EVALUATION OF A TEACHER EDUCATION PROGRAM IN ELECTROMECHANICAL TECHNOLOGY

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EVALUATION OF A TEACHER EDUCATION PROGRAM

IN ELECTROMECHANICAL TECHNOLOGY

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PREFACE

Any new third generation technology program designed to be offered in Community Colleges, Technical Institutes, and other post-secondary training institutions, needs competent, well trained teachers in order to succeed. The two-year, post-secondary Electromechanical Technology Program developed at Oklahoma State University was no exception. It was recognized early in the developmental stages that a specially trained teacher, one who was able to grasp the underlying concepts of Electromechanics was needed. Hence, the Electromechanical Technology Teacher Education Fellowship Program was begun under a Federal Grant.

This study is an attempt to evaluate this fellowship program with respect to the acceptance of the Electromechanical approach to the areas of Electronics, Mechanics, Physics, and Electromechanics by the participants. Also evaluated was the effect of the overall program design on attitudes.

I wish to express my appreciation for the encouragement and assistance given me by my thesis advisers, Drs. Donald S. Phillips and Paul V. Braden; to the rest of my doctoral committee, Drs. Lloyd L. Wiggins, J. P. Key, and H. K. Eldin; and to the fifteen graduate fellows whose participation in the program made this study possible.

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INTRODUCTION

Introduction to the Problem

New technologies are emerging on the American industrial scene which create an increasingly serious need for thousands of broadly trained technicians. These "third generation" technologies, of which Electromechanical Technology is one, require trained personnel who are capable of assisting the professionals in the design, testing, manufacture, calibration, operation, and maintenance of equipment and systems in many industries. There is evidence that the increasing shortage of electromechanical technicians could adversely affect our national ability to develop, manufacture, and operate electromechanical equipment and systems at a sufficient pace to meet national defense, space and other industrial needs.

A problem immediately recognized with the development of these new emerging technology programs to meet the estimated manpower demand, was where and how to obtain a qualified teaching staff. No longer were traditionally trained teachers going to be able to move into these new technologies successfully without some additional training in the new philosophies and concepts.

Efforts to resolve both the anticipated technigian and the technical teacher shortage for this engineering technology were initiated at Oklahoma State University in the School of Occupational and Adult

Education. A demonstration project for the development of a two-year program in Electromechanical Technology was begun with the enrollment of a freshman class of students in September, 1968. This program was funded through September 30, 1970 through the Bureau of Research under the U. S. Commissioner of Education. Prior to the actual enrollment of students in this program a nationwide field study was completed. The results of this study pointed to the need to provide more than 20,000 broadly employable electromechanical technicians to meet the demonstrated requirements of employers.[1] The curriculum development in this demonstration project will hopefully lead to the establishment of Electromechanical Technology programs in more than one hundred technical institutes and community/junior colleges throughout the country.

Likewise, a proposal was written and submitted to the U. S. Department of Health, Education, and Welfare, Department of Education soliciting funds for an Education Professions Development Act (EPDA) grant to conduct research in teacher education for Electromechanical Technology.[2] The proposal was approved and a Technical Education Master's degree fellowship was begun at Oklahoma State University on June 1, 1969 with fifteen participants.

The Problem

The overall problem which this study was concerned is the acceptance or nonacceptance of the multidisciplinary Electromechanical Technology concept approach by former single-discipline technology teachers. Specifically, could these former single-discipline teachers, who had no previous formal professional exposure to Electromechanical

Technology, be influenced to accept this new and different approach in technical education such that, at the end of their program, they would actively seek a leadership role at an institution which has plans to add an Electromechanical Technology correlated program.

Purpose

The overall purpose of this study can best be explained in terms of three major objectives.

The first objective of this evaluative study was to show if a more positive or negative attitude toward Electromechanical Technology was developed during the fellowship period.

The second objective was to demonstrate that the Electromechanical Fellowship program could develop Electromechanical Technology competencies during the stated fellowship period.

The third objective was to show the subsequent career activities of the participants upon completion of the program.

Background Information

The statistics show that there is a shortage of qualified teachers in technical education but beyond this there is a more serious situation existing. Dr. Maurice Roney, in a paper delivered to the annual meeting of the American Technical Education Association and the National Association of Industrial Teacher Education on December 5, 1965, stated, "Beyond and above the need for teachers is a desperate need for technical education professionals--people who can plan programs, develop laboratories, and organize technical curriculums."[3] Too many of the responsibilities for technical program development are being assigned to people with minimal experience because of the shortage of qualified leaders. This can only result in a further deterioration of the present standard unless more programs similar to the Electromechanical Fellowship Program are started.

If new and different technician education programs are going to continue to be developed then teacher education must keep abreast. The emerging technologies will require a new breed of technical teacher, one whose attitude will allow him to try new and different approaches and concepts. Just because a teacher has had previous teaching experience in some technical area does not mean he is qualified or committed to teach one of the third generation technologies without extensive training and attitudinal changes. How to effect attitudinal change is a subject for another study, the point here being is it effected, and if so, is the change measurable?

The fifteen fellows who were the subjects of this study, like technical teachers in general, had varying educational backgrounds including Industrial Arts, Trade and Industry, Technical Education, Mathematics, and Physics. They also had varying amounts of teaching experience from one year to several years. Many were what could be considered traditional, single discipline technical teachers. All of these participants signed a statement to the effect that they wanted to learn about Electromechanical Technology with the idea of teaching it upon graduation and eventually becoming leaders in the field. The problem with which this research was concerned was how successful the EPDA fellowship program was in assisting in the development of the participants.

Research Questions

Based upon the stated objectives of this study, the following research questions were formulated:

Question 1: Was there any significant attitudinal change in the population under study from the beginning to the end of the program across all forty-eight semantic questions?

Question 2: Was there a difference in the attitudinal change (if any) in the area of the population's original technical specialty as compared to some other technical area?

Question 3: Was the acceptance of the eleven Electromechanical concepts by the population distributed equally across the areas of electricity, mechanics, physics, and electromechanical?

Question 4: Was there a demonstrated ability by the population to develop laboratory instructional materials?

Question 5: Was the population able to conduct research in the field of Electromechanical Technology?

Question 6: What were the subsequent career activities of the graduates?

Question 7: How did the graduates rate the individual courses in the Technical Education program?

Definitions

The definition of terms is a necessary starting point in any effort to communicate in any discussion. A common understanding of technical terms and phrases are important in order to convey ideas, recommendations and conclusions in the framework in which new proposals are described. English is a living language, and the meaning of its words necessitate continual attention if it is to serve as a factor in the effectiveness of our thinking. For clarity the following terms are defined.

Education Professions Development Act (EPDA): Passed in 1967 to assist universities in developing new graduate programs for preparing and training teachers. While its purpose is to increase the quality and quantity of all types of educational personnel, its immediate focus is to continue the efforts made over the last ten years to foster maximum interaction among educational institutions and community agencies in order to bring about institutional change to improve the production of teachers--the number one priority in American Education.[4]

Electromechanical Technology. A third generation technology which is based on the technical concepts of two or more specialties. It includes not only the region of overlap between electronics and mechanical technology, but also a considerable portion of each and a substantial amount of material which is found in neither.

Technical Education. A level of education designed to prepare individuals for effective employment in a particular field of technology within the "semi-professional" sector of the occupational spectrum. Programs in technical education are usually offered in post-secondary institutes. They are designed to provide the student with the knowledge, skills, and attitudes necessary to perform in a specific field of applied science. Many technical education programs are in the physical sciences and related engineering fields while others are in the applied biological sciences and natural sciences.

Third Generation Technology. This generation of technology might be described as systems technology. The objective in this generation is to teach technical principles - dynamic concepts that are common to more than one field of technology. Important differences appear in the system of instruction as well as in the technical subject matter.[5]

Limitations

This study was limited to a maximum population of fifteen due to the fact that only one group of master's degree fellows completed the program before it was canceled by the U. S. Department of Health, Education, and Welfare.

FOOTNOTES

[1]Maurice W. Roney, _Electromechanical Technology, A Field Study of Electromechanical Technician Occupations_, Part I. (Stillwater, 1968), p. 11.

[2]Paul V. Braden, _Development and Evaluation of a Teacher Education Program in Electromechanical Technology_ - A proposal submitted to the U. S. Department of Health, Education, and Welfare.

[3]Maurice W. Roney, "Professional Education for Technical School Administration and Teachers." Paper presented at the annual meeting of the American Technical Education Association and the National Association of Industrial Teacher Educators, December 5, 1965 at Miami, Florida.

[4]U. S. Department of Health, Education, and Welfare. A Handbook for Directors - Education Professions Development Act. OE-58015. Washington: Government Printing Office, 1968.

[5]Maurice W. Roney, "Electromechanical Technology Curriculum - The Rationale and Objectives." Paper presented at the American Technical Education Meeting, December 9, 1968 at Dallas, Texas.

CHAPTER II

REVIEW OF LITERATURE

The overall problem with which this study was concerned was the acceptance or non-acceptance of the multidisciplinary Electromechanical Technology concept approach by former single-discipline technology teachers. A review of the available literature related to the problem revealed a dearth of information. However, there are related areas of study which do shed light on this investigation. Therefore, this review is divided into the following three areas: (1) Technical Education, (2) Technical Teacher Education, and (3) The semantic differential concept.

Technical Education

The society for the Promotion of Engineering Education, as early as 1931, published a summary report that recognized the rising level of knowledge required of staff experts and technical supervisors.[1] Because industry is unable to supply its own needs in filling the technical, and supervising positions, they have had to look more and more to the technical school for their supply

A post-secondary type of educational institution was needed to give the more intensive and practical applied training not being provided by the engineering colleges, and it became apparent that these schools must principally direct their education to the supervisory and technical personnel needed by particular industries.[2] The name 'technical institute' was proposed as the most suitable and all inclusive name for these schools.

Studies of the technical institute have since been undertaken. Wickenden and Spahr[3] were the first to conduct investigations, followed by many others amongst which are Smith and Lipsett,[4] Henninger,[5] and Graney.[6]

Most technical institutes follow the pattern provided by Wickenden and Spahr and are characterized as being a post-secondary school catering to those individuals with previous industrial experience and desiring intensive preparation in a specific field of interest. The educational experience would prepare the students for entry occupations that would fall primarily between the skilled and the professional level, but with enough ability to enable them to advance in time to a professional status. The programs would be intensive, shorter, and essentially terminal rather than preparatory, in comparison to those of the professional school. Though concerned with both technical and supervisory pursuits, the latter is more often emphasized relating to actual industrial usage. The teachers, while adequately prepared in a scholarly sense, are primarily chosen because of their practical experience, and for their ability to teach the directly practical, emphasizing the "doing" as distinct from study or book theory.

Dr. Maurice Roney identified the development of five general abilities in the educational content of the technical institute.[7] The abilities are:

1. Facility with mathematics, ability to use algebra and trigonometry as tools in the development of ideas that make rise of scientific and engineering principles; and understanding of,

though not necessarily facility with, higher mathematics through analytical geometry, calculus, and differential equations, according to the requirements of the technology.

2. Proficiency in the application of physical science principles including the basic concepts and laws of physics and chemistry that are pertinent to the individual's field of technology.

3. An understanding of the materials and processes commonly used in the technology.

4. An extensive knowledge of a field of specialization with an understanding of the engineering and scientific activities that distinguish the technology of the field. The degree of competency and depth of understanding should be sufficient to enable the individual to do such work as detail design using established design procedures.

5. Communication skills that include the ability to interpret, analyze, and transmit facts and ideas graphically, orally, and in writing.

In studies by Hammond,[8] Roney and Braden,[9] and U. S. Department of Labor,[10] and the Engineering Manpower Commission,[11] the technician's education was defined as "being a planned sequence of school experiences designed to prepare persons for a cluster of jobs in specialized fields of technology at the post-secondary level." The program should be at least two (2) years, but not more than four (4) years in length, leading to an associate degree or similar designations. The technician education should also include emphasis in mathematics and sciences as well as depth in a particular specialized field of technology. The curriculum in the individual technologies should meet particular objectives enabling the graduate to enter a job area after graduating with little or no further on-the-job training, that he be able to advance in his job in harmony with the new developments in his technology, and that he have a substantial foundation in his technology to continue his education if he so desires.

There is increasing evidence that, as engineering organizations increase in size and complexity, engineering work tends to diversify. New and emerging technical occupations often require combinations of skills that have previously been considered highly specialized.[12] Technical skills that cross mechanical, electrical, electronic, or chemical fields are necessary in some of the newer industrial activities: in the missile industry, in automated production facilities, and in certain field services of engineering or scientific nature.

Preparatory training for new and emerging technical occupations require new combinations of technical subject matter. In recent years, technical education has developed a pattern of two-year, post high school programs that relate to certain fields of engineering education such as electrical engineering, mechanical engineering, and chemical engineering. It seems reasonable to assume that some phases of technical education should be revised to include training that cuts across two or more of the traditional fields of engineering.

One such new or "emerging" technology is Electromechanical Technology. The curriculum for this proposed post-high school technical education program has been under development at Oklahoma State University for the past three years. It uses a system of instruction distinctly different from the systems commonly used in second-generation technology programs. The general core of the curriculum is a sequence of singular concepts common to both electrical and mechanical technology. The first year of the two-year curriculum consists of six courses with conventional titles: mathematics, physics, electricity, mechanics, electromechanics, and technical reporting. It is important to understand, however, that these courses are totally interdependent;

they are carefully structured around a sequence of eleven singular, unified concepts:

1. Energy and work
2. Opposition to flow
3. Static energy storage
4. Time constants
5. Dynamic energy storage
6. Impedance
7. Impedance matching
8. Resonance phenomenons
9. Wave motion
10. Amplification
11. Feedback

These concepts are introduced and illustrated in physics classes, repeated as specific applications in separate electrical and mechanical laboratories, and brought together in the electromechanical laboratory, using selected devices and systems of modern technology. The primary advantage obtained from this system is the reinforcement of learning that occurs when a single concept is treated in depth by at least three useful and practical applications. Similarly, mathematics can be made much more interesting when it is possible to illustrate and use the same formula or concept in electrical, mechanical, hydraulic, pneumatic, and thermal applications.[13]

Technical Teacher Education

The rapid expansion of technical education has created a major problem in the teaching profession. School administrators are being forced to compete with industry for technical specialists in fields where the supply has never equaled the demand. Technical personnel at all levels in industry and government are operating in a sellers' market and technical teachers are no exception. Where salary schedules are based primarily on academic degrees, it is doubly difficult to staff technical programs. Even where salaries are comparable to those in industry (and they are in many areas), it is not an easy matter to find persons with the combination of interests, education, and abilities needed for technical teaching.[14]

There exists a generalized concept that teacher training for any person who is technically competent is somewhat superficial, if not actually unnecessary. Those who hold this point of view think primarily of a classroom teacher or a laboratory instructor whose job is to teach a prescribed course from textbooks, prepared instructional material and the like. But this presumes that someone has set up the curriculum, selected the students, equipped the laboratories, arranged the courses, made the necessary contacts for placing students, and so on, through a long list of necessary functions. This condition may well exist in some of the older, established technical schools where the turnover of teachers is small and programs of instruction are well organized but this is not the case with the much more common problem of a junior college or an area vocational school where a new technology program is being established. In this institution, more often than not, a technical specialist with little or no administrative experience is employed to "set up a program." All too often, neither the new employee nor his administrative superiors know what is needed to develop a sound technical education program.

Grant Venn states that "technology has created a new relation between man and his education, and his work in which education is placed squarely between man and his work. Although this relationship has traditionally held for some work, modern technology has advanced to the point where the relationship may now be said to exist for all work."[15] World War II, the Korean and Vietnam conflicts, and the ensuing epidemic need for technicians are some of the factors that created the problems of technician teaching which in turn demanded the development of teachers of technical education.

It was a reasonable extension of role for many technicians to become interested and involved in teaching technical education when the federal government passed acts to meet the technological demands that have arisen in the past two or three decades. With the passage of such acts as the Vocational Education Act of 1963, the field of technical education and the development of professional teachers grew up together, each contributing to the advancement of the other.

Teacher education programs should be evaluated to provide feedback for the improvement of specific phases of the programs. According to Jerome Moss,[16] the sparce data on program evaluation could be interpreted by teacher educators to mean that (a) vocational-technical teacher education programs do seem to have a beneficial effect on teacher behavior, (b) programs and/or selection techniques appear to be slowly improving, (c) student teaching is an important aspect of teacher education, and (d) there is certainly abundant room for increasing program efficiency and effectiveness.

The original field study, which brought about the two-year demonstration project in Electromechanical Technology, pointed to the need for 20,329 trained technicians by 1970.[17] This study pointed the way for a curriculum for this new third generation technology to be developed in a pilot program at Oklahoma State University. By the very nature of the new and different approach recommended for this technology, several implications for new teaching methods were indicated. Some of these were:

1. The administrative staff of institutions offering Electromechanical Technology must be aware of the problems involved in coordinating closely the work from several fields. Not only must time be made available for planning and sequencing of learning experiences, but teachers who are working in several areas will require extra time for preparation and lesson planning.
2. Text and laboratory materials are not now available, and they must be developed.
3. Teacher education programs must be conducted to familiarize teachers with the manner in which such coordinating teaching should be carried on.
4. Pilot programs should be conducted with students to determine what modifications should be made in materials, equipment or laboratory experiments.[18]

It was immediately recognized that teachers should be trained especially for Electromechanical Technology. Because of the new integrated-concepts approach, difficulty in relating to the various areas of the curriculum. During the development of the two-year technology curriculum it became apparent that to attain the objectives set for the program would require certain changes in the established instructional methods commonly found in college teaching. It was felt that students were likely to learn best when they could see the importance of the subject matter - when there was repetition to reinforce the learning process, and when related subjects were so coordinated that they become mutually supporting. Such an approach required not only new teaching methods, but a careful integration of subject matter in terms of time, to the end that each subject would obtain support from material being taught concurrently in other courses.[19] The traditional electronics teacher or mechanics teacher under normal circumstances would not be able to relate the integrated electromechanical concepts to any area other than his own specialty.

The Semantic Differential

The semantic differential, (hereafter referred to as SD), is a method of observing and measuring the psychological meaning of things, usually concepts.[20] Although everyone sees things a bit differently, sometimes very differently, there must be some common core of meaning in all concepts. It is the definition of concept that makes this clear. Any concept has common cultural meaning. It also has other meanings, some of them shared by different groups of people, some of the more or less idiosyncratic.

Osgood invented the semantic differential to measure connotative meanings of concepts as points in what he called "semantic space."[21]

The notion of semantic space can be illustrated with two- and three-dimensional representatives of plotted data.

An actual SD consists of a number of scales, each of which is a bipolar adjective pair, chosen from a large number of such scales for a particular research purpose, together with concepts to be rated with the scales. The scales, or bipolar adjectives, are seven-point rating scales, the underlying nature of which has been determined empirically. That is, each scale measures one, sometimes tow, of the basic dimensions or factors which are found to be behind the scales: Evaluative, Potency, and Activity. These factors may be called clusters of adjectives.

The SD yields a surprising amount of data, and with so many data, a number of analyses are possible. The scores are simply the numbers 1 through 7 assigned as follows:

good 7 : 6 : 5 : 4 : 3 : 2 : 1 : bad

That is, if an individual checks the adjective pair good-bad between the first and second set of dots at the left, a 6 is assigned. Other checked points are assigned to the other numerals.

Viewed in variance and set terms, there are three main sources of variance or a three-way cross-partition of the total sample of scores. The sources of variances are: concepts, scales, and subjects. That is, the scores can be analyzed for differences between concepts, between scales, between subjects, or any combination thereof. In most studies, however, there are ways of reducing data to two categories, usually concepts and scales, or concepts and factors. The SD data are unique in that the data of one individual can be analyzed, as well as the data of groups of individuals.

According to Kerlinger[22] the semantic differential can be applied to a variety of research problems. It is flexible and relatively easy to adapt to varying research demands, quick and economical to administer and to score. The main problems are to select appropriate and relevant concepts or other cognitive objectives to be judged, and appropriate and relevant analyses.

FOOTNOTES

[1]William E. Wickenden and Robert H. Spahr, A Study of Technical Institutes. Summary Report. Society for the Promotion of Engineering Education (Lancaster, Pennsylvania, 1931), p. 3.

[2]__________, A Study of Technical Institutes, Society for the Promotion of Engineering Education (Lancaster, Pennsylvania, 1931), p. 1.

[3]Wickenden, p. 4.

[4]Leo F. Smith and Laurence Lipsett, The Technical Institute (New York, 1956).

[5]G. Ross Henninger, The Technical Institute in America (New York, 1956).

[6]Maurice Graney, The Technical Institute (New York, 1964).

[7]Maurice W. Roney, Occupational Criteria and Preparatory Curriculum Patterns in Technical Education (Washington, 1960).

[8]H. P. Hammond (Chairman), "Report of Subcommittee of Technical Institutes." (New York, 1944).

[9]Maurice W. Roney and Paul V. Braden, Occupational Education Beyond The High School (Norman, 1967).

[10]United States Department of Labor, Manpower Report of the President and a Report of Manpower Requirements, Resources, Utilization, and Training (Washington, 1966).

[11]Engineering Manpower Commission, Trends in Engineering Technician Enrollments and Graduates (New York, 1967).

[12]Cecil W.Dugger. Documentation of the Development of a Curriculum in an Emerging Technology - Electromechanical Technology (Stillwater, 1967), p. 8.

[13]Maurice W. Roney and Donald S. Phillips, "Electromechanical Technology: A Third Generation Occupational Education Program," Technician Education Yearbook (Ann Arbor, 1970), p. 201.

[14]Maurice W. Roney, "Professional Education for Technical School Administrators and Teachers," a paper presented to the Annual Meeting of the American Technical Education Association on December 5, 1965, in Miami, Florida.

[15]Grant Venn, Man, Education, and Work (Washington, 1964).

[16]Jerome Moss, Jr., "Review of Research in Vocational Technical Teacher Education" (Minneapolis, 1967).

[17]Maurice W. Roney, Electromechanical Technology, A Field Study of Electromechanical Technician Occupations, Part I (Stillwater, 1968), p. 11.

[18]Maurice W. Roney, Electromechanical Technology, A Post-High School Technical Curriculum, Part II (Stillwater, 1968), p. 9.

[19]Maurice W. Roney, Electromechanical Technology, A Field Study of Electromechanical Technician Occupations, Part I (Stillwater, 1968), p. 8.

[20]Fred N. Kerlinger, Foundations of Behavioral Research (New York, 1964), pp. 564-580.

[21]C. Osgood, G. Suci, and P. Tannebaum, The Measurement of Meaning (Urbana, Illinois, 1957).

[22]Kerlinger, pp. 564-580.

CHAPTER III

METHODOLOGY AND PROCEDURE

The purpose of this chapter is to describe the method of design utilized in the research conducted and the method by which the data were collected and analyzed. The overall techniques were chosen to best fit the problem under investigation, and the choice of techniques affected the detail of design and the operations of measuring or manipulating the variables. The lack of uniform standards and measurements methodology of previous studies dealing with attitudinal changes in teacher education precluded the use of certain investigative techniques. It was decided to apply a different type of investigative technique in an attempt to answer some of the posed research questions.

The first three research questions stated in chapter one were answered by using a semantic differential instrument. This instrument was developed with concepts applying directly to the Electromechanical Teacher Fellowship Program such that they could be rated with bipolar adjectives. The fourth research question was evaluated on the basis of grades earned in a laboratory instructional materials development course and observed practice to which this knowledge as put. The fifth research question was evaluated by observation of the researcher and the director of the EPDA Electromechanical Program. Questions six and seven were evaluated through the administration of a follow-up questionnaire.

Population and Sample

Although fifteen participants were originally selected for the program and did indeed begin, only thirteen participants actually finished. One participant dropped out midway through the fall semester and the other at the end of the spring semester. Complete sets of data have been gathered on thirteen participants. It is this number then that will represent the entire population under analysis in this report.

Instrumentation

Two types of instruments were utilized in this study. The primary instrument for determining attitudinal change (if any) was the semantic differential. As previously stated, the first three research questions were evaluated with this instrument. A copy of this instrument is included in Appendix A.

The second instrument employed was a follow-up questionnaire. This instrument was utilized to answer research questions six and seven. A copy of this questionnaire is included in Appendix B.

Data Collection

The semantic differential was administered through group sessions made up of all participants. The first administration was given in September, after the initial "settling down" or "honeymoon" period was over. (The participants began their program with the previous summer session.) The second administration was given in a mid-session situation in January, and the final or post-session administration was in May.

The follow-up questionnaire was mailed to each graduate in March of the year following their summer graduation. Those persons who did not respond within a month were contacted by telephone.

Data Analysis

The semantic differential was scored using the method suggested by Osgood.[1] Evaluation was accomplished using analysis of variance with two way classification for a fixed model. In some cases only the column effect was examined as in evaluating research question number one. In other cases, the row effect was also examined to detect any variation within groups as in research questions number two and three. Interaction effects between columns (representing test administrations) and rows (representing subjects or groups of subjects) were also examined.

In addition to analyzing research questions one, two, and three by statistical methods, a graphical representation of the data was also utilized. The mean scores of the subjects or groups of subjects were plotted against test administrations to depict graphically any change in additude during the academic year.

The questionnaire was analyzed by tabulating the answers received. No statistical analysis was deemed necessary as the small numbers pertaining to each item did not readily lend themselves to any. Rather, a percentage figure of the total population was used to interpret each answer.

FOOTNOTES

[1]C. Osgood, G. Suci, and P. Tannenbaum, The Measurement of Meaning (Urbana, Illinois, 1957).

CHAPTER IV

PRESENTATION AND ANALYSIS OF DATA

The data presented and analyzed in this chapter is in four sections. First, an analysis of attitudes with respect to overall program acceptance and individual concepts is described. The first three research questions are analyzed in this section. In the second and third sections, the results pertaining to research questions four and five are analyzed and described. Presented in section four are the results of the second research instrument utilized in this study. Research questions six and seven are answered in this section as a result of the data gathered by this instrument.

Population Attitude Changes

Research Question One: Was there any significant attitudinal change in the population under study from the beginning to the end of the program across all forty-eight semantic questions?

To evaluate this research question, a semantic differential research instrument was used. This instrument, which consisted of forty-eight questions, was administered three times during the academic year. Each question, or concept, was answered by rating ten sets of bipolar adjectives. (See Appendix A for sample instrument.) The maximum possible score for any one concept was seventy.

An analysis of variance with two way classification for repeated measures was used to test for significance. The overall mean score for each test was used as a single cell entry for each subject. Referring to Table I, the columns represent the three mean test scores for each subject.

TABLE I

MEAN SCORES OF EACH TEST

	Test Administrations				
Subjects	1	2	3	Tr.	$\bar{X}$r.
1	44	47	47	138	46.00
2	47	49	45	141	47.00
3	47	49	49	145	48.33
4	58	53	58	169	56.33
5	51	61	58	170	56.66
6	48	49	52	149	49.66
7	45	51	52	148	49.33
8	50	51	51	152	50.66
9	52	50	58	160	53.33
10	43	56	51	150	50.00
11	51	52	61	164	54.66
12	61	61	61	183	61.00
13	54	54	53	161	53.66
T.c	651	683	696	T = 2030	
$\bar{X}$.c	50.08	52.54	53.54	$\bar{X}$.. = 52.05	

When written in terms of a null hypothesis, this research question could be checked for significance by calculating the F ratio across the three test administrations. (See Appendix C for sample calculations.) Table II shows the analysis of variance data used in calculating the F ratio for research question one. The F ratio or 4.21 was significant beyond the five percent level. ($F_{.05} = 3.40$.) Since this value of F is significant, the null hypothesis that there was no attitudinal change during the academic year was rejected. There was, indeed, an attitudinal change.

TABLE II

ANALYSIS OF VARIANCE DATA FOR RESEARCH QUESTION ONE

Source of Variation	Sum of Squares	Degrees of Freedom	Variance Estimate
Rows	680	12	$Sr^2 = 56.67$
Columns	80	2	$Sc^2 = 40.00$
Interaction	228	24	$Si^2 = 9.5$

Note: n = 1 and $F_c = \frac{Sc^2}{Si^2}$

This change is further illustrated by graphically plotting test means against test administrations.

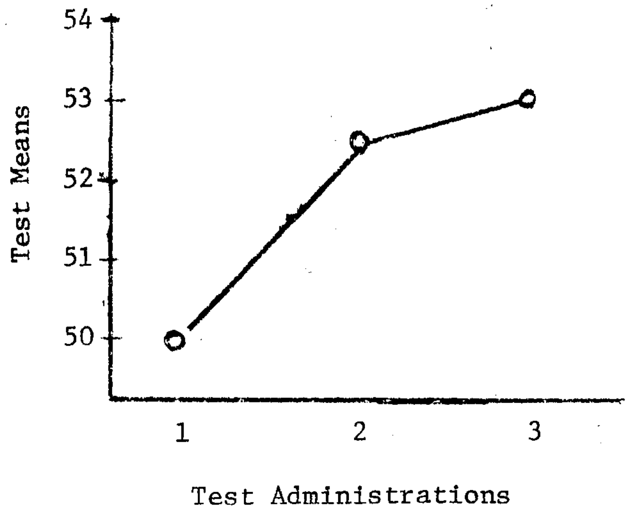

Figure 1. Attitudinal Change

Research Question Two: Was there a difference in the attitudinal change (if any) in the area of the population's original technical specialty as compared to some other technical area?

The semantic differential research instrument was also used to evaluate this research question. The subjects were divided into three sub-groups depending on their original technical specialty or teaching area. These sub-groups were: Physical Science, Electronics, and Related Technologies. Random selection was used to arrive at equal entries for each sub-group; three entries per cell.

This question was analyzed for any significant difference between two independent variables; test administrations and original technical specialty. The analysis of variance technique was utilized for two way classification with repeated measures where n>1. The F ratio calculation for the column effect was omitted because attitudinal change during the academic year was analyzed in research question number one. The row effect was calculated to determine if there was any significant difference in attitudinal change between sub-groups. The F ratio for the interaction effect was calculated to determine the independence of the variables.

Table III shows the mean scores for each cell entry, by sub-groups, across the three test administrations.

TABLE III

MEAN SCORES BY SUB-GROUPS

	Test Administrations				
Subjects	1	2	3	Tr.	$\overline{X}r.$
Physical Science	47	49	49	444	49.33
	48	49	52		
	43	56	51		
Electronics	50	51	51	495	55.00
	52	50	58		
	61	61	61		
Related Technologies	44	47	47	443	49.20
	47	49	45		
	51	52	61		
T.c	443	464	475		T = 1382
$\overline{X}.c$	50.08	52.54	53.54		$\overline{X}.. = 51.10$

The F ratio for the row effect was calculated to be 4.08. This is significant beyond the five percent level (F.05 = 3.55). The null hypothesis that original technical specialty had no affect on attitudinal change was rejected. There was a significant difference in attitudinal change between original technical specialties.

The F ratio for the interaction effect of the two independent variables was calculated to be 4.79. This is significant beyond the one percent level ($F_{.01} = 4.58$). The null hypothesis that there was interaction effect between the two variables was rejected.

Table IV summarizes the analysis of variance data used in calculating the F ratios for research question two.

TABLE IV

ANALYSIS OF VARIANCE DATA FOR RESEARCH QUESTION TWO

Source of Variation	Sum of Squares	Degrees of Freedom	Variance Estimate
Rows	196	2	$Sr^2 = 98.00$
Columns	59	2	$Sc^2 = 29.50$
Interaction	461	4	$Si^2 = 115.25$
Within Cells	436	18	$Sw^2 = 24.22$

Figure 2 illustrates graphically the change in attitudes of the three sub-groups during the academic year. The mean scores of each technical specialty is plotted against test administrations. The physical science sub-group mean was lowest at the start of the year but passed the related technologies sub-group at mid-year. Both sub-group means were at the same point at the end of the year. The fact that the physical science sub-group did cross the related technologies sub-group indicates there was an interaction between variables as pointed out above.

The mean scores for the electronics sub-group showed no change from beginning to mid-year but did increase from mid-year to end. The overall attitude of the group was higher than the other two groups throughout the entire program.

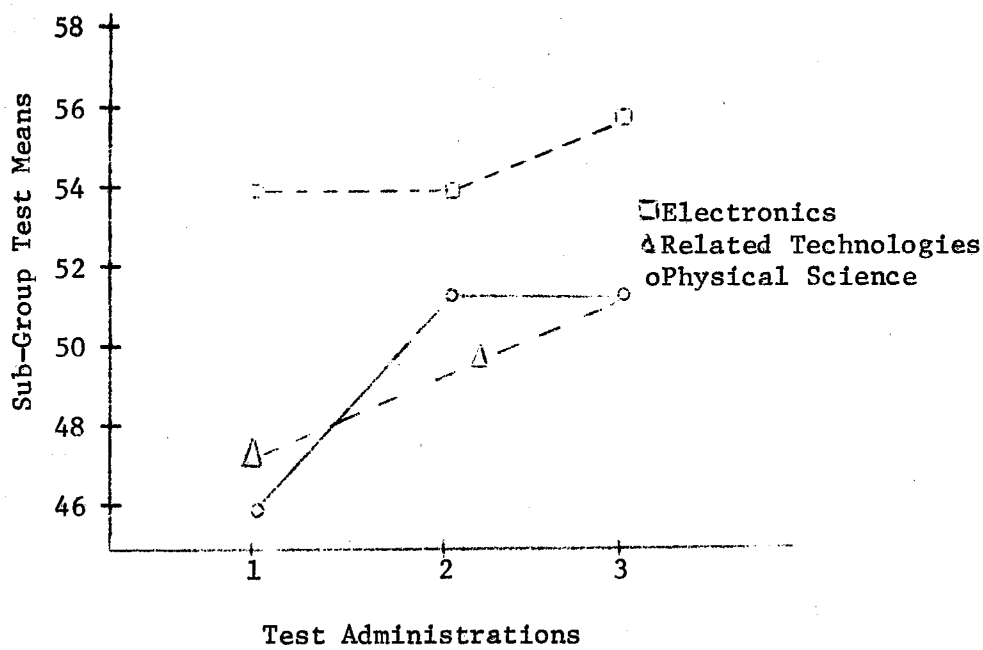

Figure 2. Attitudinal Change by Sub-Group

Research Question Three: Was the acceptance of the eleven electromechanical concepts by the population distributed equally across the areas of electricity, mechanics, physics, and electromechanical?

The analysis of this question was divided into four parts. Attitudinal change during the academic year for each sub-group was analyzed with respect to electricity, mechanics, physics, and electromechanical separately. The semantic differential included questions concerned with the relationship of the eleven electromechanical concepts to each of the above mentioned areas.

Using the analysis of variance technique it was possible to check for significant difference in degrees of acceptance by each of the sub-groups. For each member of a sub-group, a mean was determined for those scores pertaining only to electricity, mechanics, physics, and electromechanical.

In the first part of this question the row, column, and interaction effects were calculated with respect to electricity. The row effect was calculated to determine if any significant difference existed between individual sub-groups with respect to their degree of acceptance, of attitude toward the electromechanical approach to electricity. The column effect was calculated to check for attitude change toward electricity, by the sub-groups collectively, during the academic year. The interaction effect was calculated to determine any interaction between the two independent variables.

Table V shows the mean scores for each cell entry, by sub-groups, across test administrations for electricity.

TABLE V

MEAN SCORES BY GROUPS FOR ELECTRICITY

	Test Administrations				
Subjects	1	2	3	Tr.	$\overline{X}r.$
Physical Science	54	50	54		
	52	51	54	469	52.11
	48	52	54		
Electronics	55	55	53		
	52	51	59	509	56.56
	61	61	62		
Related Technologies	53	54	53		
	48	52	56	492	54.67
	52	61	63		
T.c	475	487	508		T = 1470
$\overline{X}$.c	52.78	45.11	64.44		$\overline{X}$.. = 45.44

The F ratio for the row effect was calculated to be .96. This is not significant at the five percent level ($F_{.05} = 3.55$). The null hypothesis that no significant difference existed between individual sub-groups with respect to their degree of acceptance of the electro-mechanical approach to electricity was accepted.

The column effect F ratio was calculated to be 1.87. This is not significant beyond the five percent level ($F_{.05} = 3.55$). The null hypothesis that no significant attitudinal change toward electricity existed during the academic year, by the sub-groups collectively, was accepted.

The interaction effect was calculated to be 1.43. This value is not significant beyond the five percent level ($F_{.05} = 2.93$), so the null hypothesis is accepted. There is no interaction between the independent variables.

Table VI summarizes the analysis of variance data used in calculating the F ratios for the first part of research question three.

TABLE VI

ANALYSIS OF VARIANCE DATA FOR PART ONE
OF RESEARCH QUESTION THREE

Source of Variation	Sum of Squares	Degrees of Freedom	Variance Estimate
Rows	89	2	$Sr^2 = 44.50$
Columns	175	2	$Sc^2 = 87.50$
Interaction	267	4	$Si^2 = 66.75$
Within Cells	84	18	$Sw^2 = 46.67$

Figure 3 is a graphical representation of the mean scores for each sub-group plotted against test administrations, with respect to electricity. The fact that no interaction effect exists can be seen in this figure.

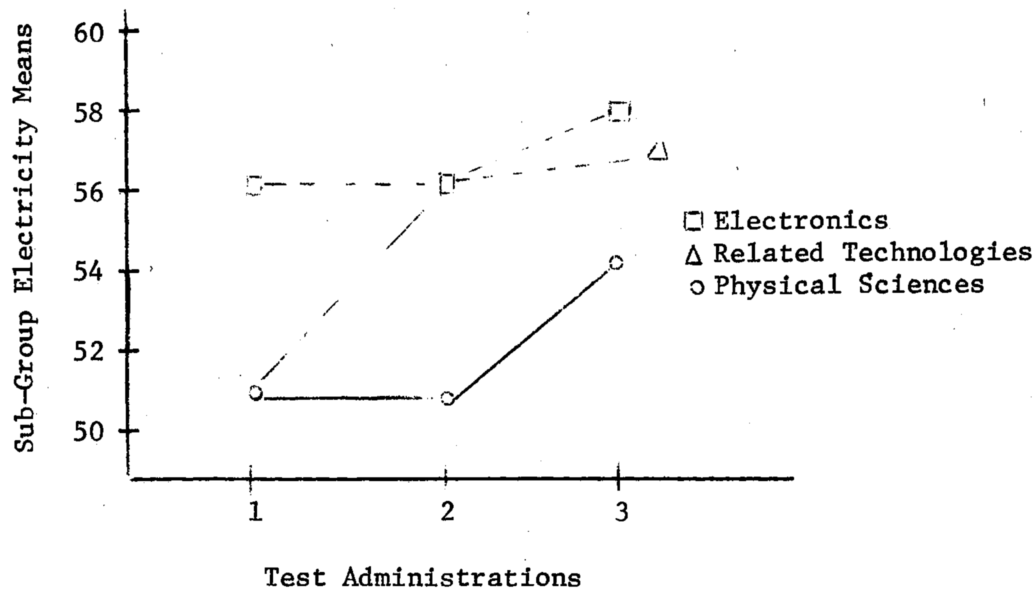

Figure 3. Attitudinal Change Toward Electricity

The second, third, and fourth parts of this question were analyzed in the same manner as the first part. Table VII shows the mean scores for each cell entry, by sub-groups, across test administrations for mechanics.

TABLE VII

MEAN SCORES BY GROUPS FOR MECHANICS

	Test Administrations				
Subjects	1	2	3	Tr.	$\overline{X}$r.
Physical Science	37	50	42		
	46	50	52	401	44.56
	38	41	45		
Electronics	48	47	48		
	52	50	58	487	54.11
	61	62	61		
Related Technologies	32	37	36		
	48	47	43	393	43.67
	50	41	59		
T.c	412	425	444		T = 1281
$\overline{X}$.c	45.78	47.22	49.33		$\overline{X}$.. = 47.44

The F ratio for the row effect was calculated to be 5.25. This is significant at the five percent level (F.05 = 3.55). The null hypothesis that no significant difference existed between individual sub-groups with respect to their degree of acceptance toward the electromechanical approach to mechanics was rejected.

The column effect calculation produced an F ratio of 0.75. This is not significant beyond the five percent level (F.05 = 3.55). The null hypothesis that no significant attitudinal change toward mechanics existed during the academic year, by the sub-groups collectively, was accepted.

The interaction effect was calculated to be 3.05. This value is significant beyond the five percent level (F.05 = 2.93), so the null hypothesis is rejected. An interaction exists between independent variables.

Table VIII summarizes the analysis of variance data used in calculating the F ratios for the second part of research question three.

TABLE VIII

ANALYSIS OF VARIANCE DATA FOR PART TWO OF RESEARCH QUESTION THREE

Source of Variation	Sum of Squares	Degree of Freedom	Variance Estimate
Rows	403	2	$Sr^2 = 201.50$
Columns	57	2	$Sc^2 = 28.50$
Interaction	465	4	$Sc^2 = 116.25$
Within Cells	686	18	$Sw^2 = 38.11$

Figure 4 is a graphical representation of the mean scores for each sub-group plotted against test administrations, with respect to mechanics.

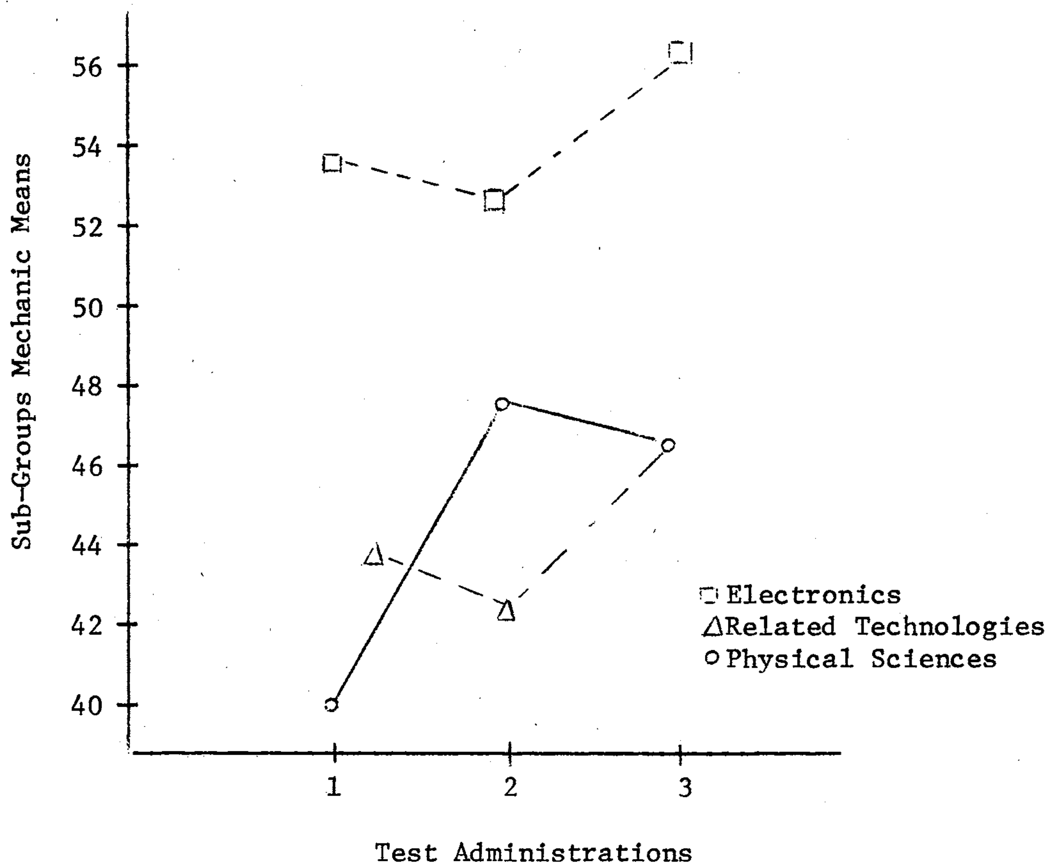

Figure 4. Attitudinal Change Toward Mechanics

Part three of question three related to the area of physics. Table IX shows the mean scores for each cell entry, by sub-groups, across test administrations for physics.

TABLE IX

MEAN SCORES BY GROUPS FOR PHYSICS

	Test Administrations				
Subjects	1	2	3	Tr.	$\overline{X}$r.
Physical Sciences	47	49	48		
	46	50	52	436	48.33
	48	43	53		
Electronics	48	49	51		
	52	51	59	494	55.00
	61	61	62		
Related Technologies	50	48	48		
	46	46	44	450	50.00
	52	57	59		
T.c	450	454	476		T = 1380
$\overline{X}$.c	50.00	50.33	52.66		$\overline{X}$.. = 51.05

The F ratio for the row effect was calculated to be 3.75. This value is significant at the five percent level (F.05 = 3.55). The null hypothesis that no significant difference existed between individual sub-groups with respect to their acceptance of the electromechanical approach to physics was rejected.

The column effect calculation showed no significance at the five percent level by producing an F ratio of 0.81 (F.05 = 3.55). The null hypothesis that no significant attitudinal change toward physics existed during the academic year, by the sub-groups collectively, was accepted.

The interaction effect was calculated to be 0.12. This value is not significant beyond the five percent level (F.05 = 2.93), so the null hypothesis was accepted.

Table X summarizes the analysis of variance data used in calculating the F ratios for the third part of research question three.

TABLE X

ANALYSIS OF VARIANCE DATA FOR PART THREE OF RESEARCH QUESTION THREE

Source of Variance	Sum of Squares	Degrees of Freedom	Variance Estimate
Rows	204	2	$Sr^2 = 102.00$
Columns	44	2	
Interaction	14	4	
Within Cells	489	8	

Figure 5 is a graphical representation of the mean scores for each sub-group plotted against test administrations, with respect to physics. No interaction exists.

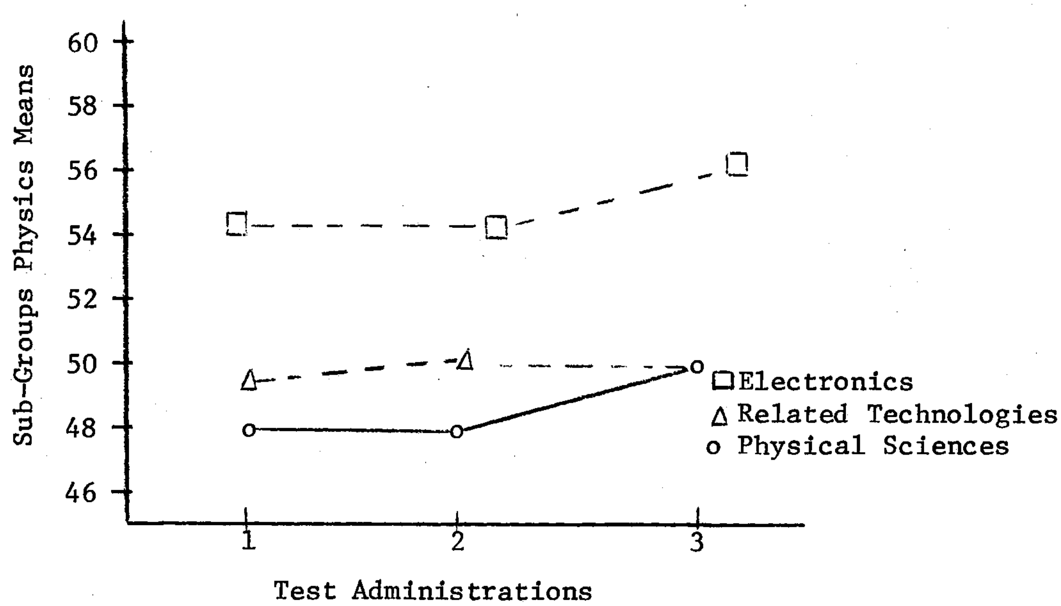

Figure 5. Attitudinal Change Toward Physics

The last part of question three related to the area of electromechanical. Represented in Table XI are the mean scores for each cell entry, by sub-groups, across test administrations.

TABLE XI

MEAN SCORES BY GROUPS FOR ELECTROMECHANICAL

	Test Administrations				
Subjects	1	2	3	Tr.	$\bar{X}$r.
Physical Sciences	50	49	51		
	46	48	51	433	48.11
	39	47	52		
Electronics	50	53	51		
	52	50	59	499	55.44
	61	62	61		
Related Technologies	41	50	50		
	48	49	46	446	49.56
	51	48	63		
T.c	438	456	484		T = 1378
$\bar{X}$.c	48.67	50.67	53.78		$\bar{X}$.. = 51.04

The F ratio for the row effect was calculated to be 5.10. This value is significant at the five percent level (F.05 = 3.55). The null hypothesis that no significant difference existed between individual sub-groups with respect to their acceptance of the electromechanical approach to the area of electromechanical was rejected.

The column effect F ratio was calculated to be 4.64. This value is significant at the five percent level (F.05 = 3.55). The null hypothesis that no significant attitudinal change toward electromechanical existed during the academic year, by the sub-groups collectively, was rejected.

No significant interaction effect was determined as the calculated F ratio was 0.14 ($F_{.05} = 2.93$). The null hypothesis was accepted.

Table XII summarizes the analysis of variance data used in calculating the F ratios for the last part of research question three

TABLE XII

ANALYSIS OF VARIANCE DATA FOR PART FOUR OF RESEARCH QUESTION THREE

Source of Variation	Sum of Squares	Degrees of Freedom	Variance Estimate
Rows	272	2	$Sr^2 = 136.00$
Columns	248	2	$Sc^2 = 124.00$
Interaction	15	4	$Si^2 = 3.75$
Within Cells	480	18	$Sw^2 = 26.67$

Figure 6 is a graphical representation of the mean scores for each sub-group plotted against test administrations, with respect to electromechanical. No interaction exists.

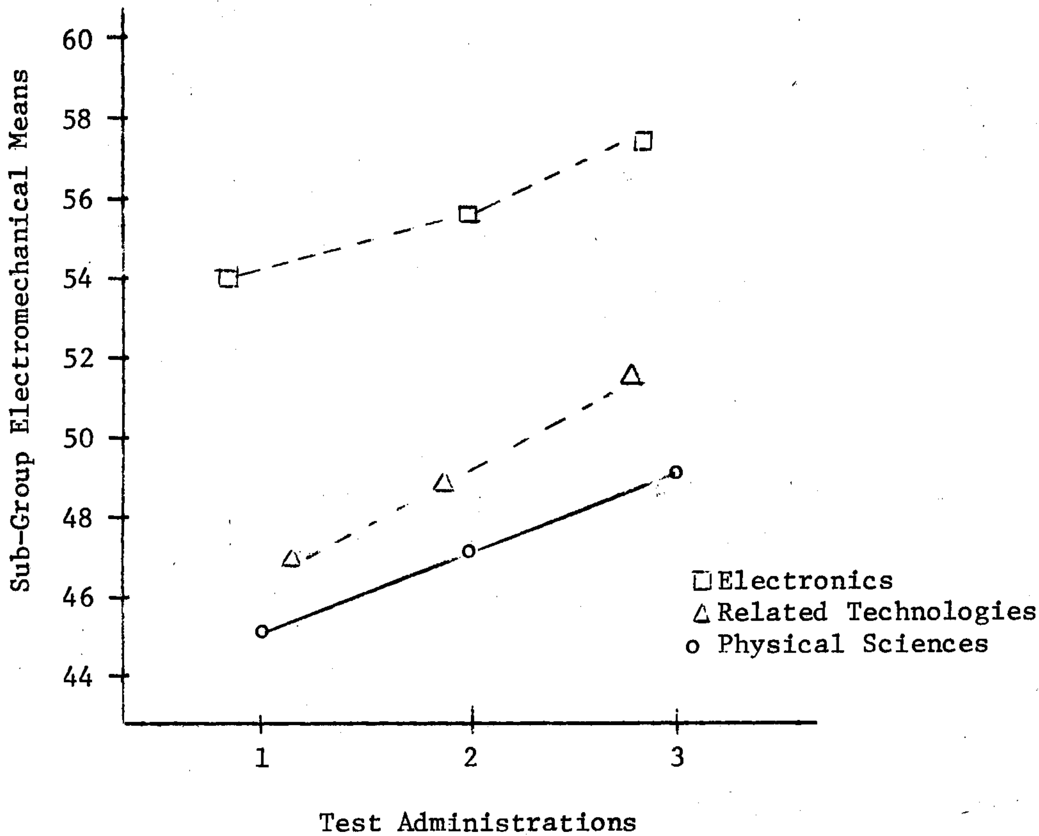

Figure 6. Attitudinal Change Toward Electromechanical

Instructional Materials Development Competency

Research Question Four: Was there a demonstrated ability by the population to develop laboratory instructional materials?

The total population was required to enroll in a variable credit hour course (1 or 2 credit hours) specifically designed to teach the development of laboratory instruction materials. Seven fellows received the grade of A (excellent) and six received the grade of B (superior).

In two subsequent courses the fellows actually wrote and tested laboratory materials in a live classroom situation within the structure of the two-year, post-high school electromechanical demonstration program. Some of this material was of sufficient sophistication as to be incorporated into the laboratory manuals published for the Electromechanical Technology Program by a national publishing house.

Research Competency

Research Question Five: Was the population able to conduct research in the field of Electromechanical Technology?

An occupational analysis instrument was developed through the joint effort of the fellows. This instrument listed 91 tasks in eight fields of technology. For each task a frequency of daily, weekly, monthly, seldom or not applicable was checked. Also, for each task a primary activity of instructing, modifying, analyzing, troubleshooting, installing, testing, constructing, calibrating, repairing, servicing, or operating was checked.

Forty-seven industrial establishments were sampled by the participants and their results were analyzed and reported in their Master's reports. The samples consisted of data from 52 electromechanical technician supervisors and 104 electromechanical technicians in 11 states. The selection of industrial establishments, for each of these 13 occupational analyses, was made either from a list of establishments that would be potential employers of the graduating electromechanical technicians from two-year, post-secondary electromechanical programs.

Each industrial establishment was contacted to determine if they did employ electromechanical technicians and to arrange interviews. The interviewees, both supervisors and technicians, were selected by management personnel on the basis of being classified as, or working as, electromechanical supervisors or technicians. The technicians were instructed to complete the questionnaire relating to their job. The supervisors were instructed to complete the questionnaire relating to what they expect the electromechanical technician to be able to do upon entry. Each researcher was available while the interviewee was completing the questionnaire to answer any questions and to make sure the questionnaire was completed correctly.

Follow-Up Data

Research Question Six: What were the subsequent career activities of the graduates?

A follow-up questionnaire (See Appendix B) was sent to the thirteen fellows who completed the program. It was mailed to them in March of the year following their summer graduation. The career activities being pursued by the subjects at a point in time approximately eight months after graduating are tabulated as follows:

Activity	Number
Returned to Original Institution	5
Teaching or Directing an Electromechanical Program	4
Teaching in Another Post-Secondary Technology Program	6
Teaching in a Secondary Program	2
Remained in College to Work on Advanced Degree	2
Institution Plans to Start an EM Program in the Future	2

Research Question Seven: How did the graduates rate the individual courses in the Technical Education Program?

All the fellows pursued basically the same program which lead to a master's degree in Technical Education. Only those courses that were commonly taken by all the fellows were rated. The individual courses and average rating given by the graduates are listed below: (1 poor - 5 excellent).

			Average Rating
TECED	3103	Introduction to Technical Education	4.2
TECED	4223	Technical Education Program Planning	3.9
TECED	5223	Curriculum Development in Technical Education	4.4
TECED	5233	Occupational Analysis	3.8
INDED	5340	EM Lab Experiment Preparation (Summer)	3.3
EDUC	5732	Seminar in EM Technology (Summer)	3.8
EDUC	5732	Seminar in EM Technology (Fall)	3.8
INDED	5340	Teaching in EM Technology	3.6
OAED	5480	Teaching in EM Technology	3.9
ELEN	3417	Systems Analysis	4.7

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

The problem with which this study was concerned was the acceptance or non-acceptance of the multidisciplinary Electromechanical Technology concept approach by former single-discipline technology teachers. Specifically, could these former single-discipline teachers, with no previous formal professional development exposure to Electromechanical Technology, be influenced to accept a new and different approach in technical education such that, at the end of their program, they would actively seek a leadership role at an institution which had plans to add an Electromechanical Technology or related program.

Summary

The purpose of this study was threefold: (1) to show if a more positive or negative attitude toward Electromechanical Technology was developed during the fellowship period; (2) to demonstrate that the Electromechanical Fellowship Program could develop Electromechanical Technology competencies during the stated fellowship period; and (3) to show the subsequent career activities of the participants upon completion of the program.

Two research instruments were used to answer five of the seven research questions. The first was a semantic differential instrument which was administered on three different occasions during the fellowship period of fourteen months. Research questions one, two, and three were answered with this instrument. The second research instrument was a follow-up questionnaire. Research questions six and seven were evaluated with this instrument.

The remaining two research questions were evaluated on the basis of grades earned and observed practices of the participants.

Fifteen participants were originally selected for the fellowship program. One participant dropped out midway through the fall semester and another at the end of the spring semester. Therefore, complete sets of data were collected on thirteen participants who represent the entire population under analysis in this report.

Conclusions

Answers to seven research questions were sought in this study. In an attempt to provide at least a partial answer to the seven questions, data were collected and analyzed from thirteen participants on the Electromechanical Technology Fellowship Program. This section states each research question and the conclusion based upon the findings.

Research Question One: Was there any significant attitudinal change in the population under study from the beginning to the end of the program across all forty-eight semantic questions?

Summary and Conclusions: In the analysis of the data relating to attitudinal change across all forty-eight semantic questions from the beginning to the end of the program, there was a significant attitudinal change. Using an analysis of variance with two way classification for repeated measures it was determined that this attitudinal change was significant beyond the five percent level. When graphically plotted, this attitudinal change is shown to increase with each test administration. The most increase was apparent between the pre- and mid-test administrations (2.5 points). Less increase showed up between the mid- and post-test administrations (1 point).

The conclusion of the investigator was that there was a significant positive attitudinal change in the population from the beginning to the end of the program across all forty-eight concepts.

Research Question Two: Was there a difference in the attitudinal change (if any) in the area of the population's original technical specialty as compared to some other technical area?

Summary and Conclusion: Random selection was used to equally divide the population into three sub-groups depending on their original technical specialty or teaching area. There were three entries per cell in sub-groups: physical science, electronics, and related technologies.

The F ratio calculation for the row effect indicated that there was a significant difference in attitudinal change between original technical specialties. This was significant beyond the five percent level. The null hypothesis that the original technical specialty had no effect on attitudinal change was rejected.

When graphically plotted the attitudinal change is apparent. The mean scores for the physical science sub-group started at the lowest point of the three sub-groups. The change in attitude of the sub-group was the greatest during the pre- mid-test period (5 points). During this same period the electronics sub-group experienced no change while the related technologies sub-group changed (2 points). During the period between the mid-, post-test the electronics and related technologies sub-groups increased while the physical science sub-group remained unchanged.

The conclusion of the investigator was that the program was highly oriented toward electronics thus causing the electronics sub-group to experience no attitudinal change during the first half, even though it started at a much higher point. The program was better received during the second half by the electronics and related technologies sub-groups than by the physical science sub-group.

Research Question Three: Was the acceptance of the eleven Electromechanical concepts by the population distributed equally across the areas of electricity, mechanics, physics, and electromechanical?

Summary and Conclusions: The analysis of this question was divided into four parts. Attitudinal change during the academic year for each sub-group was analyzed with respect to electricity, mechanics, physics, and electromechanical separately.

In the first part of this question the raw effect was calculated to determine if any significant difference existed between individual sub-groups with respect to their degree of acceptance, or attitude toward the electromechanical approach to electricity. This calculation determined the F ratio to be .96 which was not significant at the five percent level ($F_{.05} = 3.55$). The null hypothesis was accepted and it was concluded that no significant difference existed between individual sub-groups with respect to their degree of acceptance of the electromechanical approach to electricity.

The column effect F ratio was calculated to be 1.87 which was not significant beyond the five percent level ($F_{.05} = 3.55$). The null hypothesis was accepted and it was also concluded that no significant attitudinal change toward electricity existed during the academic year, by the sub-groups collectively.

The second part of this research question was analyzed with respect to mechanics. The F ratio for the row effect was calculated to be 5.29 which was significant at the five percent level ($F_{.05}$ = 3.55). The null hypothesis that no significant difference existed between individual sub-groups with respect to their degree of acceptance of the electromechanical approach to mechanics was rejected.

It was concluded that there was a difference between individual sub-groups with respect to their degree of acceptance of the electromechanical approach to mechanics and this difference was significant.

There was no significant difference in attitudinal change by the sub-groups collectively during the academic year toward mechanics. As shown graphically in Chapter IV, Figure 4, both the electronics and related technologies sub-groups experienced a decrease in positive attitude during the first half of the program. During the second half these same two sub-groups showed a increase in positive attitude toward mechanics while the physical science sub-group showed a slight decrease.

It was concluded by the investigator after analyzing this part of question three that the electromechanical approach to mechanics was weak and the participants were not able to fully grasp the relationship between the two.

The electromechanical approach to physics, as analyzed in the third part of this question, was accepted significantly different by each of the three sub-groups. Figure 5 shows a graphical representation of this fact. The electronics and physical science sub-groups showed no increase in positive attitude during the first half of the program while the related technologies showed a slight increase. During the second half, the same two sub-groups that previously showed no increase, showed a marked increase while the related technologies sub-group again showed only a slight increase.

The conclusion of the investigator was that during the first half of the program there was little or no obvious relationship between electromechanical approach and physics, but during the second half there was enough to cause a significant attitudinal change in the sub-groups, individually.

Collectively, the attitudinal change by the sub-groups toward the electromechanical approach to physics was not significant during the entire academic year.

It was concluded that the electromechanical approach to physics was not strong enough during the entire duration of the program to cause any significant attitudinal change in the sub-groups collectively.

The fourth part of question three was analyzed to determine any significant difference in attitudinal change toward the electromechanical approach to the area of electromechanical by the sub-groups individually and collectively.

The F ratio for the row effect was calculated to be 5.10. This value was significant at the five percent level ($F_{.05} = 3.55$), and therefore, the null hypothesis was rejected. It was concluded that there was a significant difference existing between sub-groups with respect to their acceptance of the electromechanical approach to the area of electromechanical.

The column effect calculation showed that there was a significant difference in attitudinal change toward the electromechanical approach to the area of electromechanical during the academic year by the sub-groups collectively.

Figure 6 is a graphical representation of the attitudinal change during the academic year by the sub-groups toward the electromechanical approach to the area of electromechanical.

It was concluded that the electromechanical approach to the area of electromechanical was sufficiently demonstrated throughout the academic year to cause a positive increase in attitude by the sub-groups both individually and collectively during the entire academic year.

In analyzing the data represented graphically in Figures 3-6, some general conclusions were drawn about the acceptance of the electromechanical approach to electronics, mechanics, physics, and electromechanical by the sub-groups.

1. Those members of the electronics sub-group had a much more positive attitude toward the electromechanical approach to all areas than did either of the other two sub-groups at the beginning of the academic year and ended up with a much more positive attitude at the end of the year. Therefore, it is concluded that persons with an electronics background can more readily accept the electromechanical approach than those with a physical sciences or related technologies background.
2. The electromechanical approach to physics was not accepted by those persons with an electronics or physical sciences background during the first half of the program.
3. The electromechanical approach to mechanics was rejected by the electronics and related technologies sub-groups during the first half of the program.

Research Question Four: Was there a demonstrated ability by the population to develop laboratory instructional materials?

Summary and Conclusion: The population developed laboratory instructional materials in a classroom situation under the leadership of a master teacher and also during a student teacher situation. While student teaching the population was allowed to use their own developed materials in the laboratories of the two-year, post-high school electromechanical demonstration program.

It was concluded that there was a demonstrated ability to develop laboratory instructional materials by: (1) The grades received at the end of the formal course taken - seven received a grade of A (excellent) and six received a grade of B (superior); (2) the fact that developed materials were actually used in a live classroom teaching situation; and (3) some of this material was of sufficient sophistication as to be incorporated into the laboratory manuals published for the Electromechanical Technology Program by a national publishing house.

Research Question Five: Was the population able to conduct research in the field of Electromechanical Technology?

Summary and Conclusion: The population, through a joint-effort, developed a research instrument which was used to conduct an occupational analysis. Forty-seven industrial establishments were sampled by the participants and their results were analyzed and reported in their Master's report. The results consisted of data from 52 electromechanical technician supervisors and 104 electromechanical technicians 11 states.

Each industrial establishment was contacted to determine if they did employ electromechanical technicians and to arrange interviews. The interviewees, both supervisors and technicians, were selected by management personnel on the basis of being classified as, or working as, electromechanical supervisors or technicians.

It was concluded by the investigator that the population was able to conduct research in the field of Electromechanical Technology as evidenced by the instrument developed and the data gathered through an occupational analysis.

Research Question Six: What were the subsequent career activities of the participants?

Summary and Conclusion: In March, following their summer graduation, a follow-up questionnaire was mailed to the thirteen fellows who completed the program. In this questionnaire, each person was asked what career activity they were presently pursuing. They were also asked if they returned to the same institution from which they originally entered the program.

The results of the questionnaire indicating the participants subsequent career activities were as follows:

Activity	Number
Returned to Original Institution	5
Teaching or Directing an Electromechanical Program	4
Teaching in Another Post-Secondary Technology Program	6
Teaching in a Secondary Program	2
Remained in College to Work on Advanced Degree	2
Institution Plans to Start an EM Program in the Future	2

The following conclusions were formulated by the investigator with respect to this research question:

1. Five of the participants were committed to return to their original institutions, hence had no opportunity to seek a position in electromechanical technology unless their institution was so committed.

2. Six of the participants did not seek, or were unable to find, a teaching position related to electromechanical technology.

3. Two of the participants were sufficiently inspired to remain in college to continue work on a doctorate.

4. Two of the institutions to which two of the participants returned had plans to start an electromechanical technology program in the future.

5. Four of the graduates were teaching or directing an electromechanical technology program.

Research Question Seven: How did the graduates rate the individual courses in the Technical Education program?

Summary and Conclusion: All of the participants pursued basically the same master's degree program in Technical Education. They rated only those courses that were commonly taken by all of them. The results of this rating are tabulated below:

			Average Rating
TECED	3103	Introduction to Technical Education	4.2
TECED	4233	Technical Education Program Planning	3.9
TECED	5223	Curriculum Development in Technical Education	4.4
TECED	5233	Occupational Analysis	3.8
INDED	5340	EM Lab Experiment Preparation (Summer)	3.3
EDUC	5732	Seminar in EM Technology (Summer)	3.8
EDUC	5732	Seminar in EM Technology (Fall)	3.8
INDED	5340	Teaching in EM Technology	3.6
OAED	5480	Teaching in EM Technology	3.9
ELEN	3417	Systems Analysis	4.7

Only three courses received a rating of 4 or better (1 poor - 5 excellent). Those courses which required active participation by the fellows received the lowest ratings.

The following conclusions were reached by the investigator:

1. The engineering course in Systems Analysis, while the most difficult, was rated highest because of its direct application to Electromechanical principles.
2. Two of the three Technical Education courses commonly taken were rated highest of all other courses taken, with the exception of the Systems Analysis course. This was due to the participants familiarity with the Technical Education discipline.
3. The overall design of the program was such that every course taken received an above average rating.

Recommendations

The teacher education program that was evaluated by this study was originally proposed to run for three years. Had this been allowed to happen, much more valid conclusions could have been drawn with respect to program design. Three groups of master's degree fellows would have given the investigator a much broader base from which to analyze the data gathered. However, the one complete program year did allow for sufficient data from which to make the following recommendations:

1. A similarly designed program be offered in the future; that is, one in which the students enter as a group and continue through the entire program as a group.

2. All students be taught to design instructional materials immediately and be allowed to experiment with materials so designed in a live classroom situation in a technology program.
3. More emphasis be given to the electromechanical approach to physics and mechanics during the first half of the program.
4. Students with a teaching background in Electronics Technology be selected for this type of program.
5. Students be encouraged to seek summer employment as electromechanical technicians to gain a better understanding of this technology.
6. More engineering courses be taken by the students which will present the concepts of electromechanics as did the one course in Systems Engineering.

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APPENDIX A

SAMPLE SEMANTIC DIFFERENTIAL INSTRUMENT

Semantic Differential

Month Day Year

Instructions:

It is of interest to observe one's feelings toward teaching and supervising an Electromechanical technician program. On the succeeding pages are several concepts regarding the EM technician program. You are to place an X in the blank of each semantic differential that most nearly describes your reaction to the concept stated in the box. Place the X between the slanted lines.

Place your birth month, day, and year in the space provided at the top of this sheet.

Please react to each differential and do not leave any blank.

Teaching energy and work as related to physics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching work and energy as related to electricity is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching work and energy as related to mechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching work and energy as related to electromechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching opposition to flow as related to physics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching opposition to flow as related to electricity is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching opposition to flow as related to mechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching opposition to flow as related to electromechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching static energy storage as related to physics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching static energy storage as related to electricity is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

eaching static energy storage as related to mechanics is:

actical	/ / / / / / / /	Impractical
ssimistic	/ / / / / / / /	Optimistic
nple	/ / / / / / / /	Complex
od	/ / / / / / / /	Bad
py	/ / / / / / / /	Sad
'mal	/ / / / / / / /	Informal
asing	/ / / / / / / /	Annoying
ecessary	/ / / / / / / /	Necessary
licable	/ / / / / / / /	Unapplicable
arding	/ / / / / / / /	Unrewarding

Teaching static energy storage as related to electromechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching time constants as related to physics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching time constants as related to electricity is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching time constants as related to mechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching time constants as related to electromechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching dynamic energy storage as related to physics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching dynamic energy storage as related to electricity is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching dynamic energy storage as related to mechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching dynamic energy storage as related to electromechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching impedance as related to physics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching impedance as related to electricity is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching impedance as related to mechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching impedance as related to electromechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching impedance matching as related to physics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching impedance matching as related to electricity is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching impedance matching as related to mechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching impedance matching as related to electromechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching resonance phenomena as related to physics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching resonance phenomena as related to electricity is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching resonance phenomena as related to mechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching resonance phenomena as related to electromechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching wave motion as related to physics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching wave motion as related to electricity is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching wave motion as related to mechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching wave motion as related to electromechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching amplification as related to physics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching amplification as related to electricity is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching amplification as related to mechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching amplification as related to electromechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching feedback as related to physics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching feedback as related to electricity is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching feedback as related to mechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching feedback as related to electromechanics is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Laboratory learning experiences are:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Teaching without a textbook is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

As a core for other technology programs, the electromechanical curriculum is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

Reinforcement of learning is:

Practical	/ / / / / / / /	Impractical
Pessimistic	/ / / / / / / /	Optimistic
Simple	/ / / / / / / /	Complex
Good	/ / / / / / / /	Bad
Happy	/ / / / / / / /	Sad
Formal	/ / / / / / / /	Informal
Pleasing	/ / / / / / / /	Annoying
Unnecessary	/ / / / / / / /	Necessary
Applicable	/ / / / / / / /	Unapplicable
Rewarding	/ / / / / / / /	Unrewarding

APPENDIX B

SAMPLE FOLLOW-UP QUESTIONNAIRE

FOLLOW-UP QUESTIONNAIRE FOR EVALUATING THE 1969-70
EPDA ELECTROMECHANICAL FELLOWSHIP PROGRAM

NAME________________________________ DATE______________

POSITION OR TITLE____
(Please be specific)

INSTITUTION____

ADDRESS OF INSTITUTION___________________________________
Number Street

____
City or Town State Zip Code

Telephone Number: ________ ____________
Area Code

JOB DESCRIPTION____

____

____

* * *

1. Did you return to work at the institution where employed before entering the EPDA Program? Yes_____ No_____

2. What technology or discipline did you teach before entering the EPDA Program? (For example: electronics, mechanics, or technical mathematics.)

____
Major Area

____
Minor Area (If any)

3. Does your institution now have an Electromechanical Technology Program? Yes_____ No_____ If no, are there plans to start a program? Yes_____ No_____ If so, what year?________

4. Were you hired specifically to start an Electromechanical Technology Program? Yes_____ No_____

5. If you have an Electromechanical Program and/or courses, please list the courses offered in Electromechanical Technology during the 1970-71 school year. (If units other than semesters are utilized, please specify.)

Fall Semester	Spring Semester

6. Are any of the courses being taught at your institution those that were developed at OSU? If so, please specify.

7. Of those courses developed at OSU, please list any that were changed for better adapting to your institution.

Course	How Changed
______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________
______________________	______________________

8. Has an advisory committee been established to advise in Electro-mechanical Technology? Yes_____ No_____

9. Has equipment been ordered to facilitate teaching electromechanical courses? Yes_____ No_____

10. Has space been alloted for EM laboratories? Yes_____ No_____

11. Have you been asked to serve as a consultant for Electromechanical Technology Program activities at other institutions, either with or without remuneration? Yes_____ No_____

12. Please rate the following courses that were taken by you as part of your Master's degree plan of study. Rate them from 1 (poor) to 5 (excellent). The concern is whether or not they helped you gain additional competency as a potential leader in Electromechanical Technology.

TECED	3103	Introduction to Technical Education	/ 1 / 2 / 3 / 4 / 5 /
TECED	4233	Technical Education Program Planning	/ 1 / 2 / 3 / 4 / 5 /
TECED	5223	Curriculum Development in Technical Education	/ 1 / 2 / 3 / 4 / 5 /
TECED	5233	Occupational Analysis	/ 1 / 2 / 3 / 4 / 5 /
INDED	5340	EM Lab Experiment Preparation (Summer)	/ 1 / 2 / 3 / 4 / 5 /
EDUC	5732	Seminar in EM Technology (Summer)	/ 1 / 2 / 3 / 4 / 5 /
EDUC	5732	Seminar in EM Technology (Fall)	/ 1 / 2 / 3 / 4 / 5 /
INDED	5340	Teaching in EM Technology	/ 1 / 2 / 3 / 4 / 5 /
OAED	5480	Teaching in EM Technology	/ 1 / 2 / 3 / 4 / 5 /
Other		______________________ (Please specify)	/ 1 / 2 / 3 / 4 / 5 /
		______________________	/ 1 / 2 / 3 / 4 / 5 /
		______________________	/ 1 / 2 / 3 / 4 / 5 /
		______________________	/ 1 / 2 / 3 / 4 / 5 /
		______________________	/ 1 / 2 / 3 / 4 / 5 /

Please use this space to clarify any answers given above: ______________

____

____

____

____

____

____

APPENDIX C

SAMPLE ANALYSIS OF VARIANCE CALCULATION

SAMPLE CALCULATIONS FOR F RATIO DETERMINATION

Research Question Number Two - Was there a difference in the attitudinal change (if any) in the area of the population's original technical specialty was compared to some other technical area?

R = 3 rows; C = 3 columns; N = 3 entries per cell; N = 27 total entries

TOTALS SQUARED

Total of row T's squared:

$$\sum_{r=1}^{R} Tr.^2 = 638,410$$

Total of column T's squared:

$$\sum_{c=1}^{C} Tr.^2 = 637,170$$

Total of all T's squared:

$$\sum_{r=1}^{R} \sum_{c=1}^{C} T_{rc}^2 = 213,054$$

Total of all cell entries squared:

$$\sum_{r=1}^{R} \sum_{c=1}^{C} \sum_{i=1}^{N} X_{rci}^2 = 71,454$$

SUM OF SQUARES

Rows:

$$\frac{1}{15} \sum_{r=1}^{R} T_r.^2 - \frac{T^2}{n} = \frac{638,410}{9} - \frac{(1382)^2}{27} = 196$$

Columns:

$$\frac{1}{NR}\sum_{c=1}^{C} T_{\cdot c}^{2} - \frac{T^2}{N} = \frac{637{,}170}{9} - \frac{(1382)^2}{27} = 59$$

Within Cells:

$$\sum_{r=1}^{R}\sum_{c=1}^{C}\sum_{i=1}^{N} X_{rci}^{2} - \frac{1}{N}\sum_{r=1}^{R}\sum_{c=1}^{C} T_{rc}^{2} = 71454 - \frac{213054}{3} = 436$$

Interaction:

$$\frac{1}{N}\sum_{r=1}^{R}\sum_{c=1}^{C} T_{rc}^{2} - \frac{1}{NC}\sum_{r=1}^{R} - T_{r\cdot}^{2} - \frac{1}{NR}\sum_{c=1}^{C} T_{\cdot c}^{2} + \frac{T^2}{N}$$

$$= \frac{213{,}054}{3} - \frac{638{,}410}{9} - \frac{637{,}170}{9} + \frac{(1382)^2}{27} = 461$$

<u>F Ratios</u> (From Table IV)

$$F_i = \frac{s_i^2}{s_w^2} = \frac{115}{24} = 4.79$$

$$F_r = \frac{s_r^2}{s_w^2} = \frac{98}{24} = 4.08$$

$$F_c = \frac{s_c^2}{s_w^2} = \frac{30}{24} = 1.25$$

Source: Statistical Analysis in Psychology and Education, by George A. Ferguson, New York: McGraw-Hill Book Company, Inc.

VITA

Marshall Graves Holman

Candidate for the Degree of

Doctor of Education

Thesis: EVALUATION OF A TEACHER EDUCATION PROGRAM IN ELECTROMECHANICAL TECHNOLOGY

Major Field: Higher Education

Biographical:

Personal Data: Born in Pasadena, California, July 21, 1933, the son of Mr. and Mrs. Joseph R. Holman.

Education: Graduated from Pasadena High School, Pasadena California, in June, 1951; received the Bachelor of Science degree from the University of Arizona in 1957, with a major in Mining Engineering; received the Master of Science degree from the University of Arizona in 1964, with a major in Metallurgical Engineering; completed requirements for the Doctor of Education degree at Oklahoma State University in July, 1972.

Professional Experience: Community College Technical Education teacher and Division Chairman, Arizona Western College, Yuma, 1964-1969; Assistant Professor, School of Occupational and Adult Education, Oklahoma State University, 1969-1970; Community College teacher and Division Chairman, Oscar Rose Junior College, Midwest City, Oklahoma, 1970-1971; County Coordinator for Vocational and Technical Education, Cochise County, Arizona, 1971-1972.