development of the electronic computer	3	3.24	
6. Today in EDP	1	3.54	3.6
7. Applications of EDP	1	3.54	3.5
8. Systems study and design	4	3.07	3.8
9. Future of EDP	1	3.54	

*Factors were entitled: (1) Computer Applications and Implications as related to Education, (2) Mechanics of Computer Use, (3) Computer Hardware, (4) Computer Software, and (5) "Hands on" Experience.

**All means were calculated on a five point scale.

training program for their teachers.[1] Table XIX compares the major topics of the Hayward in-service program and the findings from the opinionnaire.

Mechanics of computer use and knowledge of computer software were two factors which were noticeably absent from the program outlined by the Unified School District of Hayward, California. The author interpreted the program provided by the Hayward School District as striving to give teachers a general education about computers and their relation to education. This is contrasted with the "knowledgeable consumer" idea proposed by Stollar.

The idea of making the educator a knowledgeable consumer is probably best accomplished through a course of study that would follow many of the units proposed by Northwest Regional Educational Laboratory's project REACT. This program, which is in the developmental stage and will not be ready for wide distribution until August, 1972, provides for in-depth training in computer use in education. The introductory course is composed of ten units. Table XX compares the units currently being developed for project REACT with the findings from the opinionnaire.

Project REACT incorporates units which include all of the factors identified. Five of the units relate to computer applications and implications as related to education. The research procedures that are enumerated in Appendix C gave results that correlate quite closely with the findings of the opinionnaire.

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[1]Mary B. Quigley, "An In-Service Program", The Journal of Data Education, 11:16-7, October, 1970.

TABLE XIX

HAYWARD SCHOOL DISTRICT IN-SERVICE MAJOR TOPICS VERSUS FINDINGS OF THE OPINIONNAIRE

HAYWARD'S MAJOR TOPICS	RATINGS OF THE PANEL OF EXPERTS		
Topic	Factor	Factor Mean	Item Mean
1. Data processing, automation, and cybernetics-historical development	1*	3.54**	2.3
2. Functions of a computer	3	3.24	3.6
3. Operation and capacity of a computer	3	3.24	2.4
4. Programming a computer	5	3.62	3.5
5. Impact of computers and automation	1	3.54	3.6
6. Size and scope of computer industry			
7. Vocational opportunities - today and tomorrow			
8. Impact on society			

*Factors were entitled: (1) Computer Applications and Implications as related to Education, (2) Mechanics of Computer Use, (3) Computer Hardware, (4) Computer Software, and (5) "Hands on" Experience.

**All means were calculated on a five point scale.

TABLE XX

REACT UNITS VERSUS THE FINDINGS OF THE OPINIONNAIRE

REACT UNITS		RATINGS OF THE PANEL OF EXPERTS		
	Item	Factor	Factor Mean	Item Mean
1.	Orientation	1*	3.54**	
2.	Introduction to Computers	3	3.24	3.3
3.	Algorithms and Flow Charts	2	3.08	2.8
4.	Introduction to Programming	2	3.24	2.8
5.	Teletype Procedures	5	3.62	3.5
6.	Programming in BASIC	5	3.62	3.9
7.	Impact of Computer on Society	1	3.54	4.0
8.	Computers in Instruction	1	3.54	3.7
9.	Computers in Educational Administration	1	3.54	4.0
		4	3.07	4.0
10.	Computers in Guidance Testing and Libraries	1	3.54	3.5

*Factors were entitled: (1) Computer Applications and Implications as related to Education, (2) Mechanics of Computer Use, (3) Knowledge of Computer Hardware, (4) Knowledge of Computer Software, and (5) "Hands on" Experience.

**All means were calculated on a five point scale.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The purpose of this study was to identify those aspects of computer science that would provide valid curricula in computer science for educators. The summary of the investigation, the conclusions based on the findings and the recommendations for further study are presented in this chapter.

The experimental design of this study required construction of an opinionnaire designed to get the reaction of a panel of experts to items and methods that have been used or recommended for use in courses in computer science designed for the educator. These items and methods were derived from a careful study of the literature related to computer science in education.

A preliminary instrument was prepared and submitted for criticism to the director of the test scoring service at Montana State University. It was also administered to a group of graduate students in education at Montana State University and students enrolled in courses in computer science. The results obtained from this control group were subjected to a factor analysis procedure and five factors were identified.

The final opinionnaire was sent to thirty people trained in both education and computer science. Of these thirty "experts" a total of twenty-four usable returns were returned. One opinionnaire was returned blank.

A t test of significance was used to determine if there existed a significant difference between the means of the control group and the experts for each of the factors identified. Analysis of variance procedures were employed to determine if there was a significant difference between the factors as rated by the panel of experts.

Those items dealing with course procedures rather than course inclusions were also subjected to an analysis of variance procedure with a follow up of the Scheffé test of multiple comparisons to determine if and where significant differences existed among the items in this portion of the opinionnaire. A comparison of the programs and recommendations given in Chapter III and the findings from the opinionnaire was made.

Findings

Analysis of data from the opinionnaire can be summarized as follows:

1. Five factors were identified by the factor analysis procedures. Names were assigned to the factors based on the nature of the items that received large factor loadings. Factor one, entitled Computer Applications and Implications as related to Education had a mean rating significantly higher by the panel of experts than by the control group. The control group rated the importance of factor two, Mechanics of Computer Use, significantly higher than did the panel of experts. There was no significant difference in the mean rating received by factor three, Knowledge of Computer Hardware, or factor four, Knowledge of Computer Software, as

rated by the control group and the panel of experts. The control group rated the importance of factor five, "Hands on" Experience, significantly higher than did the panel of experts.

2. Analysis of variance procedures determined a significant difference in the factors as rated by the panel of experts. When the Scheffé method for multiple comparisons[1] was applied the difference between the means of factor 5 and factor 4 exceeded the calculated difference for significance. Thus the "hands on" factor, with a mean of 3.62 was rated significantly higher than Knowledge of Computer Software with a mean of 3.07.

3. The mean rating of each of the items included to determine course content was found. From a possible high mean of 5.0, three items had a computed mean of 4.0. Requiring familiarity with problems faced in the application of computers in education, requiring proficiency in utilizing computing and data processing procedures and equipment as they relate to education, and requiring an understanding of the psychological and sociological implications involved in computer assisted instruction received a 4.0 mean rating. The item relating to the necessity of awarding a certificate of achievement as a result of successful completion of the course had a mean rating of 2.0. This was tied for the lowest rating of any item with requiring the ability to change from a base ten numeration system to a base two numeration system and back to base ten.

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[1] John T. Roscoe, Fundamental Research Statistics, Holt, Rinehart and Winston, Inc., p. 241.

It is of interest to note that the mean rating dropped from 3.2 to 2.8 and lower for those items that could be classified as relating to making a programmer out of the educator.

4. A specific course designed for educators and taught by educators trained in computer science was the type of course which received a mean rating high enough to be significantly different than all of the other types except faculty seminars. Holding special faculty seminars had a mean rating of 3.63. This item had a critical difference large enough to be rated significantly more valuable than a computer manufacturer's course.

5. The BASIC language, with a mean of 3.67 was rated significantly higher than either COBOL or APL, but not significantly higher than FORTRAN.

6. Items listing administrators, math and/or science teachers, and all educators doing graduate work received ratings "of great value". The mean for the above types of educators that should be included in a computer course for educators exceeded 4.00. A mean of 3.96 obtained for including business teachers, was also high enough to be considered for attention when planning for such a course. Requiring all educators doing graduate work to participate in such a course was rated by the panel of experts as being significantly more important than having a course provided for just those educators that are interested. It can then be tentatively urged that such a course be a planned inclusion in a graduate program.

7. Providing fifty or more hours for instructional and lab activities received a mean rating significantly higher than providing less than thirty.

8. The proposals for a course in computer science for educators often omitted one or more of the factors. These factors often received high ratings. The one program that seemed to meet the findings of the opinionnaire most closely was spelled out in the recommendations for the units in project REACT. Project REACT is in the developmental stage at the Northwest Regional Educational Laboratory.

Conclusions

From the results of the findings, conclusions drawn from the investigation were:

1. A course in computer science for educators should provide laboratory experiences for the participants. These experiences would allow the student to communicate with the computer through a variety of media.

Computer applications and implications as related to education should receive considerable attention. Data processing equipment and procedures as they relate to educational uses, psychological and sociological implications of computer assisted instruction, familiarity with the role regional data processing centers play in providing electronic data processing services for education, and other phases of applications and implications of computer science as they relate to education should constitute a major portion of the instructional phase of the course.

From the mean ratings of all of the items it can be concluded that knowledge of the mechanics of computer use, computer hardware, and computer software is deemed worthwhile and therefore should be considered for inclusion in a computer science course for educators.

Because of the low rating given to those items which could be interpreted as designed to make programmers out of educators, it may be postulated that the typical course taught by the computer science department, which stresses these aspects, should not be a guide for a course for educators. Minimal stress should be given to items like: requiring the ability to code directly from a flow chart, keypunch a program, flowchart, and operate data sorting equipment.

2. A 4.50 mean rating obtained by the item dealing with providing a specific course designed for educators and taught by educators trained in computer science was the highest of any item on the opinionnaire. It is the opinion of the experts that this type of course is the most desirable kind. Special faculty seminars (utilizing experts for a short period of time) would probably be the second best choice. Self education is more desirable than either formal computer science courses or computer manufacturer's courses.

3. Because of the ease of learning and its adaptability to many of the aspects of computer application in education, the BASIC language should be the first language taught. The FORTRAN language with its formating possibilities should be seriously considered as a second language.

4. A course in computer science for educators as part of the graduate program would be of value. Others who would find it of value to take such a course are school administrators, math and science teachers and business teachers. According to the panel of experts leaving the participation in such a course strictly an option for those educators who are interested does not seem to be adequate.

5. For a course in computer science for educators to be meaningful it is proposed that at least thirty hours be made available for instructional and lab experiences. Fifty or more hours appears desirable to provide adequate time for a meaningful experience in such a course.

Recommendations

The writer considered the following areas as possibilities for further research:

1. Participants in the computer science courses that are mentioned in Chapter III would be a knowledgeable group to have react to the effectiveness of the course they took and compare it to a course outline developed in accordance to the findings of this study.

2. A replication of this study should be made using the above mentioned participants as the respondees to the opinionnaire.

3. Development of a course based on the findings of this study and then several years of testing and follow-up to determine if the course really is effective.

4. A determination of the variations in a computer science course which would most effectively meet the needs of the various groups whom the panel of experts felt should be included in such a course.

5. A determination of the kinds of inclusions in the course that the proposed participants would deem important. If the course were to be oriented toward administrators, a determination of what administrators feel they would like and need to learn should be undertaken.

Discussion

By reviewing the literature the author found that there have been several attempts to develop a course of study in computer science for educators. The Northwest Regional Educational Laboratory has developed a program entitled REACT (Relevant Educational Application of Computer Technology), this course of study seems to fit the criterion developed through this study better than any of the courses identified in the literature. A careful follow-up and evaluation program over a number of years is needed to determine if this program is successfully meeting the needs of the various groups for whom it is designed.

A program to provide some training for the graduate student in education is one area that graduate schools need to consider carefully. While the graduates are in their program it would be easy to participate in a course in computer science and the application of the principles they learn there could be an integral part of their other course work.

Advanced level courses could be designed to meet the specific needs of those going into administration or those preparing to specialize in some other area.

Six credit hours are needed to provide adequate depth so that the educator will have the ability to utilize the training in the work he is involved in. The more experience the educator can have during this time in actually using the computer to solve educational problems, the more likely the course will benefit him in his work. Providing work and equipment that will have the educator communicating with the computer is an integral part of his experience.

Computer assisted instruction is getting a lot of attention in the literature as well as in the news. The panel of experts felt that the educator needs to be aware of the psychological and the sociological implications involved in computer assisted instruction as well as some of the hardware needed.

Since many of the states have gone to the regional center concept of providing data processing services to schools in a geographic area educators must be taught how to submit data to the center and how to utilize the data that is returned. Becoming familiar with the work the regional centers can do will help to educate the educator as to the scope and impact computer science is presently having on education as well and some idea about future impact.

The educator needs to become a knowledgeable consumer of computer science services. He needs to be aware of the problems that arise in the application of computers in education such as the cost, problems in man-machine communication, user acceptance, the limitations of software in its present state and many others.

A survey of the literature would indicate that only a few universities are requiring computer training as part of the graduate programs for their education students. A large part of the problem may very well be the lack of qualified persons to teach such a course. Since the panel of experts felt that there was no approach that compared to having a specific course in computer science designed for educators and taught by educators trained in computer science, it would seem that there is a great need to establish some training centers that can qualify educators to teach such a class. Some institute programs for the retraining of university personnel in this area need to be developed.

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SELECTED REFERENCES

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APPENDIX

APPENDIX A

Respondents to Opinionnaire

Fred O'Neal, Director
Computer Assisted Instruction Project
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Keith Powell
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Dr. Louis A. Schmittroth
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Montana State University
Bozeman, Montana

Dr. Norman Johnson
Board of Cooperative Educational Services
Computer Based Instruction
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Robert L. Howe
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Dr. Robert Steffenson
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Utah State Board of Education
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Dr. George E. Miller
Pres. of SDE Federated Society for Educational Data Systems
Mansfield State College
Mansfield, Pennsylvania

APPENDIX B

OPINIONNAIRE ADMINISTERED TO THE PANEL OF EXPERTS

Please answer the following questions by marking the space on the answer sheet that best describes your judgment of the following items. Your response will be read by an optical scanner so please use a No. 2 lead pencil. Please erase cleanly any answer you wish to change. Make no stray markings of any kind.

Please mark as follows: (1) of very little value
(2) of some value
(3) worthwhile
(4) of great value
(5) vital

1. Requiring familiarity with the data communications flow from the learner through the computer and return is:

2. Requiring familiarity with the applications of electronic data processing in guidance and counseling is:

3. Providing "hands on" time at an input device is:

4. A certificate of achievement awarded as a result of the successful completion of the in-service course is:

5. Requiring the ability to submit a program to the computer via a remote terminal is:

6. Requiring familiarity with storage of data involving disks, drums, tapes, and core is:

7. Requiring familiarity with computer styles, sizes, and capabilities is:

8. Requiring familiarity with input and output devices and possibilities is:

9. Requiring the ability to change from a base ten numeration system to a base two system and back to base ten is:

10. Requiring the ability to operate data sorting equipment is:

11. Requiring familiarity with problems faced in the application of computers in education e.g. (a) man-machine communication; (b) cost efficiency; (c) user acceptance; etc., is:

12. Requiring the ability to utilize "canned" programs such as pre-programmed "t" tests in a statistical program is:

13. Requiring familiarity with unit record data processing is:

14. Requiring proficiency in utilizing computing and data processing procedures and equipment as they relate to education is:

15. Requiring familiarity with the history of electronic data processing as it relates to education is:

16. Requiring familiarity with the scope and impact of computer science on education currently is:

17. Requiring familiarity with gaming and simulation programs and techniques is:

18. Requiring familiarity with the negative aspects of computer assisted instruction is:

19. Arranged field trips to see the application of data processing to different aspects of education is:

20. Requiring familiarity with societies, journals, and individuals which might serve as resource help for post-course follow-up is:

21. Requiring the ability to keypunch a program is:

22. Requiring an understanding of the psychological and sociological implications involved in computer assisted instruction is:

23. Requiring an understanding of devices and procedures used in computer assisted instruction is:

24. The ability to code directly from a flowchart is:

25. Learning a user language well enough to communicate with the computer efficiently is:

26. Requiring familiarity with the role regional data processing centers play in providing electronic data processing services for education is:

27. Requiring familiarity with electronic data processing procedure that will grade, analyze, and record test results is:

28. Requiring a high degree of proficiency in flowcharting is:

THE FOLLOWING FIVE (5) ITEMS, NUMBERED 29-33 RELATE TO THE TYPE OF COURSE WHICH WILL MOST EFFECTIVELY TRAIN THE EDUCATOR TO UTILIZE COMPUTER TECHNOLOGY. Please rate a (1) if of very little value and as (5) if considered vital as previously done.

29. Formal computer science courses taught by computer science departments.

30. Special faculty seminars (utilizing experts for a short period of time).

31. Computer manufacturer's courses.

32. Self education.

33. A specific course designed for educators and taught by educators trained in computer science.

THE FOLLOWING FOUR (4) ITEMS NUMBERED 34-37 RELATE TO THE COMPUTER LANGUAGE TAUGHT MOST EFFECTIVELY TO EDUCATORS. Please rate a (1) if of very little value and as (5) if considered vital as previously done.

34. BASIC

35. FORTRAN

36. COBOL

37. APL

THE FOLLOWING SIX (6) ITEMS NUMBERED 38-43 RELATE TO THE TYPE OF EDUCATOR THE COURSE SHOULD BE ORIENTED TOWARD. Please rate as (1) if of very little value and as (5) if considered vital as previously done.

38. Administrators

39. Business teachers

40. Math and/or science teachers

41. All educators during graduate work

42. All educators during undergraduate work

43. Just those educators that are interested

THE FOLLOWING FOUR (4) ITEMS NUMBERED 44-47 RELATE TO THE NUMBER OF HOURS NEEDED FOR A COMPUTER COURSE FOR EDUCATORS INCLUDING INSTRUCTION AND LAB ACTIVITIES. Please rate a (1) if of very little value and as (5) if considered vital as previously done.

44. 10-30

45. 30-50

46. 50-70

47. More than 70.

APPENDIX C

INCLUDED IS A LETTER FROM NORTHWEST REGIONAL EDUCATIONAL LABORATORY AND A DESCRIPTION OF THE RESEARCH PROCEDURES USED IN DEVELOPING PROJECT REACT

Northwest
Regional
Educational
Laboratory

500 Lindsay Building · 710 S.W. Second Avenue
Portland, Oregon 97204 · Telephone (503) 224-3650

May 7, 1971

Professor Gerald Mikesell
Department of Elementary Education
Montana State University
Bozeman, Montana

Dear Professor Mikesell:

Clifford Winkler has indicated to me that you are interested in more detailed information on the REACT Program. I am enclosing a copy of a paper which was published in the Journal of Educational Data Processing. I also am enclosing a copy of our promotional pamphlet, though Cliff thought he already sent one to you.

There is not much information to be communicated to you. Our field testing is continuing at New York Institute of Technology, North Bend, Oregon and Multnomah County, Oregon. We have added another test group of administrators in-training at the University of Oregon.

We are currently working with several companies to develop a marketing and dissemination strategy. Our schedule now calls for both teacher training and administrator training courses to be tested, revised and published ready for marketing by August 31, 1972.

We appreciate your interest and would like to stay in touch.

Sincerely,

Winston C. Addis
Research & Development Specialist
Program REACT

WCA:sm

Encl.

ASSESSMENT OF NEEDS

By

Mark Greene
Al Selinger

To provide information needed in planning and implementing REACT, the need for computer services among teachers, administrators and other school personnel was studied. Districts in the Portland, Oregon metropolitan area were surveyed in May 1969 about: (a) their perceptions of their own familiarity with computers and computer services, (b) the present and projected levels of computer use in schools and school districts, (c) the importance assigned to computer services as compared to other needs, and (d) the approximate date when they would like to have selected computer services made available to them.

The sampling procedure for the major portion of the study had two stages. First, nearly 40 high schools in the Portland area were identified and categorized according to: unit of control (public vs. private), type of school (general purpose vs. vocational), and location (Portland City Schools vs. schools outside).

Additionally, the public schools within Portland were categorized according to the socioeconomic status of the area each served.

Given the foregoing categories and strata of schools, high schools were selected randomly from each category. The selection procedure resulted in a sample of 11 schools, or 28 per cent of the sample frame.

Furthermore, each cell within the sample frame was represented in the study sample although the representation was not proportional. In addition, two public schools--one from within and one outside of Portland--were selected by random means for supplementary study.

Second, individuals were selected for interview at each school. For each school in the sample, one teacher was selected randomly from among the math and science teachers, the principal and district superintendent each designated administrators to be interviewed.

Supplementary Sample

The teachers interviewed in the main sample represented a single core of subject matter (i.e., math/science). Since a study based solely on their views would be biased, a supplementary sample of 13 high school teachers was selected randomly for interview. The teachers in the supplementary sample represented a variety of subject areas, including at least one from the math-science domain. A summary of the numbers of teachers and administrators interviewed is presented in Table 1.

Table 1

The Number of Individuals Responding to the REACT Needs Survey by Category

Category of Respondents				
(1) District Administrators	(2) High School Administrators	(3) Math-Science High School Teachers	(4) Supplementary Sample Teachers	TOTAL
n = 5	n = 12	n = 11	n = 13	41

The data collection instrument, a semistructured guide for interviewing, was designed, field tested and redesigned before it was used with either the main or supplementary samples.

Results

Highlights of the survey findings are presented in the following sequence: (1) familiarity with computers/computer services, (2) present and projected uses of computer services, and (3) importance of computer services in comparison to a standardized list of school needs.

Familiarity With Computers

Respondents in the present study were asked to list their sources of information about computers and computer services. The findings deriving from this question indicated: (a) thirty-one per cent of the teachers from the supplementary sample reported they had neither heard about nor discussed computers or computer services;

(b) the most consistent source of verbal information about computers/computer services for all groups was other teachers; and (c) district administrators, high school administrators and math-science teachers rely heavily upon other teachers, administrators and out-of-district sources for verbal information about computer technology.

Responses to the question concerning written sources of information about computers/computer services revealed: (a) all district administrators in the sample used professional journals as a source of information about computers/computer services; (b) at least 25 per cent of the high school administrators, math-science teachers and teachers from the supplementary sample did not refer to reading sources for information about computers/computer services; and (c) professional journals, other than journals devoted primarily to computer subjects, represented the most pervasive source of information.

A summary of the responses to the question concerning formal training in computers/computer services revealed the math-science teachers lead all other groups in formal course work and surprisingly few administrators had taken any formal course work in this area.

In responding to a question concerning personal experience with computers, 73 percent of the math-science teachers reported previous use. The math-science teachers clearly lead all other groups on this point. A surprisingly high number (75 per cent) of the high school administrators reported they had not personally used computers.

In reporting ways in which they had used computers, 73 per cent of the math-science group indicated that they had experience which took them from initial programming through a final printout. On the other hand, very few high school administrators or teachers from the supplementary samples report even keypunching experience.

When questioned, it was quite evident the most pervasive type of computer experience among those interviewed came through formal course work. Only minimal numbers of administrators and math-science teachers reported they had computer experience in school related work. Additionally, only minimal numbers of persons outside the math-science group reported they had mastered a computer language.

Based upon the foregoing data, it seemed clear that except for math-science teachers, school personnel had had little practical experience with computers. Thus, it would seem fair to conclude course work in computer literacy might well focus on the nonmath-science teaching groups.

Present and Projected Uses

Respondents in the study were asked to describe ways in which they were currently using computer services. Nearly everyone interviewed detailed at least one way, and many indicated a number of ways they were using computer services. The most popular responses were "scheduling" and "reporting grades."

Thus, reliance upon computer services appeared fairly evident among each of the groups interviewed. Additionally, the pattern of responses to the question seemed to indicate the various groups employed computers for different purposes. Thus, endeavors to increase the computer literacy of high school personnel should take into account the somewhat divergent purposes.

Answers to questions about future computer services indicated little convergence among the groups about the type of commitment for future use, but suggested a continuing demand for computer services.

Importance of Computer Services

During the course of each interview, a standard list of eleven items was presented. The eleven items had been selected as "important" by school personnel during an earlier phase of the study. The list consisted of the following items: more auxiliary professional staff, more physical facilities, more teaching equipment, computer services, teacher summer employment, more central office staff, more teacher aides, expanded cocurricular program, higher teachers salaries, inservice training, smaller pupil-teacher ratio.

Respondents were asked to rate (on a scale of 1-7) the importance of each of the items on the list. In analyzing the resultant data, the mean ratings for each item were computed by group. Then the item means were ranked for each respondent group. For district administrators, the computer services item tied for first place in their ratings.

Math-science teachers also viewed computer services as one of the top three items on the list. The other two groups in the survey were more modest in their rating of the need for computer services, with the teachers from the supplementary sample giving a rating of six to the computer item and the high school administration giving a rating of seven to the computer items.

Summary and Conclusions

This data resulted from a limited number of interviews. However, the procedures which were used for selecting respondents provide a good basis for confidence in the results of the study. The conclusions drawn from the results are:

1. Several sources of information about computers exist concerning services used by district administrators, high school administrators and math-science teachers. The data indicates, however, that nonmath-science teachers make little use of the available informational resources.
2. With the exception of the math-science group, little course work in computer technology was evidenced.
3. With the exception of math-science teachers, school personnel in the groups surveyed have had little practical experience with computers. This finding, in combination with number two above, would seem to imply that course

work in computer technology might profitably focus on school personnel other than the math-science teaching groups.

4. Nearly everyone interviewed was able to list at least one way in which he was using computer services. Furthermore, as evidenced by the commitments which have been made for future computer services, the need for computer literacy does not appear to be diminishing. Endeavors aimed at familiarizing school personnel with computer technology would seem to be quite appropriate.

5. Not only are computer services presently in general use, they also are regarded as relatively important by the respondents of each of the survey groups.

6. While the demand for computer services appears immediate and high, familiarity with computer technology is low. These findings dictate the need for greater familiarity with computers on the part of school personnel.