CONCEPTUALIZATIONS OF TEACHING ROLES FOR COMPUTER-RELATED INSTRUCTION IN COMMUNITY COLLEGE TECHNOLOGY PROGRAMS

A Dissertation

Presented to

the Faculty of the Graduate School

University of Houston

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

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by

Oscar A. Rasmussen, Jr.

May 1975

ABSTRACT

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Introduction

The American dream of education for all citizens, each according to his individual capability and inclination, has engendered many innovations for improving the techniques of teaching and learning. One new idea of seeming promise is the use of electronic computers to enhance the role of the human teacher in the learning process. If the use of computers modifies teacher roles, what is the instructor's conceptualization of the potential change?

Problem Statement

The major purpose of this study was to analyze the differences between three experience categories of Texas community college technology instructors on their conceptualizations of future teaching roles involving computers as components of instruction. This study measured future teaching role conceptualization differences between the non-experienced, the experienced and the computer-instruction specialist.

Procedure

The measure was accomplished through the use of a field survey instrument submitted by mail to a stratified-random

sample of the specified population. The response data derived from this survey were subjected to analysis of variance to determine conceptualization differences between the three experience categories.

The survey instrument responses also provided data on perceptions of feasibility, desirability, and cost-effectiveness of computer-aided instruction. Beliefs of the instructor population were investigated on the dehumanizing effects, the reduction of teacher status, the imminence, and the permanence of computers in education.

Findings

The study findings denote no significant difference in the three experience categories of the population on conceptualizations of teacher-role changes. The field inquiry indicated the teachers favored computer incorporation in their instruction programs, that the majority of the instructor population were without training or experience in computer instruction, that most of the instructors had more than three years teaching experience and that they believed computers would improve education without dominating the educational process.

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It is a pleasure as well as a privelege to make acknowledgement of indebtedness to the many who helped in the preparation and the accomplishment of this study. As is the case for most research efforts, this study is not the product of only one person; it is the result of the work of many concerned and dedicated individuals.

To those who have helped by their offerings of time and effort - by their thoughtful advice, by their honest criticism, and by their friendly encouragement, this study is gratefully dedicated.

Sincere thanks is expressed to all members of the research committee for their helpful advice and their often-needed counsel. The writer is particularly indebted to Dr. William R. Forkner, Chairman, for his untiring effort in advising, suggesting, encouraging and inspiring. His energetic involvement went far beyond any responsibility in the continuing search for improvement of the procedures and the objectives of this study.

The preparation of the chart displays and the data tables of this report were aided through the able assistance of Roddy Dunnell. Development and organization of the computer program for processing data was accommodated in large part through the help of Gerald Pullen and others of the Data Processing Department at Alvin Junior College. Sincere thanks is conveyed to these individuals and to many others who helped in the collecting, assembling, folding, mailing, and stamping of the survey packets and associated correspondence.

It is said that environment contributes in major part to success. For providing unending patience and loving condolence when ensuing events proved to be discouraging, and for unceasing encouragement when things were right or wrong, the writer expresses deep gratitude to his wife, Eleanor, his daughter Kara, and to his son, Eric. They helped in many material and spiritual ways throughout the long process of this study.

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Chapter I

INTRODUCTION

A study of conceptualizations of technology instructors of Texas community colleges concerning their future teaching roles, when and if computers become components of their academic programs, is described here. The initial chapter elaborates on the need for and the purpose of this endeavor. The methods used in collecting and processing data are outlined. The test performed on differences between three experience categories of the specified population, namely, the non-experienced, the experienced, and the computer-instruction specialist is briefly reviewed in this chapter.

Education and Technology

Ben Franklin said, "There are two ways of being happy; we may either diminish our wants, or augment our means - either will do - the result is the same."[1] If the state of happiness in this quotation is referenced to a societal base with the public goal being a full and satisfying life to all, it may then be said that the choice of augmenting means is by far the best, and, contemporarily, the only practical one that can be made. The objective of a full and satisfying life implies development of body, mind, and personality with an expanding outlook of broadness and clarity to the total surrounding world. Generally speaking, these are the aims of formal education. Specifically, the augmentation of means includes the development of proficiencies in guiding learning by those characteristically charged with the task - the teacher and the administrator.

Responsible educators today use every tool at their command to make the process of education better, to increase efficiency, and, at the same time, to reduce costs. There are advances in methods and diversification in the accompanying technology which changes at a phenomenal rate. As industrial processes go forward under the continuing press of advancing science, so must the area and scope of technical education enlarge. Even though present-day educators know and trust those things which are historically familiar and traditionally effective, these professionals also know that the conventional practices that they know so well may fall far short of matching the projected needs and objectives of tomorrow.

With emphasis on the spreading influence of technology on everyday living, Don Fabun wrote, "The contention that persons ignorant of technology can function in a democracy to any effect when the society as a technological one is dubious. Understanding is not a prerequisite of control - it is control."[2] Today's educators, each and every one, must seriously consider all segments of the philosophies of the technocracy. Each must ask of himself, "Where do I stand on the subject of change?"

Margaret Mead, the noted anthropologist, phrased her thought in this way: "We must educate people in what nobody knew yesterday, and prepare people . . . for what no one knows yet, but which some people must know tomorrow."[3]

Robert Theobald, in writing his book, Futures Conditional, states, "Thought is action! Man makes his own future as he imagines it. The world in which we now live results from the fears, dreams, beliefs and actions of our parents and ancestors."[4] Future life depends on present actions; these actions derive from beliefs, wants, and needs. According to Theobald, the individual concepts and beliefs which reside in the mind do have a major influence in the shaping of human behavior and in ordaining outcomes.

Social and political field studies have achieved notable success in projecting popular opinion and in aiding analysis of possible future actions. The two main attributes of these surveys are: (1) They provide some basis for predicting outcomes, and, (2) They serve as indicators of trends and beliefs. Any knowledge of coming events in advance of their occurence allows time for anticipatory preparation and action. The greatest weakness of the field study is its' ex post facto nature. Causal relations are hard to identify and variables are disturbingly numerous. In spite of these weaknesses, field studies render valuable data for research. Surveys of educational attitudes and conceptualizations are done frequently because they deal with real-life situations.[5]

In accordance with thoughts expressed by the knowledgeable persons quoted here, a study was done of personal conceptualizations of Texas community college technology instructors on future teaching roles with computers as components of instruction.

Need for the Study

Those who work in the field of education have too often neglected their fundamental responsibility of communicating and explaining ideas and discoveries so that they may be understood clearly and without ambiguity. This is the contention of Paul Saltman, academic coordinator of the treatise, America and the Future of Man.[6] Educational technologists must always be responsive to the necessity for making clear distinctions between science and empiricism. It is Saltman's belief that:

> "The feeling of intellectual impotence may be built into our approach to education. We have long been geared to the notion that education should impart facts and data literally to fill up the biological data banks of our brains. Rarely do we come to grips with developing the skills of mathematics and language, the ability to see fundamental relations and explanations within the data and the facts, and, above all, the methods by which to seek and find new knowledge and new relationships."[7]

It is indeed an imposition on the intellect to employ the human brain in rote-memory trivia at a time when computers can store greater batches of information for instant recall than can the human brain. It is better by far to engage thought processes in more creative and functional fashion.[8]

As exemplified by the renowned authorities quoted in this chapter, educators today are concerned about the nation's educational systems. Sandra Stencel, writing in The Houston Post (3 December 1974) under the head, "Public Education: A Loss of Innocence," stated there is a growing dissatisfaction among teachers on the "how" and the "what" of current instruction. There is also a concern about the overall quality of contemporary education. Disappointingly, education has not been "the great equalizer of the conditions of men - the balance wheel of the social machinery," as Horace Mann so hopefully predicted. Sidney P. Marland, who served as secretary for education (1973-1974) in the United States Department of Health, Education and Welfare, has said that many Americans are beginning to question the purpose of education, the competence of the teachers, and the usefulness of the school system in general. He asked the question, "How are we preparing young minds for life in these turbulent times?" According to the data provided by the 1970 census, 1.5 million students, or 3 per cent, are two or more years behind where they should be in education. Many jobs that once required only a high school diploma are now restricted to those applicants who have, at the least, two years of post-highschool qualification. High school diplomas are required for all but the most menial jobs. Minority group students, in ever-increasing numbers, are seeking a wider involvement in the educational process, particularly at the college and university level.

The present decrease in the rate of expansion of the student population is beginning to level off and a rate upturn is expected in the near future. To turn out better qualified students in greater numbers will require improved systems with higher outputs at all levels of instruction.[9] The instructional computer assisting the human teacher is one possible way to fulfill the need. The widespread use of computers in education may require different curricula and changes in teacher roles.

The educators of teachers should know how instructors feel toward the prospect of using computers in education. With the guidance provided, they can plan and implement supplementary courses that the instructors may require in the new situation. For these reasons, this study is needed at this time.

Purpose of the Study

New developments in technology herald the changes that will be forthcoming in how knowledge will be acquired in the future. These changes may affect the teaching function in various ways. New skills in communication and in content presentation may be required by ensuing technological events. Even the established basics of teaching may need modification. Some of the possible changes are: (1) The hierarchal structure of faculty organization may be changed fundamentally; responsibilities may have to be shifted upward and downward to accomodate new techniques. (2) Completely new and as yet unknown jobs, e.g., instructional designers, learning diagnosticians, and curriculum planners, may become early realities. (3) Existing school operations and school business as practiced today may have to undergo an overhaul involving a substantive reorientation.[10]

These assumptions may be premature, since they predict events that are so far in the future that they engender only a minimal concern. And then, again, phenomenal development could occur as it so happened in the case of the electronic computer. In the immediately-preceding quarter of a century, a machine has been created and developed that is of such importance today that many segments of society would be hard put to do without it. Computers are depended upon to do the most intricate calculations, to store and process overwhelming amounts of data, and to perform process and regulatory control with a speed and accuracy undreamed of in the years prior to the 1940's. In the words of Paul von Handel, "Science, engineering, industry, and business today are confronted with problems continuously growing in size and complexity. Traditional methods and instruments are becoming less and less efficient for their solution." Many of the remarkable computations that are done simply would not be worth attempting, were it not for the modern electronic computers. These machines have improved the situation greatly by increasing computing speed and reliability by many orders of magnitude.[11]

Can the ingenuity of educators and technicians employ these attributes of the computer to make learning more efficient, easier to accomplish, to be applicable macrocosmically, and, at the same time, to be less costly? And if these things are potentially in the future of education, what are the implications as far as teacher roles are concerned? Will these changes in education occur abruptly or will they be brought about slow enough to accomodate natural human adjustment and afford a smooth transition? In the two-year colleges of the nation's educational system, there are technological resources now extant which languish in disuse and which are in a state of underdevelopment that can be attributed solely to a lack of instructor interest and a definite overconcern to prolongate established custom.[12]

The famous 19th Century philosopher-economist, John Stuart Mill has said, "The despotism of custom is everywhere a standing hindrance to human advancement."[13] This observation is every bit as true today as it was over one hundred years ago. Educational enlightenment has been and will continue to be one way to counteract this ever-present constraint. With all of these questions and contentions outstanding, it seems that now is the time to make a thorough investigation of how teachers conceptualize their future duties with computers as components of instruction. This is the stated purpose of this study.

Scope of the Study

The main thrust of this investigation is directed toward the instructors of the departments of technology in the community colleges of Texas. Community colleges serve their students with learning opportunities aimed at developing skills and knowledge which will assist the learners in making transitions to adult life and to adult responsibilities. According to the DeTurk and Mackin viewpoint, the 14- to 20-year-old scholar becomes conscious of the fact that learning is something he must do for himself, and that his personal experience in acquiring new knowledge is self-rewarding. Students at this level begin to see and understand that dividends accrue in proportion to the time and effort invested. Consequently, the students in this age range most likely to be enrolled at the junior community colleges are objectively-motivated individuals. Many are career-oriented toward technology. Their teachers should be similarly constituted if they are to meet the challenge of educating these students.[14]

For these reasons, the specific population of technology instructors of the fifty-three community colleges of Texas that offer technology instruction was the group selected for this research investigation. Determination of conceptualizations on future teaching roles for teachers using instructional computers in programs or areas beyond the Texas junior community colleges technology departments is outside the scope of this study.

Problem Statement

The major intent of this study was to analyze the differences between three experience categories of Texas community college technology instructors on their conceptualizations of future teaching roles involving computers are components of instruction.

The secondary purpose of this study was to examine data from the three categories of instructors on their perceptions of the following contentions:

1. Computer-related instruction will become an integral part of technical education within the next five years.

2. The quality of education will improve when computers become components of instruction.

3. Mechanical devices and media will make teaching easier.

4. Computers will degrade the professional status of teachers.

5. Computers will dominate education and will become more important than the teacher.

6. Computers will be a worthwhile and efficient asset to the instructor.

Hypothesis Statement

This study was designed to test the null hypothesis:

> "There is no significant difference in the future role conceptualizations between the three groups of Texas community college technology instructors categorized as:
>
> I. Non-experienced,
> II. Experienced,
> III. Specialists,
>
> in the use of computers as components of instruction."

Procedures

The main objective of this research study was to examine and analyze the technology instructor's conceptualization of his personal teaching role when and if computers become components of instruction. Toward this end, an opinion survey instrument was developed, tested in a pilot study, then refined in a final form for mailing to the population sample. This sample of the technology instructors of the community colleges of Texas was separated in three classifications, or sub-groups: (a) those who did not have first-hand experience with computer instruction, (b) those who did have personal experience with computer instruction, but had not been involved with the designing, developing, or administering of such instruction, and, (c) those who had designed, developed, and/or administered courses of instruction using computers as part of the teaching media. Answers to the category-determining questions in the survey instrument indicated the category in which each sample subject should be placed. The three groups were labeled:

I. Non-experienced
II. Experienced
III. Specialist.

The questions of the evaluating instrument were so constructed that responses could be answered "yes", "no", or, in case of doubt or indecision, "don't know". To allow for shadings of opinion by respondents, a sheet for comments was provided.

There were thirty concept-evaluating questions included in the survey questionnaire. This set of questions was worded so that "yes" answers indicated agreement with authoritative concepts on computer instruction as expressed in the literature. Each question suggested a change in the role of the teacher. The change described in each question was not presented as an absolute choice, nor was there any presumption of absoluteness in the statement. The suggestions of change served only as objects for comparative reference in evaluating the three experience groups of the study on how they agreed or disagreed.

The percentage of "yes" answers of the total of thirty was tabulated for each respondent as his raw score to be used to derive rank-order data for statistical evaluation. The Kruskal-Wallis one-way analysis of rank-order differences[15] was applied to the rank-scores of the sample of Texas instructors. Details of this test and of other tests of comparison that were performed are explained in Chapter III; the results of the tests and of the associated graphic comparisons are illustrated in Chapter IV.

Definitions of Terms

The terminology used in this chapter and in those chapters which are to follow is described here. A clarification of intended meanings (operational definitions) of uncommon terms and phrases should aid understanding and minimize repeated referrals as the material of this study is developed. Terms are arranged in alphabetical order:

Computer-oriented. Conditional to computing machines, or, having a direct relation to computing devices.

Computer-related Instruction. Teaching that involves, wholly or in part, mechanical-electrical components that interact with human teachers and students. For the purpose of this study, the application is limited to the human teacher role in conjunction with computers. These roles are concerned with designing, developing, programming, and applying learner activities using computers.

Content Specialist. A subject-matter expert who furnishes and arranges the primary materials for a course of study.

Curriculum Planners. Those who are responsible for the development of complete courses of instruction; delimited here to courses that are student-centered, and that have both mechanical and human components.

Data Banks. Computing machine storage locations for data - often referred to as "computer memory."

Departments of Technology. Educational units for teaching the principles and skills of technology.

Instructional Designer. An executive planner, who, in conjunction with operations technicians, content specialists, and program library specialists, develops complete educational packages involving, but not limited to, computer instruction.

Instructional Manager. A specialist in curriculum, who, by experience and training, is qualified to plan, direct, and supervise learning programs.

Learning Diagnostician. A highly-trained specialist experienced in learning psychology and in the human and machine processes of educational science.

Master Teacher. A supervising instructor who leads and guides subordinate instructors as well as students.

Operations Technician. A computer program analyst whose special job is to correct operational deficiencies in an educational computer program.

Proctor. A subordinate intermediate-level director/supervisor of educational activities usually not self-originated; a teacher aide.

Program Library Specialist. A computer-program librarian familiar with educational program storage and retrieval. Also a consulting specialist for program selection.

Programmed Learning. Learning through information acquisition by small sequential steps; the learning vehicle is the program and is usually administered by a machine or a "program book."

Specialist. For the purpose of this study, an instructor whose activities include professional involvement with course development, instructional guidance, and/or design of computer instruction programs.

Teacher Role. A function that provides guidance toward understanding or learning. In the broad sense, a grouping of the various duties of teaching.

Technical Education. Education that is primarily career-oriented, and provides knowledge of techniques that may be gainfully utilized in earning a living in the industrial fields.

Technology. The applied physical sciences.

Two-year-level Colleges. Educational institutions, oftentimes called "community colleges" or "junior colleges," that offer two-year educational curricula complete in themselves; curricula that is based upon the requirements of direct entry into the career fields

> or for a continuance at the higher levels of education.

Summary

The initial chapter of this study on conceptualizations of Texas community college technology instructors on their future roles when computers are used as components of instruction sets forth the need and purpose of the investigation. According to the authoritative opinion quoted in this chapter, the feeling of complacency that is now prevalent may be forced into an abrupt change, causing many administrators and teachers to be caught short in preparation and training for future events. The experts quoted apparently believe conceptions of such future prospects are important, as they do affect the shape of things to come; attitudes that are not anticipatory of change can make the transition difficult and can slow down the whole process.

The instructors of the departments of technology in the community colleges are representative of the nation's educators who are on the firing line in the ongoing battle between tradition and innovation. How instructors think also affects the thinking of students in their acceptance or rejection of progressive change. The shape of things to come is seriously influenced by the thinking of those who are involved in the happening.

Because of real-life experience, instructors who specialize in computer-assisted instruction have insight into what education using computers is really like. One question that this study strives to answer is, "Does the population of technology instructors of the Texas community colleges generally have a similar viewpoint as the experts of what they will be required to do when and if computers become commonplace as components of classroom and laboratory instruction?"

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[6]Paul D. Saltman, "Realism of Man's Potential a Must for a Successful Future," America and the Future of Man, Paul D. Saltman, academic coordinator, The Houston Post, 7 March 1974, Sec. BB, 6-7.

[7]Ibid.

[8]George A. Miller, "The Human Link," The Psychology of Communications, (Baltimore: Penguin Books, 1969), 50.

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[12]Duncan W. Hansen and W. L. Harvey, Impact of CAI on Classroom Teachers, (Washington: Office of Naval Research, 1969), 38.

[13]John Stuart Mill, Utilitarianism, (London, 1863).

[14]Paul De Turk and Robert Mackin, "Lions in the Park: An Alternative Meaning and Setting for Learning," Phi Delta Kappan, March 1973, 460.

[15]W. Kruskal and W. Wallis, "Use of Ranks in One-Criterion Variance Analysis," Journal of the American Statistical Association, XLVII (1952), 583-621.

Chapter II

REVIEW OF THE LITERATURE

Introduction

The pages of this chapter contain a collection of authoritative quotations and synopses of writings on computers and computer-instruction. This assemblage of qualified opinion was gathered to provide nominal value relative to conceptualizations of Texas community college technology teachers about computers, computer-instruction, man/machine relations pertinent to education, competencies required for effective utilization of mechanical/electronic learning devices, and teaching role changes that may ensue with the adoption of computer-assisted instruction. Although agreement was not universal, those who would know by their involvement and experience did provide a reference for further examination and evaluation on what the future teaching role might be with computers.

Computer teaching techniques use a question-and-answer sequence that was documented by Socrates twenty-four centuries ago. According to the chronicles, Socrates did not ask his students to commit profundities to memory. He began with simple questions. Developing upon the answers he got, he would ask questions requiring answers that gradually increased in complexity. The students, thus stimulated, learned well. Today's auto-teaching device works on the inductive reasoning principles of Socrates - this is commonly labeled "programmed learning."

The key to the education of the masses, a cherished dream of the venerated American forefather, Thomas Jefferson, may very well be the programmed question and answer machine. Benjamin Fine said in his book, Teaching Machines:

> "This achievement has been the hope of educators for decades. How, they have asked, do you educate millions of people in a democracy with precise regard for their individual talents? For decades, we simply didn't. Now it looks as if psychologists have found the answer - in the teaching machine."[1]

Edward L. Thorndike, in his book, Education, in the year 1912 laid out a plan for programmed learning. He said, "... the best teacher uses books and appliances as well as his own insight, sympathy, and magnetism."[2] Thorndike believed that teachers should develop their plans to use to the maximum advantage whatever aids are needed and available -- that every plan should seek the comprehensiveness of whatever is available for teaching.

These few scattered but nevertheless authoritative commentaries indicate that teachers desire, need, and would use instructional machinery when it becomes universally available as an aid to learning. If this is true, a review of what has been written on the role of the teacher in such a circumstance would be in order.

Historical Background

The basic idea of the learning machine was known and discussed in the United States as early as 1866. The learning process was then poorly understood, and the results were far less than hoped for. Some time later, John Dewey, in his article on "The Educational Situation," appearing in School Review, January, 1902, expressed the opinion that motives for acquiring information could be provided which, instead of leading to habits of competition and rivalry, would provide personal incentives to plan for, and then seek new information.[3] This is a good example of the beliefs of Dewey that individualized learning has advantages over group instruction.

Prior to American entry into World War II, Sidney Pressey published an article pointing to the fact that mechanization exerts a profound influence on practically every human endeavor, except education.[4] Pressey noted there has been a tendency in education to develop social rather than mechanical innovations. Open classroom, performance contracting, competency-orienting, team teaching and differentiated staffing, and numerous other worthy teaching techniques have been and are now utilized in modern instructional programs. Early in this century, Pressey maintained that a need existed for mechanical scoring devices in knowledge testing to relieve the teacher burden imposed by the newly-popular objective test. He believed that such devices would allow the teacher to spend more time in teaching. Perhaps he did not think at that time how mechanical aids might facilitate teaching as well as testing. Nevertheless, the pressure and demand for rapid and extensive instruction in the psychomotor skills brought on by the Second World War led Pressey and others to develop many innovative ideas for teaching ranging from the simple programmed textbook to the complex and costly aircraft flight simulators.[5]

After World War II, B. F. Skinner and other behaviorists expressed great interest in programmed teaching and mechanical learning devices. It was Skinner's idea that: "Learning should be as nearly errorless as possible - wrong answers are the static of knowledge communication; they interfere with the clear reception of ideas."[6] The main objective of machine teaching should be the constant engagement of each and every student in the learning process. The machine insists upon an individual's response. Properly used, every new bit of knowldege must be accompained by an answer from the participating student before proceeding further. Immediate reinforcement and program revision to decrease the error rate are prime factors in good design. "The use of repetition, cueing, and unwavering ever-decreasing stimuli improves the overall effectiveness."[7]

The increasing interest in the machine-teaching idea was accompanied by improvements in the techniques of using these devices. From the article, "The Supersonic Seventies," reported by the editors of INFOSYSTEMS in their January, 1970 issue, the following information is quoted:

> "In the year 1964-65, nearly 120,000 undergraduates and 29,000 graduate students received some computer training, according to statistics compiled by the Southern Regional Education Board [SREB] in the report, 'Computers in Higher Education.' In addition, 4000 undergraudates and 1300 graduate majors in 'computer science' were estimated to have been enrolled in 1964-65.
>
> The SREB's projections indicated that in the 1968-69 year, approximately 81,000 graduates and 350,000 undergraduates would be trained in at least one programming language; for computer science majors, the numbers were 19,000 undergraduates and 5000 graduates."

The editors said these increases were expected to continue, and they did so. According to SREB estimates, the number of schools with computers for research and instruction, numbering 600 in 1966, went to 1000 in January, 1969. Projections for this rate of increase would put virtually all of the existing 2200 higher-level institutions in the computer instruction business by the year 1980. The INFOSYSTEMS report also included a warning that the growth acceleration on numbers of computers available on the market must continue to keep pace with the increase in numbers of institutions of higher learning if these projections are to prove true.[8]

The primary learning tools of the past have been chalkboards, pencils, paper, and textbooks. Ron Barnes, in his booklet, Learning Systems of the Future, said:

> "Creative application of new technologies will limitlessly expand the number of learning tools available. Simple, reinvented, newly-discovered, or newly-applied, these tools can change the nature of learning. Video tapes and computer data banks will reinforce new learning styles in an electronic environment. Computer simulations, educative games, and dial access retrieval systems are present indications of the type of tools to be used by learners of the future. This is not to say that the potter's wheel and the paint brush will be replaced by mechanical robots. This is to say that a greater range of physical options, from tinker toys to laser measuring instruments, will provide an unimaginable number of alternatives for the individual."[9]

The expertise of the educators quoted shows that throughout the history of American education, teachers have spearheaded the continuing search for a better way of guiding learning. They have been, and will continue to be, acutely conscious of the need for improvement. The burning desire to improve understanding has in many instances exceeded the practical limitations. Many ideas, seemingly valid in preliminary perspective, have failed in the application. If computers in instruction can help, will these devices be accepted and utilized by instructors, or will they be intuitively rejected? The difference in concepts of members of a given sector of society can vary between wide limits. The consensus of such a group may or may not show agreement with what is or what will be. The experiences of those who can speak with authority will be examined further in the following pages of this chapter.

Individualizing Instruction

Norman Miller hypothesized that students learn from instruction if the following conditions are met:

1. DRIVE - the student must want something.
2. CUE - the student must notice something.
3. RESPONSE - the student must do something.
4. REWARD - the student must get something he wants.[10]

David P. Ausubel's "Theory of Reception" stated: "Instructional materials should follow the principles of progressive differentiation and integrative reconciliation."[11] Ausubel said that if a class is to be fairly administered, the very fact that each student should be given a chance to respond severely limits and restrains both student and teacher. Those students who apparently know the answers are oftentimes by-passed by the conscientious teacher to call on those who might not. Otherwise, those who are exuberant in their desire to answer, and seem to plead for the opportunity to do so, soon blanket the response of those who are shy and lacking in self-confidince. If this condition prevails for any length of time, the students who are apatheitc, ashamed to made fun of because of their self-conceived dullness, unconvinced that they are part of what is going on, and so ill-at-ease over the classroom competition soon decide they would prefer to be left out of the activity entirely. This problem is of deep concern to the responsible teacher, and causes him or her to exert great effort in an oftentimes futile attempt to equalize the learning. The speed of comprehension cannot be equated to learning; if it takes longer for one to do a task than it does for another, all that can be said of the relation is that the second is faster than the first. Certainly, this is not any criterion for determining intelligence.[12]

One of the essential features of machine teaching is the constant engagement of each and every student in the learning process. The machine insists upon individual reaction. Properly used, the machine program dictates that every bit of new knowledge must be accompanied by a response from each participating student before proceeding further. The Skinnerian recipe for all types of instruction is specified in three parts:

1. Small units of instruction for each reference "frame."

2. A short mental distance between "frames."

3. Use of questions and answers to chain the "frame" together.[13]

Applied Computer Instruction

Technology has enabled the average American citizen to achieve an affluence unparalleled in the history of mankind. Technological advances are quite evident in today's classroom. A variety of devices aid the instructor in his daily activities. Public address systems, projectors, mechanical teaching aids and instruments, and working models for teaching already facilitate the instructional process. In their book, New Media in Higher Education, Brown and Thornton summed up the situation, saying:

> "Recently, higher education has exhibited a trend toward a new kind of support for instructional services and an extensive development of facilities to encourage the utilization of new media. This trend is founded in the changing roles of college teachers and is influenced by increased enrollments, rising costs, and a growing understanding of the psychology of learning. The trend is encouraged by the increased availability of effective, appropriate, and convenient materials, devices, machines, and classroom facilities for improved teaching . . . a humanized technology can free the teacher from the servitude of mechanical and repetitive chores and amplify the force of his creative and distinctively human efforts."[14]

It cannot be said that there is complete and unreserved agreement, even amongst the experts, upon the munificence of technology. The director of the Harvard Program on Technology and Society, Emanuel Mesthene, warned:

> "What's good for educational technologists is not necessarily good for education. Our technologies today are so powerful, so prevalent, so deliberately fostered, and so prominent in the awareness of people that they not only bring about changes in the physical world - which technologies have always done - but also in our institutions, attitudes and expectations, values, goals, and in our very conceptions of the meaning of existence."[15]

Power of itself, particularly unknown power, is something humans have long equated to their own fear. That which is a mystery or uncertainty in the human mind is doubly suspected. Concerning the basic human fear of technology, Brown and Thornton in New Media in Higher Education said:

> ". . . One group abhors technology in education because they think it represents weak and debilitating forms of learning experience. Another group fears technology because of its strength . . . as the power to effect evil as well as good."[16]

Morris Shamos sees the power of the technology as a satisfier of the needs of society, inexorably motivated as the situation demands. In an article published in Effective College Teaching, he expressed this view:

> "Our habits, our modes of life, our health, our ability to wage war, or encourage peace - all are conditioned by advances in technology. These advances, moreover, result generally from specific needs of society."[17]

A more optimistic viewpoint of the unceasing advancement of physical science is expressed by Bruno Bettelheim. In 1961 he wrote:

> "The answer to the threat of technology is not to deny or neglect the dangers of a situation; not to run away from it by destroying it and depriving oneself of its advantages, but to realize the dangers and meet them with conscious action based upon personal decision. This neutralizes the danger and lets us enjoy the advantages of technology without letting it deprive us of our humanity."[18]

Silberman perceives problems in the widespread use of computers in education. He predicted serious limitations in the application and use of automated devices. Teachers must acquire special skills if they hope to use teaching machines to any appreciable advantage. In his book, Crisis In The Classroom, Silberman said:

> "Indeed the approach to instructional technology that most researchers are follwoing is likely to compound what is most wrong with American education - its failure to develop sensitive, autonomous, thinking, humane individuals. To program a computer, for example, one must define the instructional objectives in precise, measurable, behavioral terms; one must be able to specify the behavior to be produced with far greater precision than is needed in the conventional classroom. . ."[19]

Silberman believes this task is harder to accomplish in some fields than in others. He pointed out that in educational programs in industry and in the military services, where definitive and discrete values can be prescribed for specific behaviors and where there is intense motivation, it is relatively easy to develop machine teaching programs.

Philip Jackson, in the Horace Mann Lecture Series of 1967, said that it is evident certain educational experiences are available only through mechanical instruction. He conditioned the statement by saying:

> "But these advantages are almost invariably accompanied by a loss of administrative flexibility. . . students must stay 'on the track.' Thoughts and reactions have only tangential relationship to the task at hand."[20]

He stated that here the ability to digress is lost.

Patrick Suppes, the eminent authority on CAI (Computer-Assisted Instruction) conceded that teaching machines cannot assume the entire teaching role. He said that it is easy for tutorial systems to handle rigidly-structured subjects such as reading and mathematics. Nevertheless, the main responsibility remains with the teacher to help students who are not proceeding satisfactorily. The success of these programs depends on the teacher, especially when the learner requires individual attention.[21]

With regard to the school's role in the learning procedure, Benjamin Fine presented this thought:

> ". . . a school's function is deeper than merely teaching facts and ideas. What it should strive for is the creation of an open, elastic intelligence in its children. Such receptivity is all but throttled by the aversive discipline of most present-day schools. When a child studies to avoid the consequences of not studying, he becomes a tactician, a little master of opportunity, learning only those things which will pacify the teacher or get him over the predictable terrain of the next exam. He loses whatever sense of wonder and excitement he may have had about knowledge."[22]

Kay, Dodd, and Simes appear to be in general agreement with what others who have been quoted here believe to be true. These gentlemen have said that educators who are concerned with self-correcting instructional programs believe that with a functioning system, slight changes in the curriculum can be more effective than methods improvement. Reduced to simplest terms, this means that the best teaching machine is of little or no value without the proper program.[23]

In 1963-64, a national demonstration exhibit of programmed instruction and teaching machines was constructed. The entire exhibit was based upon the principles of programmed instruction. The exhibit was displayed at forty-four different locations; it was viewed by over 100,000 people, consisting mostly of teachers, school administrators, and students who intended to enter teaching as a profession. Professionals, serving as consultants, gave seminars and lectures and answered the questions of the visitors at each tour site. An exhibit guide containing introductory materials and a brief bibliography on program instruction was distributed to the visiting public. The impressions of the viewers, as determined by an attitude questionnaire, were favorable.[24]

The investigative results and conclusions reached by the experts that have been quoted on how teachers may feel about machine education may be summed up in this way:

> Computer instruction by itself is neither good or bad. It's character is establihsed by how it is used. To perform it's mission, the machine must be programmed to gather together the products of contemplation, of teaching expertise, of educational technology, of theory and fact, and blend them into something which will teach well; to teach those who are slow, or fast, or mediocre, or brilliant - to challenge the eager and the disinterested. That is the task to be done. How well it is done depends on those whose charge it is to direct, program, and manipulate the machine for optimum effectiveness.[25]

Teachers and Teaching Machines

A large body of educationists seem uncertain of the computer as an unreservedly-beneficial adjunct to learning. Anxieties have been voiced on the supposedly-dehumanizing mechanical aspects of computer-instruction systems. As Ron Barnes sees it, technology, properly-applied, can be a blessing rather than a curse. In his book, Learning Systems for the Future, he has written:

> "Almost inevitably, the words 'computer' and 'technology' provoke concern for dehumanization of education. The assumption seems to be that technology and humanziation are antithetical. Such is not the case. Intelligent, creative use of technology - in this case, the computer - can free people to perform tasks which are likely to be more helpful to learners than those previously performed."

Barnes advocates development of a computer network information system. Characteristically, humans are reluctant to discard their established opinions and behavior patterns until the alternatives prove more effective, or at least seem superior. Barnes phrased it this way: "It is not a question of 'either me or it' - the unlimited nature of learning encompassing the entire societal arena clearly allows for 'machines and me'; the task is large enough for both."[26]

Alfred Ellison, in presenting a paper to the annual meeting of the American Educational Research Association in 1970, put this slant to the teacher/machine question:

> "While there are doubts regarding the mode of operation and the kind of relationship which should exist between teachers and automation, the basic fact is that the two will be intimately tied together. . . The implications for teacher education are these: Prospective teachers need to gain part of their own liberal arts and professional education through the new medium and need to become familiar with the available elementary and secondary level programs. Regarding the fulfillment of the dream of applying computers to the solution of educational problems, we have, at present, a dual failure; the awful problem of getting operational and the low quality of too many present approaches to CAI (Computer-Assisted Instruction). The great failure is at the conceptual level. Most existent programs do not even attempt to fulfill the basic potential that the computer offers.

Ellison believed there is a need for providing the learner the capability to make alternative choices as he seeks ideas and answers from the available data. Also, his thought was that computer hardware producers should furnish the machinery that is compatible with software specificially developed for educational purposes. This should include the development of a universal program language or translators that would permit programs to be used on several machine systems.[27]

Hansen and Harvey had this to say concerning conceptualizations of role changes of classroom instructors due to the use of Computer-Assisted Instruction (CAI):

> "It is likely that the pattern of computer development in education will ge gradual, culminating in a new form of individualization due to the availability of advanced computers and multimedia resources, and to the differentiation of staffing. Perceptions of teacher functions are contingent upon type of system and program process time. Some factors within CAI which may cause teacher role changes can ge identified. . .
>
> The teacher's role can potentially change toward involving more strategizing, managing, individual counseling, discussing, specilizing, and diagnosing functions. There will probably be fewer correcting, lecturing, and disciplining functions."[28]

Belief in the inevitable trend of events leading to the widespread use of computers in education is testified to in the following quotation from the article, "The Supersonic Seventies," by the editors of INFOSYSTEMS - this is the fifth of a series appearing in An Introduction to Computer Systems, Bassler and Joslin, editors:

> "The experiences at Darmouth College, and at other pioneering schools where students and faculty have free access to computing power, show that given

> an opportunity, students and faculty will discover a multitude of new areas and new ways in which the computer can be applied effectively . . . This will occur in part because an increasing number of high school graduates will have been exposed to the computer and will know how to use it by the time they're ready to scout college campuses."[29]

Two commentaries worthy of quotation come from the works of Robert Glaser, professor of psychology and education and director of the Learning Research and Development Center, University of Pittsburg. In the first of these, Teaching Machines and Programmed Learning, Glaser points out that the changes happening in education are quite radical. The very foundations of formal schooling are undergoing a restructuring that affects and realigns, in greater or lesser degree, all of the factors involved in the process. Glaser stated, "There is little doubt that the school of the not-too-distant future will be able to boast a curriculum that may be offered in as many different ways as there are pupils in the school." He predicted that in this future school the student will choose and attain mastery of skills and knowledge tailored to his own needs and desires. The teacher will help by teaching the learner how to learn. Techniques and materials will be made up of "far more than learning to read and being group-paced through a 12-year parade of textbooks."[30]

Glaser becomes more specific in The Design and Programming of Instruction. He visualized that the instructional process will be carried out in this way:

> "In subject-matter learning, the instructional process can be defined as a way of arranging the student's environment to expedite the kinds of learning which

> comprise subject-matter competence . . . Teaching the student to use previously learned skills in response to new subject material is the pertinent instructional task, and this involves transferring stimulus control to new subject matter . . . Decisions need to be made on some basis about 'what is to be learned before what.'"

Glaser hypothesized that in the future, four main areas of the educational process will be affected:

1. Instructional goals will be analyzed in terms of both subject-matter content and categories of student behavior that suggests strategies of teaching.

2. The diagnosis of the learner's strengths and weaknesses prior to instruction for appropriate pedagogical guidance will become a more definitive process so that it can aid in the design of a curriculum specially suited for the student involved.

3. The techniques and materials employed by the teacher will undergo significant change.

4. The ways in which the outcomes of education are assessed, both for student evaluation and curriculum improvement will receive more attention.

The current levels of computer technology and instructional development indicate that computers can handle the problem imposed by the instructional requirements, and that the urgent need is for specification of the display and response requirements that is to be provided for the learner.[31]

Regarding teacher adaptation and role changes complementary to the computer instruction environment, Robert Travers contributed this general thought on teacher behavior modification:

> "The design of teacher behavior is a much more complex matter than the design of the objects in the educational environment, and yet the matter is a crucial one. Most educational reformers have directed their efforts toward the problem of changing

> teacher behavior in such a way that it provides effective conditions for learning. Few have been concerned with changing other aspects of the educational environment . . . The problem with the design of teacher behavior is twofold. The first is that of deciding which teacher behaviors are to characterize the teacher in relation to his work. The second is that of developing teacher-training methods or otherwise arranging conditions so that the desired teacher behaviors occur . . . The generalizations derived from research on learning already provide some basis for the design of teacher behavior. A plan for teacher behavior is still a far step from arranging for teachers in the classroom to perform according to the plan. A plan for teacher behavior might well be such that many teachers could not perform in accordance with it. Just as composers have been known to write pieces of music that no musician can possibly play, so too can educational planners produce blueprints for education that require the actors on the educational scene to play parts that are incompatible with their personalities.

Who Will Control the Schools?

A shift of emphasis on teacher roles, from inward motivation to externally-generated influence, is noted in the writings of Tom Sine. He presented a convincing argument against the future "almost-absolute domination" of humans by the "megamachine." Although the present-day system of education was molded in part by unanticipated events of the past decade, the fundamental development of the school was brought about by its fixed role in society. Ivan Illich and others have opined that not only is education guided by the technocracy, but also by the evaluating and testing procedures serving the industrial interest. These factors are major in determining college access and social status. Sine believed that those who would try to guide the trouble-ridden school system forward should understand the essence and the objectives of technology, including the pervasive influence science has on the schools:

> "To understand the role of technology in society we must look beyond the cornucopia of plenty it has generated. Technology is no longer a mindless robotic servant, as characterized in the past. Technology has quietly and unobtrusively evolved into a megamachine of gargantuan power and influence."

Many chroniclers, from Jacques Ellul to Lewis Mumford, are concerned about effects of the technology on formal education. Sine asks, "In what ways does this 'megamachine' pose a threat to human society?" He addressed his own question by saying, "What we are building now is the nervous system of mankind, which will link together the whole human race, for better or worse, in a unity which no earlier age could have imagined."

The conglomerates bringing about these powerful systems of information interchange throughout the world are interested in only one thing - unrestricted "progress." The implication made by Sine is that technology is rapidly losing its "friendly giant" image. Sine concluded his remarks by saying:

> "Those who would strive to chart a humane course for the schoolhouse in the future must critically evaluate the implicit value assumptions of the schoolhouse in the present. The human imperative must replace the technological imperative and man must be given precedence over the machine."[33]

What Tom Sine has said seems quite pertinent to teacher roles in future education.

Alan Ellis, in his book, The Use and Misuse of Computers in Education, may have provided answers to the questions asked by Sine. Ellis stated the automation of activities should not become the central objective of education. This would mask the rightful role that computers could play and it would certainly influence the way educators think. The supposed "help" of the computer could foster a dependence without any real enlightenment. The control of learning will remain with the schoolmen only as long as they maintain their responsibilities. Only in this way will they be able to grasp fully the role computers can play in education. Otherwise, the real role that the computer could achieve would be denied, and the way educators think about computer instruction would be altered in a detrimental way. Ellis consolidated his argument by saying:

> "Down the end of the logical road which begins with the definition of a computer as an incomplete machine is the notion that if computers are to be used fruitfully in education then the educator must be an active participant in their use. That is, because automation in education means thinking and rethinking educational practice, there can be no expert in this endeavor other than the educator. While the need for the educator to participate directly in the process of automation in education is an easily drawn implication which flows from our definition of a computer, the participation itself is not easily accomplished."[34]

These comments stand as a reinforcement on why this study is of fundamental importance.

One fully-operational and almost universal application of computers in the education enterprise today is EDP (educational data processing). EDP is mainly concerned with the clerical accounting, posting and book-keeping educational chores - a rather unglamorous job. Most of today's educators would agree that EDP has already achieved much influence in their professional activities. Compiling school statistics, scheduling classes, assigning students to classes, updating and posting report cards, scoring and normalizing test results, initiating and updating pupil records, and maintaining student, faculty, and staff personnel files are some of the commonly-accepted tasks currently performed by EDP.

EDP services are deceptive because teachers may see in computers a relief from monotonous and repetitive tasks that take up so much of their time, thereby allowing the teacher freedom to do the "tasks of ultimate choice." But, cautions Ellis, instructors may be running the risk of losing the very thing they need in dealing with these desireable tasks. People are products of the assistance they will accept. They are probable victims of those who, for whatever motive, want to run things. However successful the undertaking may appear to be, this must not become the goal, but rather a means for the effective and systematic development of school operations. Ellis contended that the more responsibility the educators place on machines by automating various functions, the greater the possibility of takeover, unintentional as it may be.[35]

"It speaks well for the teaching profession that so many are so ready to consider new methods." This is the observation of Kay, Dodd, and Simes in their book, <u>What Teachers Say</u>. They expressed the belief that when teachers show opposition toward a new innovative teaching method, this opposition is fervent and eloquent. The teacher's conviction is often representative of a lifetime of teaching worthy of deep respect. Frequently, there is a hint that the speaker is protesting too much and revealing his own insecurity about his long-established methods.[36]

Kay, Dodd, and Simes noted the fact that programmed instruction is only trying to provide a means whereby effective instruction may take place. In our present educational system, every good teacher is overburdened with work. Anything that will increase the opportunity of the teacher to make more contact with his pupils and decrease the demand for class lecture will give the teacher the flexibility that too often an over-crammed timetable with over-sized classes will not allow.

The writers of What Teachers Say have the conviction that the personal relationship between teacher and pupil is the permanent influence in teaching, and by its' means something far more subtle and important can be conveyed:

> "It is a well-nigh universal experience that everyone had some teacher whom they revered and who taught them well and was respected; but alas, it is also common enough to find that there was some representative whom they heartily disliked if not hated, and from whom they learned little. It has to be accepted that often personal relations do sour a pupil's judgement of a subject; the teacher symbolizes his subject and too often it is liked or disliked accordingly. In the negative instances it would be only too beneficial for some objective method to take over and restore the balance . . ."

Teachers frequently voice the objection that the new innovative systems make learning too easy. The new curricula painstakingly try to anticipate every problem in educating students. Incremental learning staged in easy steps offers little challenge to the budding intellect. The young aspirant entering the career arena oftentimes cannot use fractions in math computations - spelling is an unknown skill. Kay, Dodd, and Simes have said that education has enough of such casualties - it needs more successes, where students can spell and add upon emergence from the scholastics.[37]

Another interesting facet of teacher influence is illustrated in these Kay, Dodd, and Simes observations:

> ". . . No teacher is complimented because he makes his subject more difficult than another . . . yet to hear some teachers talk it might be thought we do. The fact is that the simpler and more penetrating the teacher can make his explanation, the more his students will understand and - this is the nub of the matter - the farther they will advance in the subject . . ."

Comment was then made that mechanized programs are not designed so that all students complete a course with equal timeliness and comprehensibility. The aim is for all to understand at the highest possible level. With each individual having opportunity to respond, all-around attention is provided, and this can achieve for all a high level of success.

> "But the outstanding point here seems to be the success that has been achieved where programmed instruction has been integrated into normal teaching courses. Here it has been able to provide some variety of instruction, it has relieved the teacher of part of his routine classwork so that he has more time to devote to personal supervision and it has ensured that every student can take advantage of detailed and evaluated preparation of the subject matter. Where the programme is included as part of the course and is being used by the teacher as an adjunct to his teaching there is no doubt that this powerful technique creates an atmosphere of purpose and progress. In our discussions with teachers who have used the method it is clear that this is more than beginner's enthusiasm; this is confidence both of success and the satisfaction of being able to do a difficult job well."[38]

To summarize what has been said thus far in this review: there is one body of opinion believing that machine teaching is of little value in the learning process: another group seems convinced computerized instruction may be the ultimate answer to the American dream of truly universal mass education. The middle ground of opinion is that mechanical learning aids are neither worthless nor are they the sole answer to the mass education problem. Most of the experienced people quoted apparently are in agreement that computers are nothing more than tools, which, in the hands of skilled and talented craftsmen, can produce educated individuals as end products more efficiently, of better quality, and at a lower cost than conventional methods. Caution is advised that an undue reliance on machines for schooling could emasculate human initiative. It would diminish control by the instructor and assign the teacher a secondary role in formal education.

Functions of Machines and Roles of Instructors

In the final pages of this review of the literature, two comprehensive and authoritative condensations of what experts say and think are reported. The first of these is a wide-ranging study by renowned educators of the American and European continents. The second is a recapitulation of the research done at Purdue University by Feldhusen and Szabo.

Working Group Three (WG3) of the International Federation for Information Processing (IFIP), Technical Committee for Education produced a document in 1973 that was titled *Computer Education for Secondary Schools: Aims and Objectives in Teacher Training*. This publication attempts to show the changing roles of society and education, the role of the computer in rationalizing the transition, and the needs of the teacher in this context. The writing group consisted of eighteen educators from America and Europe and was chaired by William F. Atchison of the University of Maryland. Many ideas on computer instruction were examined and a consensus on each of these was developed and documented.[39] Some of these summarizations are set forth here in reinforcement of, or in argument with, other opinions previously cited.

On computer education per se, the Atchison Working Group Three agreed that:

> "Computers and computer methods are playing a significant role in education. Despite all the spectacular achievements of computer use, such as the control of space travel, it is this educational role which will be seen as the main reason why teachers should be familiar with computers . . . because computers and computer concepts can augment our thinking, it is most desirable for everyone to have some understanding of them. The introduction of computer education for all teachers is specially justified by the contribution computers have brought and can bring to education."[39 (p.5)]

On the present and future contributions of the computer to education:

> An examination of the aims and objectives of education will show that computers have helped and will continue to help achieve instructional goals. Computers have enormous capacity and speed for information storage and retrieval. The quick sorting and ordering of information allows humans to perceive patterns and structure, heretofore impossible by manual means.[39 (p. 5)]

Computers may be programmed to facilitate adaptive learning. The inquiry technique can lead the student through course material stored in the computer or available in standard texts. Materials applications and the development of skills can also be included in the programs. The machine will constantly update the record of student answers. This record is valuable as a criterion for selecting subsequent course activities.[39 (p. 6)]

Analytical proficiency and decision-making skill can be developed and aided by using the computer to perform simulation. An example of this usage is described:

> "A computer program can be written to assist in developing skills in medical diagnosis. Medical data is fed into the computer by the teacher and in this way, the computer 'simulates' a patient. The student can question the 'patient' and at a certain stage, give a trial diagnosis. The computer will comment on this. The initiative comes from the student who asks questions, analyzes the responses, and forms judgements . . . Simulations encourage students to explore . . . They require the student to adapt to changing situations . . . A sense of values is developed by discussion with the teacher and with fellow pupils about the decisions which are to be made and the reasons for making them."[39 (p. 6)]

As the student becomes more involved, he will reach a point where he will want to develop his own simulation. By simulating a problem and then seeking ways that it may be solved, the student is on firm ground relative to the current educational practice of learning the principles rather than learning discrete solutions. Since the computer follows instructions explicitly and unquestioningly, the test for the correct formulation can be absolute.[39 (pp. 6-7)]

On keeping education in step with knowledge expansion, the Atchison Group said:

> ". . . There are fundamental differences between the changes taking place today, and those that took place one or two centuries ago. This difference can be partly explained by the increased rapidity with which new information is being created . . . modern communication methods propagate the effects of change almost instantaneously. As a result, new ideas interact with one another. Because of this, technological developments can now rapidly exert influence far beyond the immediate tasks for which they were designed."

Educators should be well founded in the major concepts of computer science so they may be able to develop courses in keeping with the development of knowledge.[39 (p. 9)]

Computer technology and instruction together present many important issues for education. The Atchison Group considered the seven listed here among those of major consequence:

1. What are the educational needs that suggest the application of computers?

2. What are the major early applications of computer technology to education and what problems do they encounter?

3. What have been the more recent efforts to utilize computers, and what have been their results?

4. How can we compare the cost and effectiveness of computer-based programs and processes with other programs and processes?

5. <u>How will computers affect the nature of work and jobs and the ways they are likely to be organized in the future?</u> [underline added]

6. What is the nature of the man-machine relationship which can now, perhaps, be better thought of as evolving into a society-machine or society-system relationship?

7. What have been the resistances to computer uses or efforts to introduce computer use?

A new complex operation requires a systematic treatment of all component activities involved. The process is not as simple as just adapting information processing techniques to fit old procedures. Methods and techniques must be tailored to fit the structure of the new system.[39] (pp. 10-11)

From what has been quoted, it seems quite evident that the instructor must be equipped with knowledge and experience in information processing and computing to conduct effective activities mutually supportive and conjunctive to computer instruction.

The following list summarizes the uses of computer instruction that were discussed in the preceding paragraph by the Atchison Working Group:

1. The use of the computer to model or simulate real situations. This enables the student to investigate environments beyond the real ones to which he has access.

2. The use of the computer to relieve the student of tedious and time-consuming computation related to his investigations in various disciplines.

3. The application by the teacher and the student of the concepts of information processing which can help the logical development of ideas and activities.

4. The use of the computer directly to assist the teacher in organizing and presenting information and ideas and in monitoring student progress.[39] (p. 12)

This list describes a few of the uses of the computer in education - uses that are beneficial to both student and teacher.

The Atchison Group treated some of these applications in detail. They said that proven practice has shown that the computer can, and does, support instruction through its' ability not only to compute, but to also search, sort, and list in the process of information retrieval. The computer can play a more direct role in teaching. For instance, the computer can assist in matching each student's need for specific learning materials, resources, and activities. This includes maintaining files of complete course packages and of source inventories of knowledgeable people and materials. This is known as CMI (computer-managed instruction). The computer can be used to directly assist instruction. In this instance, the computer presents instructional sequences in the tutorial mode; it then analyzes student responses, and finally branches in accord with the displayed record of achievement. This is commonly referred to as CAI (computer-assisted instruction). For drill and practice, the computer can present many pertinent exercises that would reinforce student confidence and improve ability. By sorting, classifying, and analyzing what the student has done, the computer can branch to, or by-pass remedial routines, in immediate sequence to the expressed need. Transfer of training to new situations is facilitated as the student learns the techniques of problem definition, formulation, and solution. If the teacher wishes to show differences in numerical methods in math, or to calculate quickly the results of an experiment, or simply to retrieve information in the course of a group investigation, he can do so with the computer, and thereby enhance his presentation.

The student benefits in many ways as he learns to use the machine as a computational tool. He is soon conscious of the tremendous power and capability of the computer. He also sees that the computer has limitations - that it is not a magic "box of tricks." Instead, he sees it as a valuable and useful tool - a tool that bilaterally transforms his approach to problems and how he formulates and resolves them.[39] (pp. 12-14)

Appropriately, the final chronicling of the study by the Atchison Group dealt with the role of the teacher in educating programs involving computers. From what has been extracted and written in reference, it seems obvious that the activities directly related to the computer are only part of the total teaching process. Teachers need to determine strategy which should include entry-level knowledge, how the computer will be used, how achievement will be evaluated with respect to overall objectives, and how new knowldege will be utilized as a consequence of the instruction. The writers concluded their review by saying that teachers should be able to:

1. Understand the nature of information processing, its contribution to teaching in general and to their discipline in particular.

2. Discuss the influence of information processing and the computer in modern society.

3. Understand the computer as a machine which requires man to be capable of formulating problems in an algorithmic way.

4. Recognize the capabilities and limitations of a computer and the misleading myths and misconceptions associated with it.

5. Use the computer as a device which can extend, enhance, and supplement the teacher's role in education.[39] (p. 15)

For the teacher to be able to use the computer to "extend, enhance, and supplement" his role, he must meet the other requirements that were listed above. Not only does he need to know the power and limitations of computers, he also must know how to apply his knowledge on where and how the computers can be used for the best educational advantage. He may easily become proficient in programming, but it is more important for him to be able to specify objectives and the methodology he intends to use to bring computers into his curricula.[39]

John Feldhusen and Michael Szabo, in the April, 1969 issue of Contemporary Education, presented an in-depth research review titled, "The Advent of the Educational Heart Transplant, Computer-Assisted Instruction . . ."[40] In this second and final summarization on what has been written on the roles of educators and the functions of instructional machines, the emphasis is primarily upon computer-assisted instruction (CAI) and how experts conceptualize this as a component of modern education. According to the literature, computers have a broad application as media for learning. This review limits the imterpretation to those instructional activities in which the machine communicates with the student. The writers say that this definition includes:

1. Didactic instruction in which linear or branching programming techniques are used.

2. Tutorial dialogues in which the student is relatively free to query the computer.

3. Inquiry approaches in which the student attempts to explain a phenomenon by using the computer as a resource tool to seek necessary information.

4. Gaming or problem solving in which the student is led into a simulation of some real life problems and in which the computer controls the sequence and nature of simulated events.

The following citations from Feldhusen and Szabo were considered most representative of computer-assisted instruction (CAI) research:

> Hickey's anthology of writings on CAI is a comprehensive summary of computer-assisted instruction research. It covers developments through 1968 in other countries as well as in the United States.
>
> Gentile's review of "The First Generation of Computer-Assisted Instructional Systems" is an excellent commentary on systems circa 1967.
>
> Regan in 1967 called attention to misgivings of many educators and researchers on the current and projected state of CAI. The impersonal and mechanistic aspect evoked much concern. On balance, the final issue could be settled on the unquestioned effectiveness and untiring assistance that instructional computers offer to the learner.
>
> Bushnell queried CAI researchers in the field in 1965 and found that CAI research is part and parcel of systems development and application. He concluded that because of the magnitude of the hardware involved, systems development will be primarily considered prior to development of computer-assisted instruction.
>
> Stolurow (1962) deplored comparison of programmed instruction research with traditional human teacher instruction. Human instruction is very difficult to specify, particularly on the same basis as machine instruction.

(Continuation of selected CAI research studies from the Feldhusen ans Szabo review):

Feldhusen, in the following year, said that, despite the differences in the variables of comparison, educators want to know how well computer instruction works, compared to human instruction.

Lumsdaine, also in 1963, pointed out that the instructional intervening variables must be made specifiable and reproducible.

Schurdak made a study in 1967 on the effects of a CAI program, a programmed text, and the standard workbook/textbook combination used in a FORTRAN program language course. He reported the CAI group was significantly superior to the two other groups in scoring.

Schwartz and Haskell set up a program using CAI to train electronic technicians in basic data-processing. This was compared to a programmed instruction course already in use. There was no difference in posttest means. However, completion time was significantly better with CAI. Learning and interest were about equal.

Feldhusen and Chavers completed a study in 1969 on a graduate-teacher educating program using the Flanders classroom interaction analysis system. A computer program in Coursewriter language was administered using the tutorial mode. A combination of slides and typewriter i/o (input-output) performed the instructional sequence. On a constructed-answer posttest, CAI students were superior to a

(Continuation of selected CAI research studies from the Feldhusen and Szabo review):

self-study group using a programmed workbook and to controls not receiving the instruction.

In 1960, the effects of branching and of fixed-sequence modes using CAI were studied by Silberman, Coulson, Melaragno, and Estavan. Branching students used a sequence determined by their errors. Fixed-sequence students and branching students were paired by level of ability. There was no significant difference between groups on the criterion test of achievement.

Davis, Denny, and Marzocco in 1967 examined courses in college-level remedial math using CAI and programmed instruction. Their area of interest was individual differences in learning and the interaction of individual differences and method vairables. Individual differences were observed on a number of ability, attitude, and interest tests. Results showed no relationship between treatments and individual difference variables.

The effects of prior knowledge of subject matter on learning using CAI in mathematics was studied by Brown and Bahn in 1968. In the student sample, the level of prior knowledge was measured. Those students with prior knowledge scored significantly higher on the post and retention tests, even with adjustments for individual differences. Also, the prior-knowledge students took significantly less time to complete course requirements.

(Continuation of selected research studies from the Feldhusen and Szabo review):

> Stolurow and Davis examined studies of the interaction of individual difference variables with mode of instruction in 1965. They concluded that interactions do occur in many instructional environments using different methods. It is their belief that CAI that matches student with method will be a great help. In conducting research in individual-difference/method interactions, CAI will have tremendous advantage.

A number of other studies also yielded comparable data but are not included here because of the repetitive nature of the results. The empirical research noted here on comparative studies, basic instructional variables, and of individual differences is not complete and may even be inadequate, according to the authors. This may be attributed to the fact that many CAI systems are so often being developed simultaneously and, although costs have decreased steadily, the expense of terminal time severely limits the outlays for investigation. However, Feldhusen and Szabo stoutly maintain that, ". . . the evidence clearly indicates that CAI will teach at least as well as live teachers or other media." There will be a saving in time to learn. Students will respond favorably to CAI. The researchers say that the computer can be used to accomplish heretofore impossible versatility in branching and individualizing instruction, that true natural instructional dialogue is possible, and that the computer will perform near-miracles in processing performance data.[41]

Summary

The literature reviewed in this chapter indicates that computer instruction has grown rapidly into a dynamic and promising field for applied learning. The conclusion for the present is that computer instruction is already at the feasibility stage. Students can learn from computer instruction both didactically and inductively. The computer seems to have great promise of unusual instructional control powers not possible with any other media or with live instructors, and the outlook for research on computer instruction and on basic learning processes is very good. It seems clear that the computer's effectiveness depends in large part on the skill with which data is accumulated and presented and on how well instructors avail themselves of this new tool of instruction. Many educators, it appears, are firmly convinced that within the next few years we will see these remarkable instruments bring about a revolution in the classroom and in the entire educational process. Instructors seem destined to become personally involved in a number of instruction applications, even if only as passive members of learning systems which use a computer.

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Chapter III

PROCEDURES OF DATA COLLECTION AND ANALYSIS

Problem

The primary purpose of this study was to analyze the differences between three experience categories of Texas community college technology instructors on their conceptualizations of future teaching roles involving computers as components of instruction.

The secondary purpose of this study was to evaluate data from the three categories of instructors on their reactions to these questions:

1. Will computer related instruction become an integral part of technical education within the next five years?

2. Do you think the quality of education will improve when computers become components of instruction?

3. Are you convinced mechanical devices and media will make teaching easier?

4. Do you believe computers will degrade the professional status of teachers?

5. Are you concerned about computers dominating education and possibly becoming more important than the teacher?

6. In your opinion, will computers become a worthwhile and efficient instrument for instruction?

Hypothesis

"There is no significant difference in the future-role conceptualizations between the three groups of Texas community college technology instructors categorized as:

I. Non-experienced,
II. Experienced,
III. Specialists,

in the use of computers as components of instruction."

<u>Outline of Procedure</u>

The investigation and evaluation of differences between three categories of technology instructors' conceptualizations of their teaching roles for computer-related instruction in future programs of Texas community colleges was performed in listed sequence:

1. The target population was determined.

2. A stratified-random sampling of the population was obtained.

3. A questionnaire was designed to obtain the conceptualizations of each of the instructors included in the sample.

4. Individual copies of this survey instrument were presented to a randomly-selected pilot group of instructors available in the local Houston metropolitan-suburban area. This was done to test for instrument validity and reliability.

5. A final refined evaluating document was mailed to each of the selected sample subjects. A glossary of the terms used was included in the mailing.

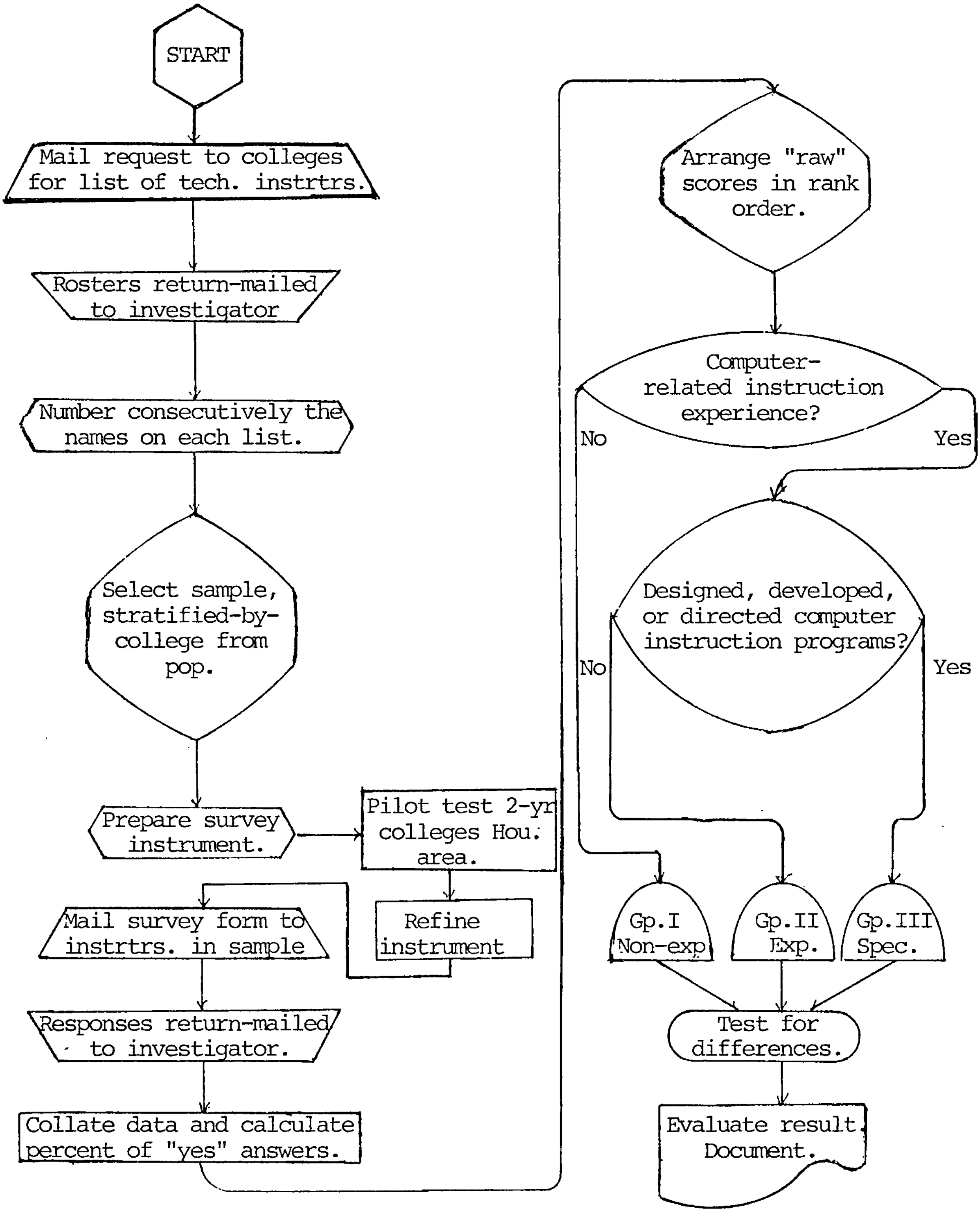
6. The data in the responses were analyzed by using the Kruskal-Wallis rank-ordered analysis of variance[1] applied over the three experience categories of instructors; (a) the specialist, (b) the experienced, and, (c) the non-experienced.

7. Comments on the research subject were solicited for later comparison and evaluation.

A flow diagram of the data collection and treatment process is illustrated in Figure 1.

Figure 1

DATA COLLECTION AND TREATMENT FLOW CHART INSTRUCTOR CONCEPTS - COMPUTER-RELATED INSTRUCTION



The Population

Rosters of personnel were requested and obtained by mail from the technology department chairmen at the fifty-three community colleges of Texas offering technical instruction. The technical faculty population so obtained totaled one thousand six hundred and fifty-eight (1658). The rosters of personnel that were furnished, in a number of cases, did not differentiate between instructors and non-teaching personnel. Therefore, adjustments and reselections had to be made wherever the initial sample selections were revealed to have included non-teaching staff. Cases in point included registrars, computer operators, secretaries, non-teaching administrative personnel, and ex-faculty members. Those identified as inappropriate candidates were approximately ten percent of the aggregate sample. In due course, these ineligibles were eliminated from the final sample set.

The Population Sample

To reflect accurately the nature of the population of instructors and their conceptualizations, the evaluated sample would have to be representative of the technology teaching faculty of every school considered for the test. For this reason, a stratification of the sample was accomplished by making randomized selections from each individual college faculty roster. The instructors selected from each school were then combined to form the total sample. By treating each roster of personnel separately, and taking the nearest onetenth (plus one for fractional tenths), an integral number of sample subjects was determined for each school. Allowing for the ineligibles as described in the preceding paragraph, an overall aggregate sampling of between ten and eleven percent was expected. Actually, the final sample percentage of total population proved to be 10.1%. Random selections for this approximate ten percent of instructors from each college were made (as described above) from each list by using an abridged index of random numbers[2] taken from Table 33 of R. A. Fisher and F. Yates' Statistical Tables for Biological, Agricultural, and Medical Research, (Edinburgh: Oliver and Boyd, Ltd., 1953). The selections were made using the following procedure:

1. A page from the list of random numbers was selected.

2. A pointer was directed and then moved forward to a randomly-selected area of the chosen page.

3. Using the number-group nearest the pointer contact with the page as a starting point, then counting off a chance number (usually 3, 4, 5 or 6) of number-groups to the right, or left, or up, or down from the starting point, a number-group was finally chosen. This list number was referred back to the particular instructor roster.

4. The numerical order of the name on the list matching the chosen number determined the subject selection to be used in the sample.

5. This process was repeated, using the last number-group chosen as the new starting point, until the required 10% of the particular list was selected.

The Survey Instrument

The survey questionnaire was constructed so as to permit conceptualization comparisons of each set of responses on traditional-to-new teaching roles. Examples of these comparisons are:

a. Developing and using learning strategies versus preparing and delivering lectures.

b. Program monitoring and control versus lesson assignment and lecture discussion.

c. Subject-enrichment activities versus narrowly-structured curricula.

d. Creative investigation versus restriction to fundamentals.

e. Guidance toward exploration and discovery versus textual, historical, and traditional review.

f. Person-to-person instruction and counseling versus generalized group discussions of subject matter.

g. Individual-progress monitoring versus group examination and evaluation.

h. Optimizing individual potential versus maximizing group performance.

i. Advising on expected individual behavior versus maintaining group discipline.

j. Evaluating individual learning versus analyzing group performance.

k. Designing programs with parallel learning branches and recycling loops versus assigning additional drill and practice wherever deficiencies occur.

The survey instrument totaled fifty questions which were to be answered "yes", "no", or "don't know". Thirty questions dealt exclusively with conceptualizations of future teaching roles. Answers to this group of questions were used in the statistical evaluation. Two questions in the questionnaire were worded for determination of group classification, i.e., Group 1 - Computer Instruction Non-experience, Group II - Computer Instruction Experienced, and, Group III - "Specialist".

The remaining eighteen questions concerned background and attitude of the respondent. These were included to provide data for the later development of tabular and charting information as described in Chapter Four. A copy of the complete instrument is included in Appendix B.

The survey instrument, a letter of transmittal, a glossary of terms used, a blank comment sheet, and a return-addressed, stamped envelope were mailed to each sample subject/instructor. A follow-up letter to prompt lagging responses and to convey appreciation for participating in the study was personally addressed and mailed two weeks after the initial mailing to all members of the sample group. Copies of all documents are attached as Appendix B.

Data Collection Procedure

Individual role concepts of each member of the total population sample were obtained by mailing to each instructor so designated a set of questions designed to be answered "yes" or "no". The respondents were asked to return the completed answer sheet to the investigator.

The questionnaire was constructed to obtain data concerning:

a. Experience with computers as components of instruction. The answers obtained determined classification into three sub-groups:
   - Group I - No experience with instruction using computers.
   - Group II - Experienced with instruction using computers.
   - Group III - "Specialists." (Those instructors whose activities have included course development, instructional responsibility

and/or other direct involvement in developing computer-aided instruction programs.

b. Individual instructor's opinions on whether computers will be or will not be integral parts of technical education in the two-year-level college within the next five years.

c. Individual instructor's answers to a variety of questions on role changes when and if computers become components of instruction in their teaching program. The questions used in this survey concern equipment, materials, technical design, record-keeping, environment, reinforcement, instructor/student interaction and evaluation of learner performance. Careful attention was given to phraseology used in the questionnaire so as to minimize mis-understanding and encourage a direct and positive response. Terms of dubious interpretation were operationally defined to reduce measurement error; the goal in the instrumentation was simple construction to permit a quick and accurate response with least effort on the part of the respondent.

d. Personal opinions on why, if such were the case, there was a lack of experience with computer instruction. A supplemental section of each questionnaire asks only those who have no experience with computer instruction why this is true in their case. If the cause happened to be equipment unavailability, lack of necessary training, incompatibility with the existing curriculum, or was simply due to a mistrust or disinterest, the answers furnished were a source for tabular and charting data of real value to this study. Extremely-biased answers are analyzed and evaluated in the final chapters as set forth here to determine and account for possible skew effects in the statistical treatments that were undertaken as a part of the study.

e. Personal background information which would provide peripheral data for determination of the causes for biased answers - either positive or negative in scope.

f. Prior to the main data-collection from all of the Texas community colleges, a preliminary pilot test was made to assess and improve measurement validity. The pilot test was conducted separately; there was no direct relation to the main test that was to follow at a later time. Using the "split-half technique" described in Appendix D, correlation measures were made to determine the coefficient of correlation (Pearson "r").

The population sample, consisting of technology instructors selected by the stratified-random technique previously described, numbered one hundred and sixty-seven. The actual number of completed and returned responses to the questionnaire totaled one hundred and twenty-two. This was 73.1% of the requests initially mailed.

There was some concern that sampling errors would affect the overall test results. The two chief sources of sampling error are: (1) inaccuracies in response, and, (2) non-response. In the first case, asking a person how he conceptualizes his own performance in the future might imply that a response is desired based on some official or expected outcome. Feelings may exist also that the inquiry is a personal threat to the status in quo and to future job security. In other words, the respondent might be deluded into thinking the results of the questionnaire will have effects that will determine future events.[3] The letter of transmittal that was sent along with the questionnaire was written so as to allay such feelings. In the second case, instances where there was a shallow or no response were followed up by a second request on a person-to-person basis. A stamped and self-addressed envelope was included in each mailing.

Treatment of Data

The first step in processing the returned responses was to calculate the "raw" score of percentages of "YES" answers for each return on the set of thirty "conceptualizations" questions. The scores were then arranged in decreasing order of the percentages - the proportion of "YES" answers to the total number of questions on conceptualizations determined rank order from high-to-low for each of the respondents in the population sample. With a sample as large as the one used, several identical percentages likely would, and did, result. This required special treatment to assure equal consideration for all respondents. This problem was resolved by assigning equal ranks of intermediate value (ranks that were tied were given the average value of the ranks they would ordinarily occupy). This was necessary, as each rank assigned for the test needed equal weighting for reliable evaluation.[4] In cases involving identical scores, the total sum of ranks still would equal the total number of subjects in the sample, regardless of the existence of identical values in percentages and ranking. The tied ranks favor a lesser variation than truly exists, and small corrections were made to account and correct for this happenstance.[5] (Correction calculations are shown in Appendix C.)

All members of the population sample, regardless of group assignment, received the same treatment in the determination of rank order percentages of "YES" answers to the total number (30) of role-conceptualizations questions. The assigning of ranks agreed with the accepted procedures for applying the Kruskal-Wallis Analysis of Variance.[6]

The members of the three groups, namely, Group I (the non-experienced), Group II (the experienced), and Group III (the specialists), were charted in column array for the statistical comparison of differences in mean values using the Kruskal-Wallis Analysis of Variance.

A Kruskal-Wallis Analysis of Variance was also done for the pilot sample to compare differences in the pilot group with differences obtained from the population sample in the main investigation. The sole purpose of this comparison was to determine if there was a kinship between these groups that would relate back to the parent population of technology instructors. (This evaluation is described along with other data on the pilot study in Appendix D.)

The facilities of the Department of Data Processing, Division of Technology at Alvin Junior College were offered and gratefully accepted for the processing of data. With the help of the college computer center personnel, a computer program was developed for the reduction of data and the consequent determination of the "H" value of significance using the Kruskal-Wallis Analysis of Variance procedure. The hypothesis tested, observations that were noted and charted, the computer program that was developed and utilized, and the consequent statistical results are described in Chapter IV and in Appendices A and C of this study.

Summary of Techniques and Procedures

The operations and methods used in this research study were laid out along conventional lines for this type of field survey. The target population, consisting of all of the technology instructors in the community colleges of Texas, was chosen for this research effort because of ready accessibility and a proven willingness to cooperate in unusual fields of investigation. This population was sampled, using conventional randomized selection techniques, on a college-by-college basis. The sample of the total population was subjected to the Kruskal-Wallis test for variance.[8] A determination was made of the differences between the conceptualizations of future teaching role of technology-instructor non-experienced, experienced, and specialist in computer-related instruction. The data that was gathered from the population of Texas community college technology instructors was machine-processed, using the facilities at Alvin Junior College in Alvin, Texas. Result and analysis of the tests that were made are treated in detail in Chapter IV.

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Chapter IV

ANALYSIS OF DATA

Synopsis of Results

This investigation was conducted in the junior/community colleges of Texas. It was primarily concerned with the conceptualizations of three categories of the technology instructors concerning their teaching roles if computers were extensively used as components of instruction. This study compared viewpoints of the non-experienced with the experienced and specialist on teaching roles using computers for instruction. A notable finding was that technology instructors in the Texas colleges, whether experienced or inexperienced in computer instruction, held similar views and expectations regarding the future implementation of these devices as instructional tools. It was discovered the respondents of the survey were affirmatively inclined toward the proposition of computer-aided instruction. In the test performed on the population sample, the statistical results revealed a homogeneity of opinion without significant differences between the three groups considered in the test. Negatively-biased opinion among those of the sample group who were inexperienced in computer instruction did not materialize to any notable degree. The study results show that community college technology instructors agree with the specialists already in the field on the specific changes that will take place in their teaching role when computers are incorporated in their instructional programs.

The responses to the survey indicate that Texas two-year college technology instructors have a positive outlook toward computer instruction. Approximately two-thirds of the sample subjects polled (eighty-six of one hundred and twenty-two) were without experience or preparation in computer techniques and the applications of computing machines for instruction.

The survey responses indicated doubt about the real benefit and the financial soundness of computer-assisted educational programs. The apprehensions that were expressed were mostly concerned with the mis-use and the cost-effectiveness of computer teaching media. These relationships of opinion are charted in the following pages of this chapter.

The Pilot Investigation

The preliminary pilot survey was undertaken to check the validity of the measure to be made with the research instrument. This pre-test of the questionnaire served as an indicator of defects which could be corrected or taken into account before the dissemination of the research instrument in the main field test. Comparing two halves, randomly determined, of a small (18) pilot sample, two different measures of correlation were made. The first measure showed a correlation ratio of 0.9625; the second measure produced a correlation value of 0.85, which confirmed the first measure. The pilot survey for validity is detailed in Appendix D.

Statistical Evaluation

The Kruskal-Wallis One-way Analysis of Variance Test[1] was applied to evaluate differences in conceptualization of future teaching roles of instructors using curricula involving electronic computers. Evaluations were made between the non-experienced, the experienced, and, those with design developmental experience, classified as specialists. These categories were labeled Group I, Group II, and Group III, respectively, for all tests and investigations. Statistical calculations are attached as Appendix C: details of procedures were described in Chapter III.

A test was performed on this hypothesis:

> "There is no significant difference in future-role conceptualizations between the three groups of instructors categorized as:
>
> I. Non-experienced,
> II. Experienced,
> III. Specialists,
>
> in the use of computers as components of instruction."

There were eighty-six instructors in the sample who had no experience with computer instruction. Thirteen instructors had participated in educational programs using computers. Twenty-three members of the sample professed experience in designing, developing, and administering computer instruction programs. Group assignments were made by categories of experience. Group I contained the non-experienced; Group II consisted of the instructors with experience in machine instruction; Group III was made up of instructors who were specialists in design, development and in administration of computer instruction programs.

The Kruskal-Wallis Analysis of Variance[2] was applied across the three groups, comparing individual rank-order in a one-way test of differences. The analysis yielded a chi-square "H" equivalent[3] value of 3.7214. This was compared to the table value[4] of 5.991 at the .05 level of significance, with two degrees of freedom. The value of 3.7214 obtained was not significant. The hypothesis is tenable in this case. (The calculations and the computer routine used in this analysis are explained in Appendix C.)

Distribution of Scores

The frequencies of scores for the total sample of one hundred and twenty-two instructors were plotted over the rating range of zero to one hundred percent in the broken line graph of Figure 2. The scores show a normal distribution, with minor bunching of scores at the higher percentages of the rating range.[5] The slight negative skew (positive emphasis) of the distribution may be attributed to the larger number of positive responses from Groups II and III, the sample subjects having experience with computer-instruction. The column display of the three groups, separated by categories, is illustrated in Figure 3. As pictured in Figure 3, the larger non-experienced Group I (eighty-six subjects) shows a normal distribution, whereas Group II (thirteen subjects) and Group III (twenty-three subjects) are skewed. Biased responses were minimal. Although there were but few totally, a greater number of low

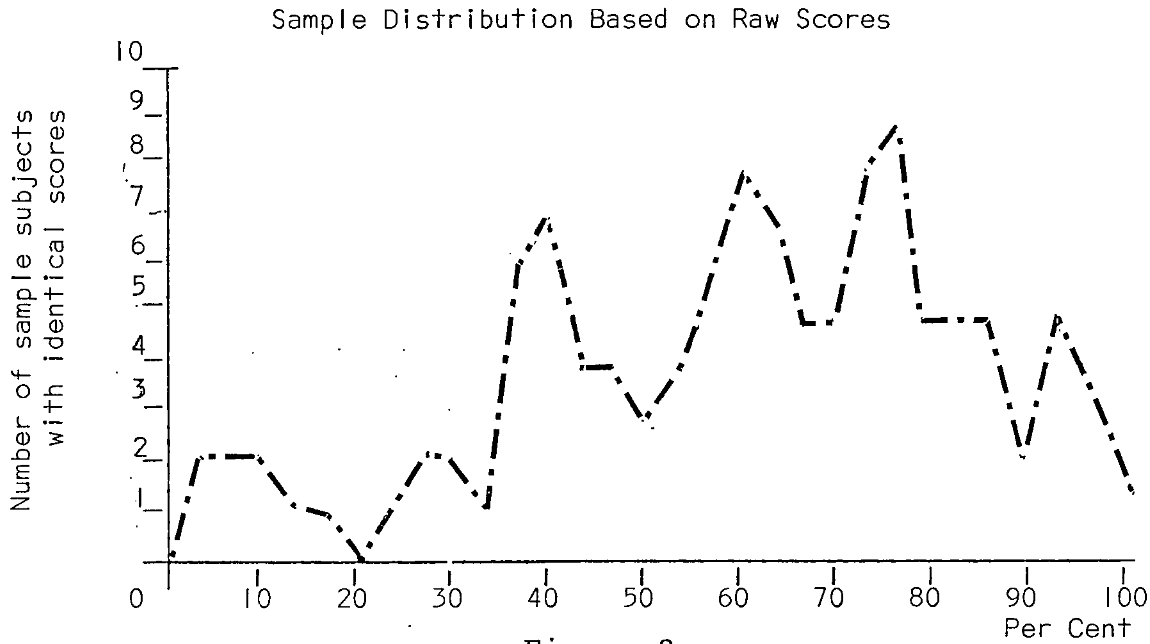

Figure 2

Total Sample - 122 Instructors

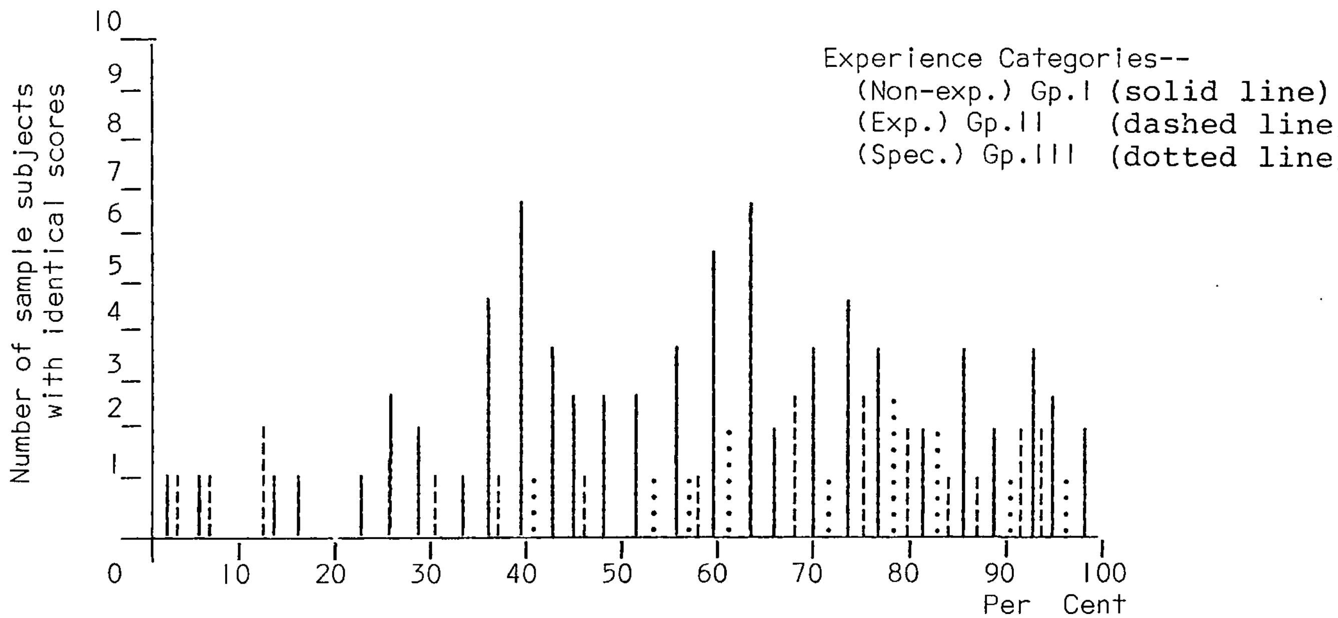

Figure 3

Separate Groups - $S_I = 86$, $S_{II} = 13$, $S_{III} = 23$

scores were derived from sample subjects professing specialist classification (Group III) than from the experienced (Group II) and the non-experienced (Group I) sectors.

Survey Responses on Relevant Factors

The survey instrument included items for determining instructor perceptions of electronic computers in general and of computer instruction in particular. Soundings were made on the extent of fears and apprehensions perceived in facing the prospect of electronic computer incorporation in the educational curriculum (questions number 14, 15, 47). Conceptual ideas on the imminence of change, on the integration of computers in the instructional process, and on the speed of the development were investigated (questions number 11, 12, 46). The teaching experience of the sample membership was catalogued for comparative reference (question number 1). Individual concepts of cost and effectiveness were probed (questions number 48 and 49). The sample subjects of the non-experienced group in particular were queried on their current involvement and association with computers and computing processes in related areas (question number 45). Attitudes toward computing devices as facilitators of work activities were examined (question number 13). Data on these aspects of conceptualization were tabulated and charted in order to give an insight on prevailing thought among the Texas community colleges technology instructors. Answers were sought on beliefs of the subject instructors on how well the computer-teaching human-teaching partnership of the future will work (question 50). The questions referenced are listed by number in the survey instrument, attached to this study as Appendix B.

Perceptions of Non-experienced Group on Computer Instruction

In the planning and design of the survey instrument, it was decided to include a means of determining any significant bias which could affect results. The human trait of perpetuating the familiar established methods, along with the characteristic mistrust of the new and the unknown could prejudice the attitudes of the sample members. This would apply particularly to those without any association or experience with computer-aided instruction. To appraise the extent of any antagonistic feelings toward computers in education, a series of five questions were incorporated in the survey instrument. (Questions number 45, 46, 47, 48 and 49.) The questions referred to are shown in Appendix B.

A branching operation was provided in the questionnaire to single out those who had no previous experience in machine instruction. The answers to this set of questions revealed no fundamental bias or aversion to computer usage. The responses to these questions are charted in Figures 4 and 5.

Opinion Comparisons Between Groups

This study of the population sample indicated agreement of opinion between the three self-assigned groups, in many areas. A presumption that the instructors in the sample who

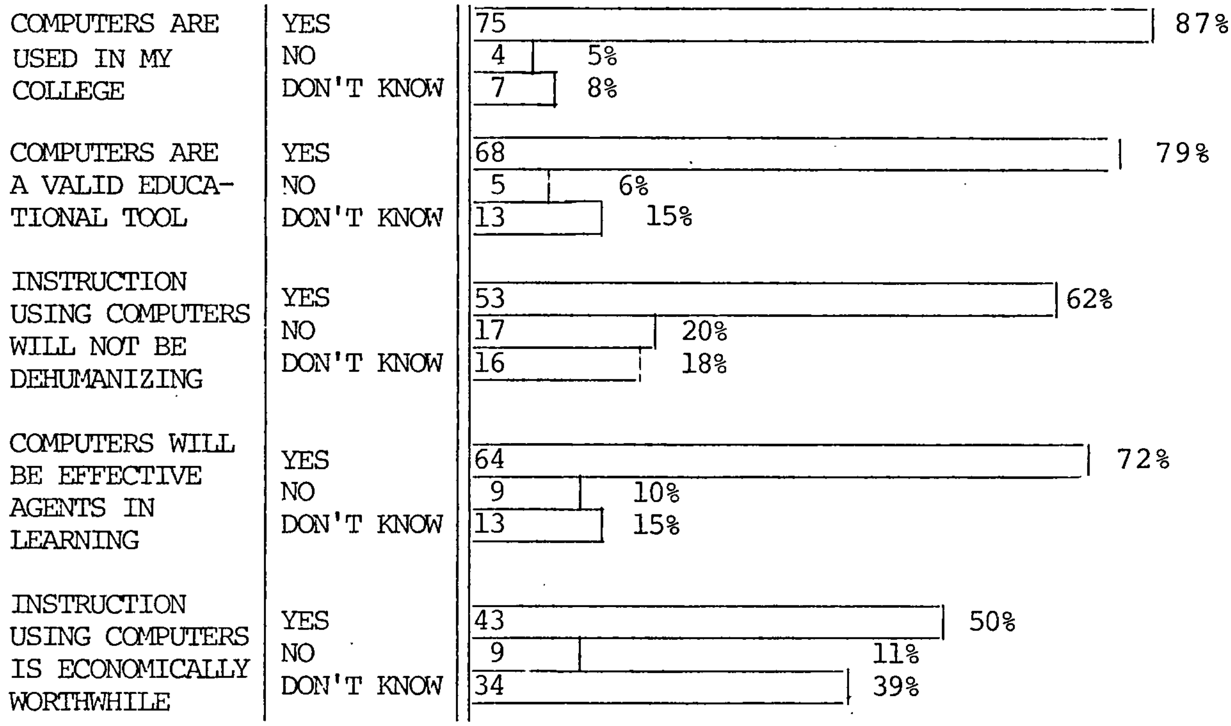

Figure 4

Perceptions - Non-experienced Group I

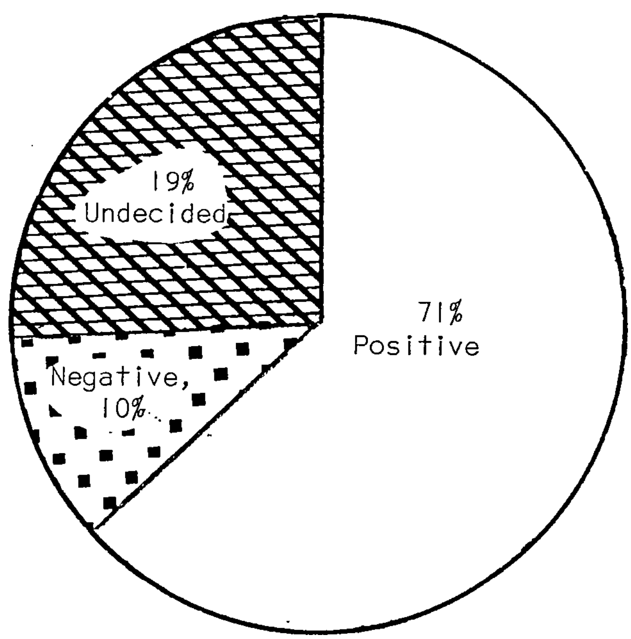

Figure 5

Non-experience Group I Perceptions - Cumulative Totals had no experience with computers would have widely-differing conceptions from those instructors in the experienced and specialist groups was found to be wrong; the survey did not support this contention. Although there were differences and some indecisiveness amongst individuals in answers on specific points, these responses were distributed among groups and not concentrated in any one of the classifications. Concepts reflected in the responses showed a kinship between groups that was noteworthy.

The question was asked, "Have you taught professionally for three years or longer?" (question number 1). The answers indicate that a large portion of this population are experienced educators. Figure 6 compares teaching experience in graphic relation.

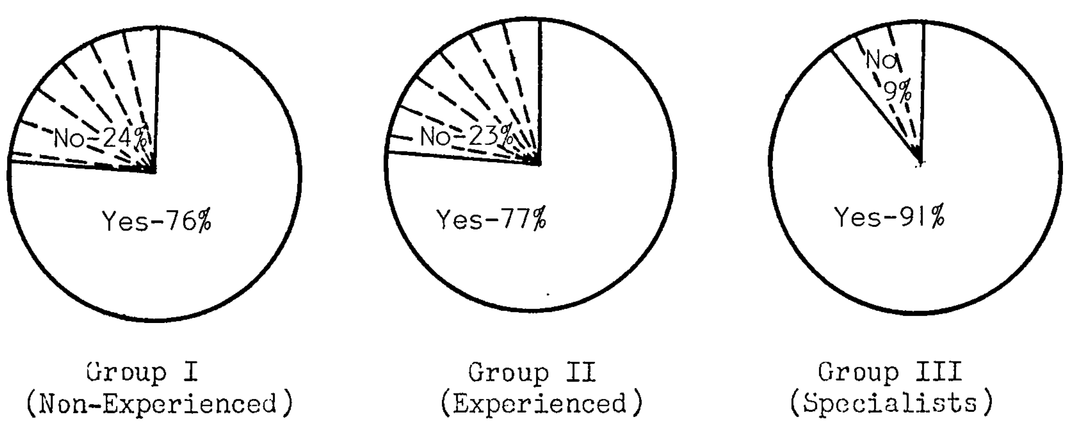

Figure 6

Teaching Experience More Than Three Years - Percentages "Yes" and "No"

According to the tabulations made on the sample, a majority of the technology instructors of the junior colleges of Texas feel that "computers will be a significant component of technical instruction within the next five years." Of the one hundred and twenty-two sample subjects queried, eighty-eight, or seventy-two percent agreed with this statement. Eleven percent (13 subjects) disagreed, and seventeen percent (21 subjects) were non-committal. A break-down of the expressed views in each group on this contention is displayed in Figure 7. (In considering the three pie charts which represent the three groups of the sample in Figures 6, 7 and 8, it must be remembered that these groups have unequal membership.)

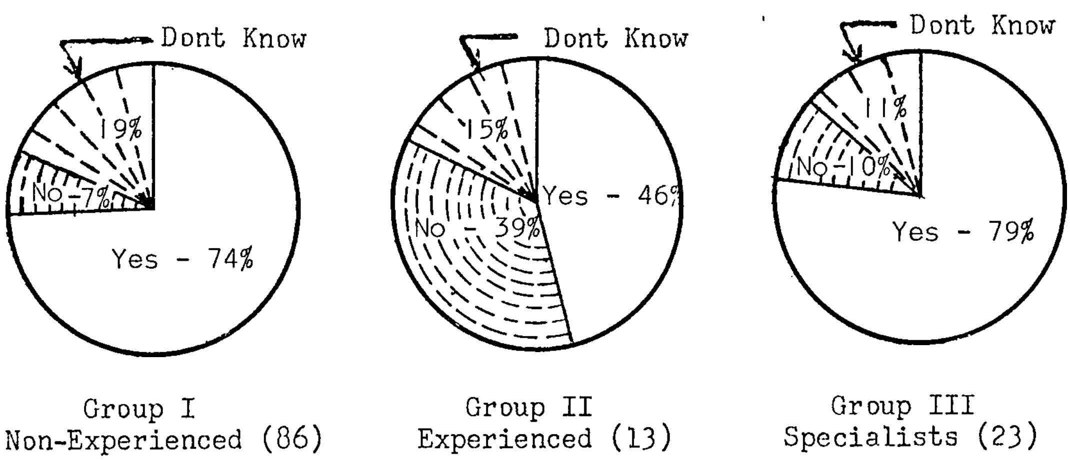

Figure 7

Computers As A Significant Part of Instruction in Five Years

The findings show the majority of the technology instructors of Texas community colleges favor the early adoption of computer-aided instruction: at least, this segment of the teaching fraternity seems resigned to the idea of working with computers in education.

The survey instrument contained another set of five questions that were directed to all sample subjects for the purpose of assessing trends of thought on the future of mechanical or electronic teaching media. Response data was broken down and assigned according to group classification. The set of questions and the responses for the three groups are shown in Table 2. Proportions of cumulative response on the set of five questions for each of the three groups are depicted in Figure 8.

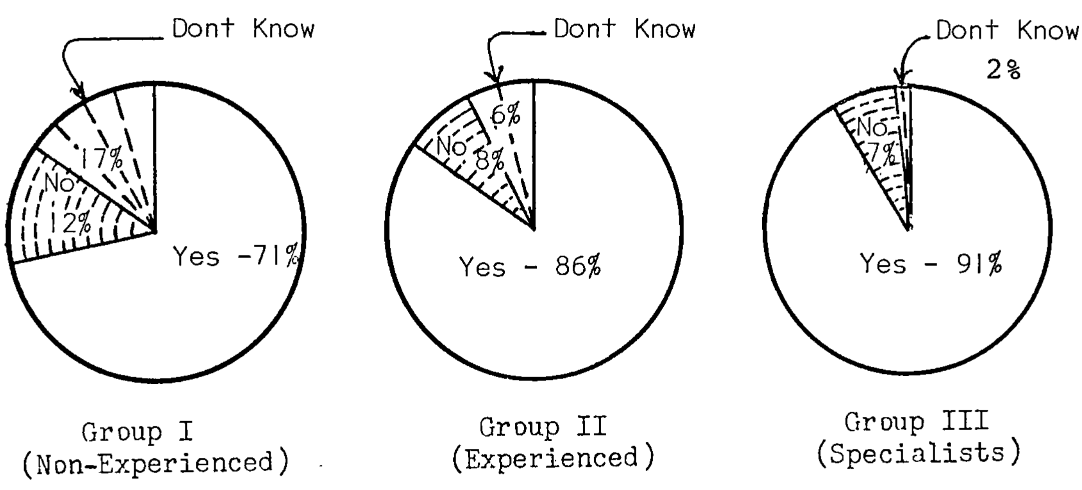

Figure 8

Consolidated Response by Groups -
Views on Computers Relating to Instruction

Table 1

VIEWS ON COMPUTERS RELATING TO INSTRUCTION BY GROUPS

	Survey Question Number	Statement
1.	50	Computer instruction is not just a passing fad.
2.	14	Computers will not degrade teacher status.
3.	15	Computers will not become more important than teacher.
4.	13	Mechanical media will help to make the teaching job easier.
5.	12	Quality of education will improve with increased computer usage.

Responses

	Non-Exp. Group I			Exp. Group II			Spec. Group III		
	Yes	No	Don't Know	Yes	No	Don't Know	Yes	No	Don't Know
1.	62	12	12	13	0	0	22	1	0
2.	70	5	11	12	1	0	22	1	0
3.	71	5	10	12	1	0	22	1	0
4.	67	12	7	10	0	3	19	3	1
5.	36	15	35	9	3	1	18	4	1

Summary of Findings

The examination and analysis of data obtained in this survey of conceptualizations of technology instructors of the community colleges of Texas brought forth a number of conclusions. The first and foremost of these observations showed the teaching professionals were alike in opinion on their future teaching role with computers as components of academic programs. The analysis of variance[6] revealed no difference of a significant value in concepts of teaching functions with machine incorporation. Comparisons between the three groups - the inexperienced, the experienced, and the specialists - showed viewpoint similarities.

The respondents to the survey sample were generally in favor of, or at least convinced of, a soon-to-be implementation of instruction with computers. The test sample indicates the population from which it was taken is composed, in large part, of career teachers. The data indicated the Texas technology instructors are not apprehensive of this prospective innovation; in fact, the finding here was the majority welcomes such a curricular change. Computer-assisted instruction is viewed as a beneficial development for education and a worthy adjunct to the teaching function.

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[2]Ibid.

[3]Allen L. Edwards, Statistical Methods for the Behavioral Sciences. (New York: Rinehart and Company, 1956), 423.

[4]Ibid., 500.

[5]J. P. Guilford, Psychometric Methods (New York: McGraw-Hill, 1936), 255-259.

[6]Kruskal and Wallis, loc. cit.

Chapter V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Need for the Study

This study examined and evaluated the personal conceptualizations of future teaching roles of technology instructors in the community colleges of Texas on the proposition of computer instruction in their academic programs. These questions were asked: (1) What changes in teaching roles do the instructors think are likely to occur? (2) If computers as components of instruction achieve widespread acceptance in the near future, would this important segment of the nation's educators, namely, the technolgoy instructors of Texas community colleges, be prepared for and receptive to the transitions of roles? These questions are timely and they beg for answers. This research effort sought to resolve these questions.

Problem Statement and Purpose of the Study

The purpose of this undertaking was to acquire and organize data and assess differences in conceptualizations between three experience categories of Texas community college technology instructors on their possible future teaching roles using computers as components of instruction. By comparing differences between (1) the non-experienced, (2) the experienced, and (3) the specialists (who would have insight into the constituency of future computer-instruction ancillary teaching roles), the readiness and receptivity for such a happening was measured. This study effort is considered to be only a mere beginning; it could lead to many other studies directly and indirectly concerned with the human part of modern education involving the use of computing machines.

Examples of study development are listed below:

1. Adaptations of courses in education to new computer-related instruction requirements.

2. Development of curricula for computer instruction.

3. Computer-instruction educational programs for instructors.

4. Course design for teacher education in computer techniques.

5. Preparatory student instruction for self-paced-learning using computers.

6. Computer programs for projects in creative thinking.

7. New methods in education using computer instruction.

8. Design criteria for computer programs in education.

Limitations of the Study

Vertical generalizations (the possibility of using the results of this study at other educational levels such as high school and four-year college or univeristy) may be worthy of consideration. However, determination of any relationship beyond the Texas junior colleges is outside of the scope of this study. Lateral similarity of results (assumptions that other two-year level community colleges outside the State of Texas are subject to the results of this study) is more likely.

These, too, are left for further investigational research. In either case, external validity would have to be qualified statistically before any extension of results could be assumed.

Research Procedure and Data Collection

There were fifty-three community colleges offering technology instruction in the State of Texas from which data was available for this study. Rosters of technology faculty were requested and obtained from these schools. Random samples were taken from each school list. These samples were combined to form the stratified-random sample of instructors of all the Texas colleges.

A survey questionnaire was developed to serve as the evaluating instrument. Validity correlation tests were made on a pilot group of instructors randomly-selected in the metro-suburban area of Houston, Texas. Personal interviews with members of the pilot group were made to enhance and refine the test potential of the survey instrument. The questionnaire was then mailed to the population sample of instructors. Responses were processed to obtain raw scores in percentages of "yes" answers to the conceptualizations questions of the survey instrument. These scores were rank-ordered and classified into the three experience categories: I. The Non-experienced, II. The Experienced, and, III. The Specialists. The Kruskal-Wallis Analysis of Variance[1] was applied to determine significant difference at the 5% level between the three groups.

A number of perception-evaluating questions were included in the survey instrument. These were used to acquire response data for tabulation and charting. The viewpoints of the questionnaire respondents were solicited for review in the "comments" section of this chapter.

Summation of Results

The null hypothesis of the research study stated:

> "There is no significant difference in future-role conceptualzations between the three groups of Texas community college technology instructors categorized as:
>
> I. Non-experience,
> II. Experienced,
> III. Specialists,
>
> in the use of computers as components of instruction."

A statistical treatment using the Kruskal-Wallis Analysis of Variance[1] was applied to this hypothesis. The result of the analysis showed no difference of significance at the .05 level. With two degrees of freedom, an "H" value of 3.7214 was obtained, which is within the table value[2] of 5.991 for a significant variation of mean values between groups. The substantiation of the hypothesis statement implies that the population of technology instructors of Texas community colleges recognize and indorse the authoritative opinions of what teaching roles will be with the incorporation of computer instruction in classroom/laboratory curricula. One-third of the total or responding instructors (33%) were not sure or did not believe that computers in education were effective agents of learning. Expressed opinions showed more of a concern for defects in application or method, rather than witholding indorsement of the process itself.

Some doubts existed, particularly on the part of the computer-inexperienced instructors, on cost-versus-value of computers for instruction. Those who were unconvinced totaled about 10.5% of the group. The ones who were not sure of value/ cost balance summed 39.5% of the total of the inexperienced group. This left exactly half, or 50%, who believed instructional computers economically worthwhile. The specialists (Group III) and the experienced (Group II) were not questioned on these points. Responses to questions about computers improving the quality of education, and having a lasting effect on education show favorable agreement for better than 70% of the total population sample.

The responses to questions concerning the instructional computers' fundamental efficacy, environmental improvement, reduction of workload, disbelief in status degradation and in dominance of teaching field brought predominantly positive answers from all three experience-level categories. Generally, the instructors of the population sample were not fearful of computer-instruction development; they have a basic understanding of their future teaching roles that compares favorable with the experts. In response to the question of computers becoming an integral part of education, the majority of the instructors polled believe that extensive computer instruction will come to pass and that it will happen within the next few years.

Discussion of Comments

The survey instrument included a request for comments from the respondent, and a blank sheet was attached to be used for this purpose. Design specified that the instrument be objective for reasons of directness, clarity, and simplicity, both in responding and in evaluating. This left little or no opportunity for shades of opinion, and the "comment section" was included to provide opportunity to express other degrees of perception and personalization.

Many worthwhile thoughts were recorded in this part of the response. The comment that was noted as appearing most often was that computers are useful instructional tools, but careless or inept handling could destroy their usefulness. Inept handling could establish a mis-trust and aversion to the whole idea of computer-aided instruction - an idea that most of the instructors polled were in favor of as a valuable adjunct to accelerated and expanded learning. Comments typically expressed on use and application were:

> "Computers must be utilized appropriately to be effective.
>
> "Computer-assisted instruction may become a victim of careless and ineffective planning."
>
> "Computers will definitely be an assist to the instructors if the instructor understands its uses."
>
> "Computer-aided instruction, like any modality, can be misused and dehumanizing."
>
> "Tools are only as good or bad as the people using them."
>
> "Yes, computers would or could help if done in the proper way."

"Faculty preparing to use CAI must be adequately prepared in its strengths and pitfalls if it is to be effectively used as a part of the curriculum."

"A surgical instrument in the hand of a professional skilled practitioner can mean the difference between life and death for the patient."

"Instructional computers are nice but can be a trap if not used properly. They should be integrated into a system including:

Specialized Text Materials
Audio-visual Materials
Practical Demonstrations
As much "Hands-On" Lab as possible
Personalized attention to the needs of each student."

"No media aid is a 'gadget' or 'sophisticated tool' if properly utilized. Only through ignorance of the unknown have teachers made such rash statements as 'dehumanizing' and 'gadgets'."

"Computers will definitely be an asset to the instructor if the instructor understands the uses."

"... remember the big excitement over CCTV (closed-curcuit television) - a videotape lesson displayed on a CRT (TV Tube) is not as cheap as a training film and when amateurs create home movies with video tape, the lesson is probably not as effective. CAI may be a victim of the same careless and ineffective planning and use."

"This of course depends on the material covered and the ability of the instructor to use this tool - like any other educational tool, it will be used and abused."

"We are considering implementation of computers in instruction of our vocational-technical courses. At the present time, the extent of this is not known, but I feel that this could be a very effective teachers' tool."

"We use test questions compiled by us, put on computers, chosen when appropriate for us, and have them run off on the computer. We find it very effective and helpful (time-saving) when making tests. To really be most effective, the questions should be revised, renewed, etc., periodically, which we really have not had the time to do."

"I do see considerable value in using well done programmed instruction, even in courses such as salesmanship, human relations, and communications."

"Computers [will be] useful for certain learning situations. They may be economically feasible. I have some apprehensiveness on CAI as another novelty not seriously applied."

"My answer to Question #50 was no. However, depending on the quality and simplicity of the programs made available to vocational instructors, and their availability in specific vocations will determine their usefullness. By 'simplicity of the programs,' I do not imply that the subject matter should be simple - only the apparatus which serves to aid the instructor."

"Much educational innovation seems characterized by false starts, vague objectives, and lack of disciplined leadership. But the potential is so pervasive and the implications of the computer as a tool cuts across such a wide range of activities associated with the educational process, that the long range effect will happily be helpful. But I think a lot of money and effort is and has been invested in activities considerably below this potential. I think it will be a good sign when we stop thinking of the computer as a machine to put 'something on' and regard it as an alternative tool to consider for reaching educational goals."

One worthy comment dealt with actual experiences with computer instruction:

"The students were exposed to much more material, without increased time requirements being placed on the instructor. Students were able to pace themselves through certain phases of course material, etc. The 'feedback' from instructors and students has been most encouraging."

Approximately one-half of the instructor sample expressed their thought on what they believe the situation will be like under computer-related instruction. Some offered suggestions based upon their own experience. Less than seven percent expressed concern over subversion by the machine; a few were worried about the dehumanizing effects of machine instruction.

Four instructors expressed some fear of the computer, particularly about the possibility of the "giant brain" taking over the job of the human teacher.

The foregoing comments by the survey respondents are concise and to the point; any further elaboration would be superfluous. These contributions to the research effort are appreciated sincerely and the depth of thought expressed by the many anonymous contributors in Texas college technology education does indicate a great interest in the subject of the study. The comments that were made show a personal concern in the application and use of computers in education. The instructors of the population sample projected their own teaching roles, thereby disclosing their pragmatic outlook and an objectivity that implies a belief that computers will certainly become a real part of the educational scene.

Conclusions and Recommendations

According to the research results, the consensus of the population of technology instructors of Texas community colleges was that computers will soon be an important factor of technology education. Furthermore, these educators show agreement on future teaching roles with involvement of instructional computers that closely approximates the views of experts already in the field. The study also discloses that the members of this population of instructors are predominantly career teachers with years of experience. They tend to favor the use of instructional computers in academics. They believe computers are effective components in education - that computers are physical instruments for human betterment, and that they are not mystical devices possessing an intelligence that might dominate the educational process.

In every investigation that is carried forth to a conclusion, there are resultant products. The obvious question that appears is, "Of what use are these products of research?" True, they add to the store of knowledge, but can they also be used in planning and in directing action? In the case of this study, the major disclosure was that the majority of the technology instructors of the Texas community colleges are cognizant of what their duties might be with computers assisting instruction.

Another significant fact brought out in the data search is that 71% of the instructor population are untrained for the computer-involved curriculum. This implies a comprehensive educating program is needed prior to widespread implementation. It is believed that the upper-level colleges of Texas that offer teacher education should start now to develop and implement, at the earliest possible time, courses that take into account computer-assisted instruction.

Comprehensive programs should be implemented that relate computer techniques to:

1. Individual learning.
2. Program diagnostics.
3. Prescription.
4. Drill.
5. Reinforcement.

6. Performance analysis.
7. Scheduling.
8. Problem construction.
9. Problem analysis.
10. Problem resolution.
11. Open-ended study.
12. Research in education.
13. Development of the as-of-now unprecedented student-inspired creative activities that are altogether possible with demand-structured programming.

Undoubtedly, there are many other possibilities of application for which teaching faculty should be prepared. Teacher education should be oriented to take into account the exciting probability of computers performing a vital role in future instruction.

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[2]Allen L. Edwards, Statistical Methods for the Behavioral Sciences, (New York: Rinehart and Company, 1956), 500.

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Appendix A

STATEMENT OF NULL HYPOTHESIS

Appendix A

HYPOTHESIS

There is no significant difference in the future-role conceptualizations between the three groups of Texas community college technology instructors categorized as:

I. Non-experienced,
II. Experienced,
III. Specialists,

in the use of computers as components of instruction.

Appendix B

THE SURVEY INSTRUMENT AND ASSOCIATED CORRESPONDENCE

UNIVERSITY OF HOUSTON
CULLEN COLLEGE OF ENGINEERING
HOUSTON, TEXAS 77004

CURRICULUM AND INSTRUCTION

Dr. Joseph A. Airola
North Harris County Junior College
12620 North Freeway
Houston, Texas 77037

Dear Dr. Airola:

I am writing to ask your help in completing a research study on computer-related-instruction conceptualizations of instructors in technology in the junior or community colleges of Texas.

I need a complete list of technology instructors at your college (only the names of instructors will be required). From this list I intend to make random selections which will be tabulated with similar data from the other community college technology instructors.

This study will examine and analyze the opinions of instructors on what they believe will be their teaching roles when computers are used as components of instruction.

If you would please mail the roster of technology faculty members at your institution in the enclosed stamped and self-addressed envelope, I will appreciate it. Thank you for your cooperation.

Sincerely,

Oscar Rasmussen
Department of Technical Education
University of Houston

UNIVERSITY OF HOUSTON
CULLEN COLLEGE OF ENGINEERING
HOUSTON, TEXAS 77004

CURRICULUM AND INSTRUCTION

Charles Riley
Occupation Education and Technology
Western Texas College
Snyder, Texas 79549

Dear Mr. Riley:

I am writing to ask your help in completing a research study on computer-related-instruction conceptualizations of instructors in technology in the junior or community colleges of Texas.

This study will examine and analyze the opinions of instructors on what they believe will be their teaching roles when and if computers are used as components of instruction.

No commitment or obligation, intentional or implied, will result from your participation in this study.

Please fill in and return the included information form in the enclosed stamped and self-addressed envelope.

All of the responses, including your valued comments (if you desire and choose to record them), will be handles anonymously for research purposes only.

Thank you for your cooperation.

Sincerely,

Oscar Rasmussen
Department of Technical
Education
University of Houston

INFORMATION FORM

Conceptualizations of Technology Instructors Personal Role in Computer-related Instruction

The purpose of this data request is to sample Texas Community College technology instructor's opinions of their teaching role when computers become components of instruction. No commitment or obligation, intentional or implied, will result from your participation. All of the responses, including comments, will be handled anonymously for research only.

1. Have you taught professionally for three years or longer?

Degrees Held:

2. Bachelors?
3. Masters?
4. Doctors?
5. Associate?
6. Certificate?

Have you taken academic or trade/industry courses in computer-

7. Programming?
8. Designing?
9. Application?
10. If the total instruction hours received under Items 7, 8, and 9 are six or more, mark Yes.
11. Do you believe that computer-related instruction will become an integral part of technology education within the next five years?
12. Are you convinced that the quality of education will improve when computers are components of instruction?
13. Do you think that mechanical devices and media will make your job easier? (Visual projections, films, program machines, etc.)
14. Have you a feeling that computer-related instruction will degrade your status as a teacher?
15. In your opinion, will computers ultimately have a commanding role greater than that of the instructor?

Color of Sheet - YELLOW   Trim to Line

If computers do become a major part of your school's education program, do you believe that you will devote more professional time to:

16. Curriculum planning and organization?

17. Small-group micro-teaching?

18. Small-group content discussion?

19. Advising individual students on their specific learning pursuits?

20. Animating or enlivening learning for the individual?

21. Planning creative activities tailored to individual needs and desires?

22. Encouraging inquiry and in-depth investigation?

23. Developing interpersonal rapport with each of your students?

24. Student confidence reinforcement?

25. Analyzing and circumventing learning roadblocks?

26. Simulating 'real-life' learning situations?

27. Authoring computer programs for these simulations?

28. Developing knowledge acquisition evaluations and assessments that are NOT group- or population-oriented, but rather are centered upon the individual student's interpretation in his language and in his experience.

29. Devising new and better ways of managing and administering the new computer-based instructional system.

30. Keeping track on an individual basis of where students are in terms of where they should be in their studies.

31. Reporting individual pupil progress to appropriate people.

32. Working closely and effectively with colleagues to minimize overlap and omission of content.

33. Becoming familiar with a broader base of curriculum, in terms of resource materials and equipment.

Color of Sheet - BLUE   Trim to Line

If computers do become a major part of your school's education program, is it your opinion that less of your instruction time will be required for:

34. Preparing and delivering lectures?

35. Organizing lesson assignments?

36. Developing textual exercises?

37. Evaluating overall classroom performance?

38. Maintaining classroom discipline?

39. Drill exercises and review?

40. Doing manipulative and skill demonstrations?

41. Group paced instruction.

42. Grading and reporting class or group performance in comparison with school, state and/or national norms.

43. Have you been directly involved in teaching programs which use computers for any instructional activity?

(If your answer is NO, skip Item #44 and answer all of the other items following.)

44. Have you designed, developed, or directed computer instruction programs?

(If you answer Item #44, skip all other items except #50. Answer Item #50.)

45. Does your school use computers for any purpose whatsoever?

46. By your estimation, will computers become a viable part of future education.

47. Do you believe that it is wrong to say computers will be dehumanizing agents in the learning process?

Color of Sheet - PINK   Trim to Line

48. Do you consider computers compatible with effective teaching and learning?

49. Would you say that the integration of computers into the educational system is economically worthwhile?

50. Do you think that computers will really help the technology teacher in his job and not be just another useless gadget of false sophistication appearing on the educational scene?

(If you wish to elaborate on the Yes or No of your answer, space is provided on an attached page for your comments. Your comments are encouraged and are considered to be a valuable contribution to this investigation.)

Color of Sheet - GREEN Trim to Line

When you have completed this information form and the comment sheet, please detach the answer sheet and the comment sheet and mail in the pre-addressed envelope included herewith. Thank you for your cooperation.

Oscar Rasmussen
Dept. of Technical Education
University of Houston
Houston, Texas 77004

YES NO DONT KNOW

YES NO DONT KNOW

YES NO DONT KNOW

YES NO DONT KNOW

DEFINITIONS OF TERMS

"Appropriate People" - Teachers who are directly involved with the particular student, program directors, planners of curricula, supervisors, administrators, and counselors.

"Authoring" - Specifying first the instructional routines and then working with programming specialists to develop a complete and objective instructional package.

"Computer, or Computer-Related Instruction" - Teaching that involves, wholly or in part, mechanical-electrical devices that interact with human teachers and students. This study is primarily concerned with the human teacher role in conjunction with computers. These roles involve designing, programming, and working with learning activities using computers.

"Confidence Reinforcement" - The interpersonal teacher-to-student communication that utilizes positive methods of assessment and encouragement of individual progress rather than aversive criticism.

"Content Discussion" - The inquiry mode, both teacher-to-student and student-to-teacher, of in-depth investigation of a subject or discipline.

"Curriculum Planning" - The design of systems of information, procedures, and exercises that are sequentially arranged to accomplish an instructional or learning goal.

"Dehumanizing Agent" - A statement of thinking that projects computers as a force for debilitating independent human action and human control; a feeling of apprehension that computers may somehow dominate human society to satisfy technological needs and goals.

"Group-paced Instruction" - The traditional procedure of developing instruction in accordance with the overall requirements of a class or group.

"Micro-teaching" - Discrete and detailed instruction on fundamental principles in a course of study.

"Resource Materials" - A variegated and comprehensive assortment of sources, methods, and media for instruction and learning pertaining to a particular subject of study.

"Textual Exercises" - Problems and drill that is oriented only to the materials in a particular text or set of texts.

UNIVERSITY OF HOUSTON
CULLEN COLLEGE OF ENGINEERING
HOUSTON, TEXAS 77004

CURRICULUM AND INSTRUCTION

Benny Tschoerner
Paris Junior College
2400 Clarksville Street
Paris, Texas 75460

Dear Mr. Tschoerner:

Approximately two weeks ago I sent you a questionnaire requesting your help in evaluating what Texas junior/community college instructors think their teaching role will be when computers are used as instructional components of education. Hopefully, the data you provide will be useful in this research investigation.

If you have already completed and returned the answer sheet of the questionnaire, please consider this letter an expression of appreciation for your willingness to participate.

If you have not responded yet, please do so within the next few days, so that your valued opinion may be included in the research study.

Thank you,

Oscar Rasmussen
Department of Technical Education
University of Houston

Appendix C

NUMERICAL DATA AND CALCULATIONS

Appendix C

NUMERICAL DATA AND CALCULATIONS

Kruskal-Wallis Analysis of Variance

A test was made of the null hypothesis as stated:

> "There is no significant difference in the future-role conceptualizations between the three groups of Texas community college technology instructors categorized as:
>
> I. Non-experienced,
> II. Experienced,
> III. Specialists,
>
> in the use of computers as components of instruction:

The test was performed on a randomly-selected sample of the described population. The population sample was divided into three experience categories as listed above.

The hypothesis was tested in terms of a statistic developed in 1952 by Kruskal and Wallis.[1] The statistic, labeled H, compares rank differences between the three experience groups. The functional relation is given by:

$$H = \left[\frac{12}{TN(TN + 1)}\right] \left[\sum_{1}^{n} \frac{R_j^{\,2}}{n_i}\right] - 3(TN + 1),$$

where, j = number of groups

n = the number of sample subjects in the jth group

$TN = \Sigma\, n_j$, the total number in the sample

R_j = the sum of ranks for the jth group

and where, d.f. (degrees of freedom) = $j - 1$.

Kruskal and Wallis show that H is distributed as x^2, with j - 1 degrees of freedom; therefore, table-value for the x^2 distribution was used for comparative reference, for significance at the .05 probability level.[2]

The computer FORTRAN program that was used for processing data in accordance with the stated formula is described on the following page.

Adjustment for Tied Ranks

Identical raw scores presented problems in making equitable rankings or weightings in the statistical treatment. To assure equal treatment, tied ranks were assigned the average value of the ranks they would ordinarily occupy.[3] These necessary adjustments are shown in the listings of Table 1C, "Raw Scores and Ranks by Groups."

In cases of rank ordering where the number of tied ranks is large, the summation of squares in the analysis may be unrealistically reduced due to the lesser numerical-average values necessarily introduced in "averaging" the tied ranks.[4] Kruskal and Wallis (1952) allowed for this eventuality with the H function relation for corrected or adjusted H as shown below:

$$H_{adj} = \frac{H}{1 - \frac{\Sigma C}{\frac{n^3 - n}{12}}}$$

where, C (the correction factor for each tied rank = $\frac{k^3 - k}{12}$

n = total number of ranks (122)

and, k = number of tied ranks for each case

ANALYSIS OF VARIANCE

Difference Between Groups I, II, & III

01/15/75

MS FORTRAN (4.2) / MSOS

```
    PROGRAM KWANOVA
    Total = 0
    TN = 122
    DO 50 J = 1,3
    Sum = 0
    DO 10 L = 1,130
    Read (60,15) Rank
15  Format (5X, F5.1)
    IF (Rank .LE. 0) Go To 20
    Sum = Sum + Rank
10  Continue
20  N = L - 1
    Total = Total + ((Sum**2)/N)
50  Continue
    Big K = 12.0/(TN*TN + TN)
    Small K = 3.0*TN + 3
    H = Big K*(Total) - (Small K)
    Write (61,70)H
70  Format (1H1,5X,2HH = ,F10.4)
    Stop
    End
```

Fortran Diagnostic Results for Kwanova

H = 3.7133

```
No errors
Load,56
Run,1,NM
```

I SYS 400 ET = 00/00/29 ID = OSCAR

Table 1C

RAW SCORES AND RANKS BY GROUPS

Non-experienced Group I Score (%)	Rank	Experienced Group II Score (%)	Rank	Specialists Group III Score (%)	Rank
3.3	1.5	40.0	27.5	3.3	1.5
6.6	3.5	53.3	44.5	6.6	3.5
13.3	7	56.6	49.5	10.0	5.5
16.6	8	60.0	56.5	10.0	5.5
23.3	9	60.0	56.5	30.0	15
26.6	11.5	70.0	75	36.6	20.5
26.6	11.5	76.6	90	46.6	37.5
26.6	11.5	76.6	90	56.6	49.5
26.6	11.5	76.6	90	66.6	70
30.0	15	80.0	97	66.6	70
30.0	15	80.0	97	66.6	70
33.3	17	86.6	107	73.3	81.5
36.6	20.5	96.6	118.5	73.3	81.5
36.6	20.5			73.3	81.5
36.6	20.5			76.6	90
36.6	20.5			76.6	90
36.6	20.5			80.0	97
40.0	27.5			83.3	102
40.0	27.5			86.6	107
40.0	27.5			86.6	107
40.0	27.5			90.0	110.5
40.0	27.5			90.0	110.5
40.0	27.5			93.3	114
43.3	33.5				
43.3	33.5				
43.3	33.5				
43.3	33.5				
46.6	37.5				
46.6	37.5				
46.6	37.5				
50.0	41				
50.0	41				
50.0	41				
53.3	44.5				
53.3	44.5				
53.3	44.5				
56.6	49.5				
56.6	49.5				
56.6	49.5				
56.6	49.5				
60.0	56.5				
60.0	56.5				
60.0	56.5				
60.0	56.5				

Raw Scores and Ranks by Groups (Cont.)

Non-experienced Group I		Experienced Group II		Specialists Group III	
Score (%)	Rank	Score (%)	Rank	Score (%)	Rank
60.0	56.5				
60.0	56.5				
63.3	64				
63.3	64				
63.3	64				
63.3	64				
63.3	64				
63.3	64				
63.3	64				
66.6	70				
66.6	70				
70.0	75				
70.0	75				
70.0	75				
70.0	75				
73.3	81.5				
73.3	81.5				
73.3	81.5				
73.3	81.5				
73.3	81.5				
76.6	90				
76.6	90				
76.6	90				
76.6	90				
80.0	97				
80.0	97				
83.3	102				
83.3	102				
83.3	102				
83.3	102				
86.6	107				
86.6	107				
93.3	114				
93.3	114				
93.3	114				
93.3	114				
96.6	118.5				
96.6	118.5				
96.6	118.5				
100.0	121.5				
100.0	121.5				
ΣR	4983		999		1521
$\bar{X}_R$	57.9		76.8		66.0
ΣR^2	24,830,289		998,001		2,307,361

Table of "C" Values

5 Ranks with k = 2	C = 5(.5)	=	2.5
2 Ranks with k = 3	C = 2(2)	=	4
5 Ranks with k = 4	C = 5(5)	=	25
6 Ranks with k = 5	C = 6(10)	=	60
2 Ranks with k = 6	C = 2(17 1/2)	=	35
1 Rank with k = 7	C = 1(28)	=	28
3 Ranks with k = 8	C = 3(42)	=	126
1 Rank with k = 9	C = 1(60)	=	60
	ΣC	=	340.5

Calculation:

$$H_{adj} = \frac{3.7133}{1 - \frac{340.5}{1815848 - 122}} = \frac{3.7133}{1 - \frac{340.5}{151310}} = \frac{3.7133}{1 - 0.0022} = 3.7214$$

The adjusted H is different by a very small amount from the originally-calculated value.

Test for Validity - The Pilot Investigation

Eighteen technology instructors were randomly selected from community colleges in the metro-suburban area of Houston, Texas. This pilot sample of the population was divided into two parts, or groups, which were determined by random selection. These two halves were subjected to the survey questionnaire and the response correlation was evaluated to check instrument validity. Two measures of correlation were made.

The first measure used the method of rank differences.[5] The coefficient, ρ (rho), was calculated by using the formula

$$\rho = \frac{6\Sigma d^2}{N(N \quad - 1)},$$

where d = difference between corresponding ranks

N = number in each group (9).

Rank orders of raw scores were determined for each of the two groups, using the methods employed for the study analysis. Pertinent data is tabulated below; the two groups are labeled a and b:

Raw Scores, % Gp. a	Gp. b	R_a	R_b	d	d^2
28.5	32.1	1	1	0	0
34.3	35.7	2	2	0	0
53.5	39.3	3	3	0	0
57.1	46.4	4	4	0	0
67.8	50.0	5.5	5.5	0	0
67.8	50.0	5.5	5.5	0	0
71.4	85.7	7	7.5	-0.5	0.25
75.0	85.7	8	7.5	0.5	0.25
96.4	92.8	9	9	0	0
				$\Sigma d^2 =$	0.5

Calculations:

$$\rho = 1 - \frac{6(0.5)}{9(81 - 1)} = 1 - 0.004 = 0.996$$

For Pearson r: $r_P = 2 \sin (\frac{\pi}{6} \rho) = 2 \sin 0.504(0.996) = 0.997$

Probability Error (P.E.):
for NT = 18,

$$P.E._{r_P} = .7063 \frac{(1 - r^2)}{\sqrt{NT}} = \frac{(.7063)0.016}{4.24} = .003$$

The second correlation measure was obtained by determining the Pearson product-moment correlation coefficient.[6] This statistic is the resultant of the ratio between the co-variance and the geometric mean of the variance. Symbolically, this is stated:

$$r = \frac{Co\ V_{xy}}{\sqrt{V_x V_y}}$$

The following table shows a collation with partial processing of the data used in obtaining r with the formula stated above:

Raw Scores, % Gp. a	Gp. b	x	y	x^2	y^2	xy
28.5	32.1	-32.8	-28.8	1075.8	789.6	921.7
34.3	35.7	-27.0	-25.2	729.0	635.0	680.4
53.5	39.3	- 7.8	-21.6	60.8	466.6	168.5
57.1	46.4	- 4.2	-14.5	17.6	210.3	60.9
67.8	50.0	6.5	-10.9	42.5	118.8	- 70.9
67.8	50.0	6.5	-10.9	42.5	118.8	- 70.9
71.4	85.7	10.1	24.8	102.0	615.0	250.5
75.0	85.7	13.7	24.8	187.7	615.0	340.0
96.4	92.8	35.1	31.9	1232.0	1017.6	1120.0
Σx_i=551.8	Σy_i=547.7			Σx^2= 3489.0	Σy^2= 4586.7	xy=3399.9

MEAN VALUES

$\bar{x} = 61.3$ $\bar{y} = 60.9$

$$\text{Co } V_{xy} = \frac{3399.9}{9} = 377.8$$

$$V_x = \frac{3489.0}{9} = 387.8$$

$$V_y = \frac{4586.7}{9} = 509.6$$

$$\sqrt{V_x V_y} = \sqrt{(387.8)(509.6)} = 444.55$$

Calculation:

$$r = \frac{377.88}{444.55} = .85$$

Pilot Sample Analysis of Variance

Rankings of raw scores for the total sample of eighteen instructors were made for a Kruskal-Wallis Analysis of Variance as accomplished in the main study. This test on the pilot sample was performed as a substantiation of the validity and reliability of the survey instrument.

Calculations were made by computer and by manual methods to confirm the correctness of the procedure. Data required for this test is set forth below:

RANKS

	Non-experienced	Experienced	Specialists
	11.5	9	6
	10	17	7.5
	4		13
	1		15.5
	3		15.5
	18		7.5
	14		11.5
	5		
	2		
ΣR_j	68.5	26	76.5
ΣR_j^2	4692.3	676	5852.25

Kruskal-Wallis formula for H;

$$H = \frac{12}{N(N + 1)} \Sigma \frac{R_j^2}{n_j} - (3N + 3),$$

where, R_j = Column sum of ranks

N = Total number in sample

n_j = Number in group.

$$\frac{R_j^2}{n_j} = \frac{5852.25}{7} + \frac{676}{2} + \frac{4692.3}{9} = 836.03 + 338 + 521.37 = 1695.4$$

$$H = \frac{12}{18(19)} (1695.4) - 57 = \frac{20,344,764}{342} - 57 = 59.49 - 57 = 2.49$$

NO SIGNIFICANT DIFFERENCE

Degrees of Freedom (df) = j - 1 = 3 - 1 = 2, Significant difference (.05 level) > 5.991

The computer FORTRAN program for the pilot sample is shown on the following page.

01/15/75

```
MS FORTRAN (4.2) / MSOS

        PROGRAM KWANOVA

        Total = 0
        TN = 18
        DO 50 J = 1,3
        Sum = 0
        DO 10 L = 1,18
        Read (60,15) Rank
    15  Format (5X,F5.1)
        IF (Rank .LE. 0) Go To 20
        Sum = Sum + Rank
    10  Continue
    20  N = L - 1
        Total - Total + ((Sum**2)/N)
    50  Continue
        Big K = 12,0/(TN*TN + TN)
        Small K = 3.0*TN + 3
        H = Big K*(Total) - (Small K)
        Write (61,70)H
    70  Format (1H1,5X,2HH = ,F10.4)
        Stop
        End
```

Fortran Diagnostic Results for Kwanova

H = 2.495

No errors
Load,56
Run,1,NM

I SYS 400 ET = 00/00/29 ID = OSCAR

Appendix D

THE PILOT STUDY

Appendix D

THE PILOT STUDY

Prior to the main data collection, a pilot study was accomplished in the junior/community colleges located in the area surrounding Houston, Texas. The purpose of the pilot study was to assess and refine the validity and reliability of the survey instrument prior to the field survey. Eighteen technology instructors from Brazosport, San Jacinto, Alvin, Lee, and Mainland Colleges were randomly selected. Visitations were made to each of the listed colleges to administer the survey questionnaire and to interview the selected technology instructors of this pilot sample of the target population. Personal comment on the objectiveness of the instrument and on how it might be improved was solicited from each instructor. In some cases, (approximately one-third of those selected), the selectee was not present at the time of visitation, and therefore could not be interviewed. These interviews served as a basis for revision of items in the survey instrument to enhance clarity and understanding.

The pilot sample of eighteen technology instructors selected from the community colleges of metro-surburban Houston as representative of the Texas colleges was then sub-divided into two equal groups. The two halves were randomly determined from the original group of eighteen. Each member of the nine-individual sub-groups was asked to answer the questions of the survey instrument. The resulting scores in each sub-group of nine were rank-ordered and compared; a moderate-to-high correlation ratio would indicate a similarity of reaction between the sub-groups, indicating interpretational validity of the survey instrument. Two tests for correlation were performed. The first of these used the method of rank differences to find the difference coefficient, rho.[1] The rho-value obtained from the test was $\rho = 0.9962$ (see Appendix C for calculations). The correction for the Pearson coefficient, as derived for the rho-value, rendered the value $r_p = 0.9973$. The approximate probability error of the normal distribution was negligible; P.E. = 0.003. (The statistical calculations producing these results are outlined in Appendix C.)

The high-value coefficient obtained in the method of rank differences was double-checked by applying the Pearson product-moment correlation technique[2] in a second test for similarity. The Pearson "r" obtained in this second test confirmed the results of the first - the resulting value was $r = 0.85$. The calculations for the second test are also in Appendix C.

Comparison of Means Between Pilot and Main Investigations

Calculated means of scores for groups, for both pilot and main samples, show relationship within the samples and also between the pilot and main observations on conceptualizations. This is shown in Table 1D.

Table 1D

COMPUTED MEANS OF THE THREE GROUPS

	Main Sample	Pilot Sample
Group I	$\bar{X} = 57.4$	$\bar{X} = 52.4$
Group II	$\bar{X} = 70.2$	$\bar{X} = 73.2$
Group III	$\bar{X} = 60.1$	$\bar{X} = 65.3$
	$X_m = 62.5$	$x_m = 63.6$

The smaller pilot sample has larger diversification or spread, characteristically the case for small samples.[3] The "means-of means" for the pilot sample was 63.6, and for the main sample it was 62.5. Between these two independent samples of widely-differing size, there seems to be a close agreement. (See Appendix C for calculations of means.)

A graph was prepared to show the relationship of ranks and raw scores for each half-segment of the pilot sample.[4] These groups were labeled "A" and "B", and the relationships described are shown in Figure 1D.

The broken-line graphs of the "A" and "B" groups compare differences in sample subjects scoring. Identical rankings are multi-noded with the appropriate symbols for each group. Group means of scores were almost identical; for Group "A" the mean score was 61.3%, and for Group "B", it was 60.9% - a difference of only 0.4 percentage point. The line-graphs average slopes were quite similar, and they correspond to the normal curve

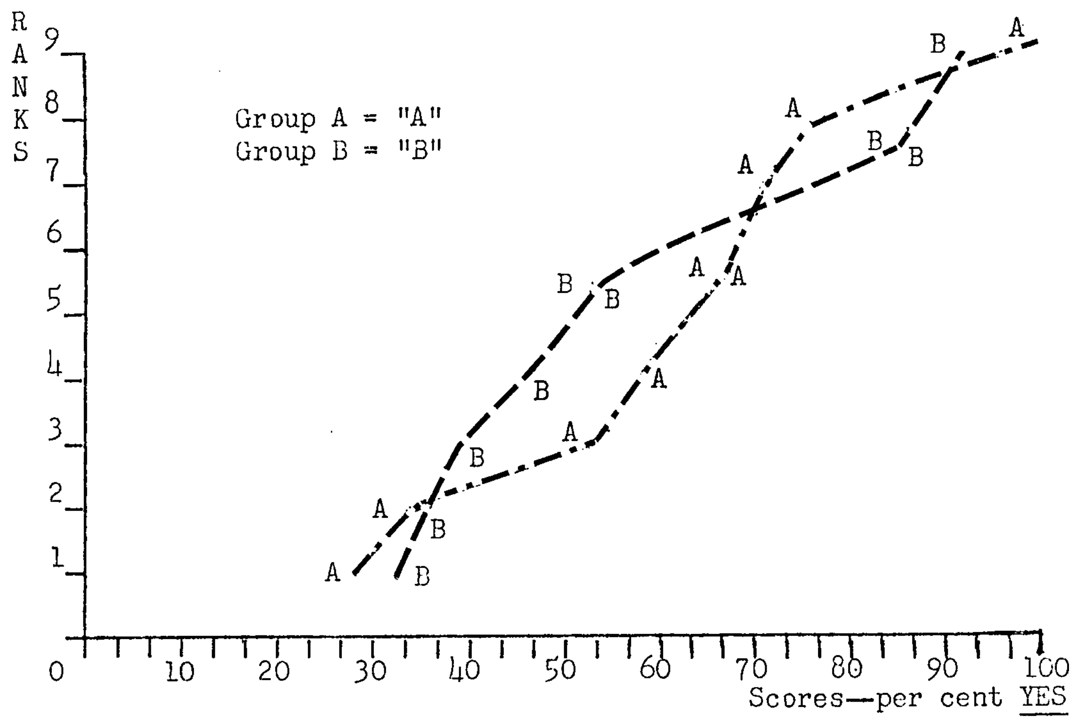

Figure 1D

Pilot Sample Rank Correlation

over the ranges recorded. No scores were received below the 28.5% level. Sample subject raw scores and the calculations of means for each group are shown in Appendix C.

Pilot group rankings over the total eighteen sample subjects were made for a rank-ordered analysis of variance test.[5] The analysis of variance for the pilot sample was performed as a comparison with the similar test that was administered for the main investigation. This test yielded a chi-square/H value of 2.495, well within the table value of 5.991 for significant difference with two degrees of freedom and a 95% probability of no difference.

The overall rankings were also plotted against raw scores for the total pilot sample. This relation is illustrated in Figure 2D.

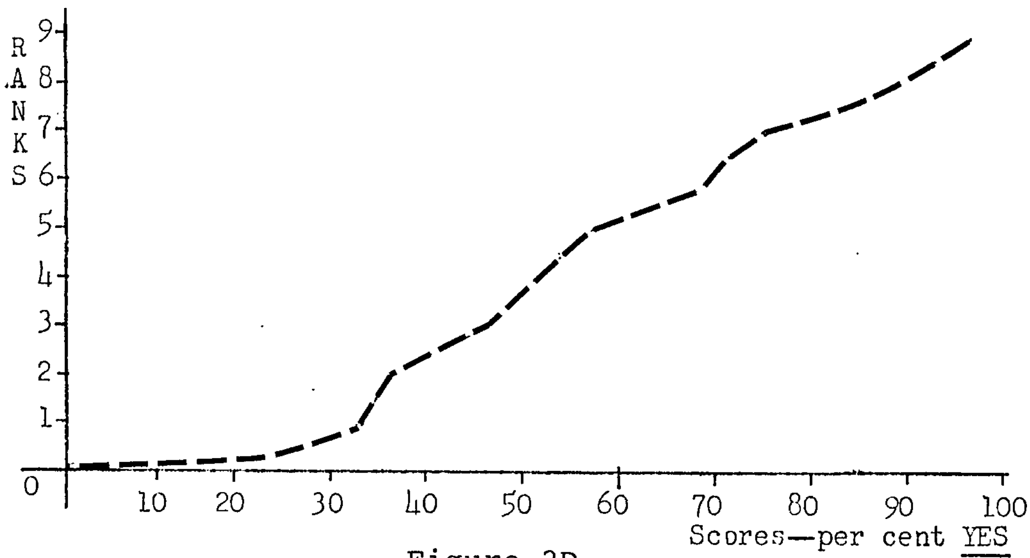

Figure 2D

Pilot Group-Ranks versus Scores

A similar plotting was done for rankings versus scores for the main field sample of one hundred and twenty-two instructors. This relation is shown in Figure 3D.

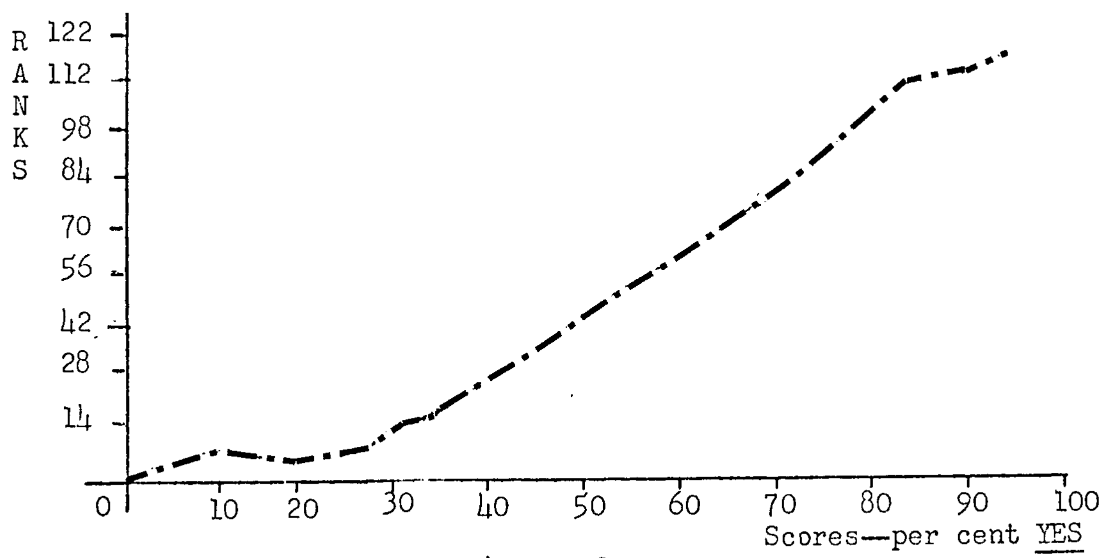

Figure 3D

Main Test Sample-Ranks versus Scores

Even though the pilot sample was considered too small in relation to the population of technology instructors to make any substantive statistical inference, a comparison of raw scores distributions for members of both the pilot and main samples showed a close similarity.[6] Curves checked for similarity, (Figures 2D and 3D of Appendix D), were in excellent agreement when superimposed as shown in Figure 4D.

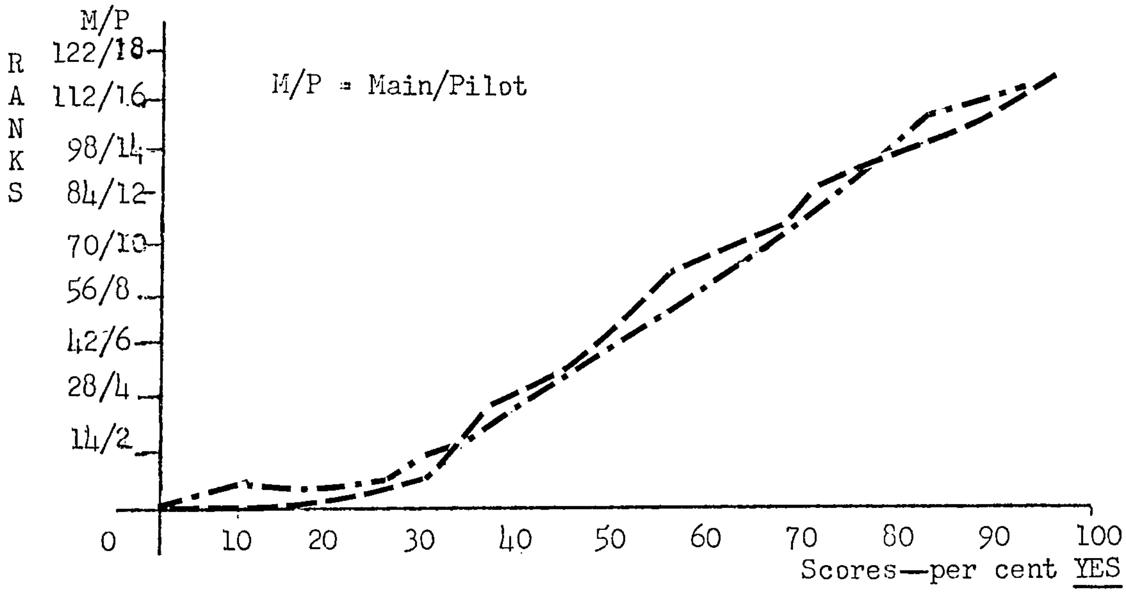

Figure 4D

Main and Pilot Samples-Ranks versus Scores, Superimposed

The similarities in these comparisons between the pilot group and the main field sample tend to reinforce both the validity and reliability of the test instrument. The correspondence between the two analyses of variance that were performed for both the pilot and the main population samples further substantiate the internal consistency of the findings of the study.