DOCUMENT RESUME

ED 041 144 VT 011 395

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TITLE Instructional Approaches and Content in Vocational Education.
INSTITUTION American Educational Research Association, Washington, D.C.
PUB DATE 70
NOTE 69p.; Papers presented at the Annual Meeting of the American Educational Research Association (Minneapolis, Minn., Mar. 5, 1970)

EDRS PRICE EDRS Price MF-$0.50 HC-$3.55
DESCRIPTORS Academic Achievement, *Conference Reports, *Educational Strategies, Guidance Services, Problem Solving, Resource Materials, Speeches, Teacher Attitudes, Teacher Education Curriculum, Teaching Methods, Teaching Techniques, *Vocational Education

ABSTRACT

This collection of papers presented at the 1970 Annual Meeting of the American Educational Research Association includes: (1) "An Experimental Evaluation of the Effectiveness of Selected Techniques and Resources on Instruction in Vocational Agriculture," by A.A. Kahler and others, discussing the influence of techniques and methods on student attainment in selected subject matter areas, (2) "Individual Learner Variables and the Prescribing of Instructional Methods: An Experimental Investigation" by R.W. Haskell, reporting the relationship between selected personality variables of learners and their academic performance, (3) "The Effectiveness of Selected Self-Instructional Approaches in Teaching Diagnostic Problem Solving" by C.R. Finch, describing the effects of three different approaches of teaching trouble-shooting, (4) "A Factor Analysis of the Common Training Needs in Teacher Education Programs for Occupational Education" by E.W. Courtney, presenting an approach to developing common curriculums for vocational teachers, and (5) "A Multi-Dimensional Approach to the Guidance Concept Among Secondary School Personnel" by C.I. Jones and P.S. Vivekananthan, discussing an attempt to determine differences in selected educational and career concepts held by secondary school faculty. (SB)

INSTRUCTIONAL APPROACHES AND CONTENT
IN VOCATIONAL EDUCATION

Papers Presented at the 1970 Annual Meeting of the American Educational Research Association, March 5, 1970, Minneapolis, Minnesota

AMERICAN EDUCATION RESEARCH ASSOCIATION
Special Interest Group - Vocational Education
1970 Annual Meeting
Minneapolis, Minnesota
March 5, 1970

AN EXPERIMENTAL EVALUATION OF THE EFFECTIVENESS OF SELECTED TECHNIQUES AND RESOURCES ON INSTRUCTION IN VOCATIONAL AGRICULTURE

Paper Presented By

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Purpose:

The purpose of this study was to evaluate selected techniques and resources on student attainment in selected subject matter areas in vocational agriculture. Specifically, two questions were posed: (1) What is the effect of certain instructional techniques and resources in the teaching of vocational agriculture in Iowa? (2) What is the effectiveness of these techniques and resources on student achievement at each of the four high school grade levels: ninth grade, tenth grade, eleventh grade, and twelfth grade?

Design of Study:

Iowa high schools offering an approved four-year program of vocational agriculture were identified and a random sample of 48 high schools were selected to participate in the experiment.

Each of these 48 selected high schools was randomly assigned to one of the eight treatments. The eight treatment groups consisted of audio-tutorial, demonstrations, field trips, prepared lesson plans, single concept films, transparencies, video-tape and control. When the students in these schools were stratified by grade level, it was observed that 696 were in grade nine, 629 in grade ten, 639 in grade eleven, and 539 in grade twelve. This comprised a total of 2,503 students in the 48 high schools.

Development of Instructional Materials:

An appropriate unit of instruction was selected for each of the four high school grade levels. These units of instruction included animal health for the ninth grade, commercial fertilizer for the tenth grade, small gasoline engines for the eleventh grade and farm credit for the twelfth grade. A three-week teaching outline for each of the grade levels was developed which provided the overall objectives, day-by-day objectives and reading assignments.

The instructional technique tested in each treatment group and the material needed to implement the use of the techniques were developed by the researchers after consultation with subject matter specialists at Iowa State University. Identical equipment and material were provided for the six schools within each treatment group. Uniform reference material was provided for each of the 48 participating schools.

Training of Teachers:

The participating teachers received two training sessions prior to the experiment. The first meeting was held to explain the purposes and design of the study and explain the controls imposed on the experiment. Data were also collected on teacher experience, tenure and education level. Measures taken on the teachers included the Minnesota Teacher Attitude Inventory and a pre- and post-test on teacher knowledge of the four subject matter areas. Item analysis of the instructor post-test scores revealed the following reliability coefficients: animal health, .80; commercial fertilizer, .87; small gasoline engines, .85; and farm credit, .84.

The second training meeting was held to familiarize the teachers with the experimental techniques and resources to be tested and train them in the use of these techniques and resources.

Implementation of the Study and Data Collected:

The experiment was conducted over a three-week period beginning March 21, 1969. During this time the instructors followed outlines provided for each of the units of study and taught as they would normally teach that unit injecting the use of the instructional media on the pre-determined days. The only other limitation placed on the teacher was that he was not to use any of the other media being tested in the experiment.

Student achievement was measured by the use of a pre- and post-test in each of the four subject matter areas. The reliability of the four subject matter tests were as follows: animal health, .85; commercial fertilizer, .85; small gasoline engines, .85; and farm credit, .87. The reliability was computed using the Cronbach alpha formula.

Prior to the experiment, the following tests were administered by each of the school counselors:

a. Otis Quick-Scoring Mental Ability Test

b. Kuder General Interest Survey

c. Nebraska Agriculture Achievement Test

d. Differential Apptitude Test - Mechanical Section

e. Differential Apptitude Test - Abstract Section

f. Differential Apptitude Test - Verbal Section

A questionnaire was also administered to obtain data on the students socio-economic background. In addition, each student was asked to indicate which of a selected list of activities they had performed in the appropriate subject matter area.

Findings:

A single classification analysis of variance was computed on the mean pre-test scores in order to determine if there were differences between the treatment groups. The mean pre-test scores and appropriate F values are listed in Table 1. Inspection of the data in the table revealed that there were no significant differences in student knowledge among treatment groups prior to the application of the treatments.

A two-factor experiment with repeated measures was the next analysis completed. The analysis was to determine if there were significant differences in knowledge gained by students in the treatment groups from the time of the pre-test to the post-test. A separate analysis was computed for each class. Analysis for the classes taught animal health is presented in Table 2. The F value for time indicates a highly significant increase in knowledge gained during the experiment as measured by the pre- and post-test scores. This analysis also reveals no significant differences due to method or interaction of method and time. Similar results were observed for commercial fertilizer classes (Table 3), small gasoline engine classes (Table 4), and farm credit classes (Table 5).

Instructors were placed in three equal sized groups of high, medium and low based on their pre-test scores. The relationships between instructors' knowledge of subject matter and student achievement were then evaluated by analysis of variance and t test techniques. In the animal health, commercial fertilizer and farm credit units, the highest mean post-test scores were achieved by students whose instructors were in the medium group. In the

Table 1. Mean pre-test scores and calculate F values by subject matter unit for the treatment groups.

Subject Matter	Treatment Means								F Value
	1[a]	2[a]	3[a]	4[a]	5[a]	6[a]	7[a]	8[a]	
Animal Health	33.45	35.09	35.38	30.98	30.53	36.22	37.11	34.04	2.02
Commercial Fertilizer	29.23	31.29	33.43	31.66	29.48	30.33	27.46	33.62	1.41
Small Gasoline Engines	44.93	40.41	40.28	43.08	41.23	40.54	41.33	38.42	0.47
Farm Credit	40.65	44.25	51.52	46.00	44.55	40.74	47.13	48.39	0.88

[a]1 - Audio-tutorial, 2 - Demonstrations, 3 - Field trips, 4 - Prepared lesson plans, 5 - Single concept films, 6 - Transparencies, 7 - Video-tape, 8 - Control

Table 2. Analysis of a two-factor experiment using the repeated measures of mean pre- and post-test scores from classes taught the animal health unit.

Source of Variation	Degrees of Freedom	Mean Square	F
Method	7	110.04	1.96
Error (a)	40	56.01	
Time	1	8044.45	433.92**
Method X Time	7	23.75	1.28
Error (b)	40	18.54	
Total	95		

**Significant beyond the one percent level.

Table 3. Analysis of a two-factor experiment using the repeated measures of mean pre- and post-test scores from classes taught the commercial fertilizer unit.

Source of Variation	Degrees of Freedom	Mean Square	F
Method	7	66.50	.88
Error (a)	40	75.66	
Time	1	4901.02	249.81**
Method X Time	7	20.19	1.03
Error (b)	40	19.62	
Total	95		

**Significant beyond the one percent level.

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Table 4. Analysis of a two-factor experiment using the repeated measures of mean pre- and post-test scores from classes taught the small gasoline engines unit.

Source of Variation	Degrees of Freedom	Mean Square	F
Method	7	22.22	.34
Error (a)	40	64.48	
Time	1	11,315.62	399.78**
Method X Time	7	45.08	1.59
Error (b)	40	28.30	
Total	95		

**Significant beyond the one percent level.

Table 5. Analysis of a two-factor experiment using the repeated measures of mean pre- and post-test scores from classes taught the farm credit unit.

Source of Variation	Degrees of Freedom	Mean Square	F
Method	7	117.44	.83
Error (a)	40	141.64	
Time	1	5204.53	200.10**
Method X Time	7	34.01	1.31
Error (b)	40	26.01	
Total	95		

**Significant beyond the one percent level.

small gasoline engine unit, the highest mean scores were obtained by students whose instructors were in the low group. These differences were not significant for animal health, commercial fertilizer and small gasoline engine units. The post-test score differences between groups were significant for the farm credit unit.

For each of the subject matter units, a highly significant difference between the mean pre- and post-test scores of the instructors' knowledge was observed when a t statistic was calculated. These findings indicate that the instructors did change in their knowledge of the subject matter while teaching the units.

When students were stratified by size of class, it was observed that those in large classes (15-25) achieved somewhat higher when the audio-tutorial, prepared lesson plan, single concept film and video tape media were used. Students in the small classes (5-14) excelled when taught with demonstrations, field trips and transparencies. Students in the large classes had a mean overall gain of 10.17 compared to 10.14 for those in small classes. These differences were not statistically significant.

Correlations were calculated between student achievement, as measured by the post-test scores and 44 other variables in each of the four classes. In the animal health classes, the post-test score was correlated with student intelligence (.45), mechanical reasoning (.57), agricultural achievement (.58), outdoor interest (.29), mechanical interest (.28), and scientific interest (.29).

Student post-test scores in the commercial fertilizer unit were correlated with intelligence (.46), mechanical reasoning (.32), abstract reasoning (.49), verbal reasoning (.60), agricultural achievement (.62), outdoor interest (.32), mechanical interest (.30), and scientific interest (.32).

In the small gasoline engine unit, student post-test scores were correlated with intelligence (.45), mechanical reasoning (.40), abstract reasoning (.41), verbal reasoning (.50), agricultural achievement (.54), mechanical interest (.26), scientific interest (.26), semesters of science (.21), and semesters of mathematics (.30).

The following variables were found to be correlated with student achievement in the farm credit unit: intelligence (.51), mechanical reasoning (.29), abstract reasoning (.44), verbal reasoning (.54), agricultural achievement (.60), outdoor interest (.30), mechanical interest (.20), computational interest (.23), scientific interest (.26), semesters of science (.31), and semesters of mathematics (.37).

The proposal for the project was written and initiated by Dr. Alan A. Kahler and Professor C. E. Bundy and submitted to the Iowa Department of Public Instruction, Division of Vocational Education for funding from ancillary funds provided by the Vocational Education Act of 1963. This project was conducted in cooperation with the Department of Agricultural Education and the Iowa Agriculture and Home Economics Experiment Station of Iowa State University, the Vocational Agriculture Section of the Department of Public Instruction, and the Iowa Research Coordinating Unit.

Individual Learner Variables and the Prescribing of Instructional Methods -- An Experimental Investigation*

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Large numbers of research studies have been devoted to the efficacy of utilizing a specific teaching method versus this or that alternative method. Such media comparison studies have "produced in most cases the same monotonous results of 'no significant differences...'" (Saettler, 1968). Where significant differences have been found, they generally have not been in agreement with other findings concerned with the same problem area. These findings may indicate that investigators have not examined adequately the performance of individual learners under a particular treatment condition, but have expected or hypothesized (perhaps wrongly) that <u>all</u> learners will do better under a given instructional method.

Studies have shown, for example, that students with the same ability level perform differently in different learning situations. The findings of a study by Porter (1961) indicated that when conventional instruction was used the lower half of the IQ distribution of subjects made the greatest gains. When programmed instruction was used, however, the upper half of the IQ distribution made the greatest gains. Eigen, (1962) using a teaching machine,

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*Paper presented at the annual meeting of the American Educational Research Association -- Special Interest Group in Vocational Education, Minneapolis, March, 1970.

a horizontal programmed text, and a vertical programmed text, found that the academic performance of learners with the same ability level was significantly affected depending on the type of presentation mode utilized.

In a study that examined various methods of student response to programmed materials, McNeil (1962) found oral responding to be particularly effective for subjects in the lower IQ range. Burton and Goldbeck (1962) also found an interaction between response factors and ability level. The studies of Gropper and Lumsdaine (1965) and Hanson and Komoski (1965) also lend support to the contention that learners with the same ability level perform differently in different learning situations.

The interaction between specific learner personality characteristics and classroom environments has been investigated by several researchers also. Snow and others (1965) conducted a study designed to determine if, and how, selected personality variables might be differentially associated with student achievement when the same subject matter was presented by film and lecture methods. Using the Gordon Personal Profile to assess personality, and an immediate recall test to measure achievement, it was found that subjects characterized as active, assertive, self-assured, and independent, who were subjected to the lecture method, significantly outperformed ($p < .05$) similarly described students who were assigned to the film condition. The lowest quarter of students on the Responsibility scale, who were placed in the lecture group, achieved significantly higher scores ($p < .05$) on the criterion test than did their counterparts who were in the film-presentation group.

Doty and Doty (1964) identified low social need as an important personality characteristic for learners exposed to programmed instruction. Traweek (1964) showed that successful students who were exposed to programmed instruction were characterized by more withdrawn tendencies and were less likely to be self-reliant. The results of other studies also have demonstrated that the academic performance of learners who possess similar personality characteristics will be significantly affected depending on the instructional method utilized (McCurdy and Eber, 1953; Beach, 1960; Lublin, 1965).

Such findings strongly suggest that the best teaching method for <u>some</u> students is not the best teaching method for <u>all</u> students. Thus, the answer to effective instruction may be found in the interaction between learners and instructional method rather than in the method per se. Moreover, such information would be essential for those interested in adapting the school environment to individual learner needs and differences.

The purpose of the present study, then, was to investigate the relationship between selected personality variables of learners and their academic performance under two specific methods of instruction, using industrial education content. Of particular concern to the author was whether individual learners would be differentially affected by the method of instruction utilized and if so, could the characteristics of learners be specified in such a way that one might increase learning by prescribing instructional method for such learners in the future.

Method

Subjects for this study were 163 students who were enrolled in one of nine industrial education drafting courses at two large senior high schools in Lake County, Indiana.

Instructional Content, Treatments, and Procedures. The content which was utilized during the course of this experiment consisted of a short unit on arc welding symbols. This unit included the basic symbols used on drawings and blueprints to properly designate various types of arc welds according to American Welding Society standards.

This content was presented to subjects either by means of a linear-type programmed instruction booklet (Bowman and Dixon, 1966), designated as the experimental treatment group (N=78), or by a lecture-discussion presentation method, designated as the comparison treatment group (N=67). One group of learners (N=18) was used as a control. Treatment conditions were assigned randomly to these groups.

In the case of the experimental treatment students studied the programmed material and were required to make written responses to the program as they proceeded. The teacher went over the first few frames of the linear program with subjects in order to insure that they understood exactly how they were to proceed. Thus, with the exception of the first few minutes of the first class period, students studied the material at their own pace without any assistance from the teacher.

Subjects receiving the comparison treatment were exposed to a lecture presentation by the teacher who utilized a series of transparencies to help convey the content. Students, in turn, were requested to make either oral responses to questions, or written responses on the chalkboard at the request of the teacher. They also were encouraged to ask questions of the teacher whenever they failed to understand any of the material being taught. Maximum treatment time was four 54-minute class periods or 216 minutes. The control group did not receive any instruction concerned with arc welding symbols during the course of the study.

Instruments. The data for analysis were obtained from three sources: The Guilford-Zimmerman Temperament Survey (GZTS) was used to obtain ten specific personality measures on each individual learner. The Wonderlic Personnel Test (WPT) was used to measure the general mental ability of each student. A researcher-developed 72-item multiple-choice type test was used to measure learner academic achievement. The K-R 20 estimate of reliability for this test was .95.

Analysis. Individual scores on each of the ten personality traits measured by the GZTS were categorized into one of three groups: (1) scores which fell one-half a standard deviation or more above the mean, (2) scores which were between one-half a standard deviation above the mean and one-half a standard deviation below the mean, and (3) scores which fell one-half a standard deviation or more below the mean. Data were then analyzed using a 2 x 3 (treatments x levels of personality) analysis of covariance statistical test for each of the ten personality variables. In each case, general mental ability scores as measured by the WPT served as the covariate, while scores on the achievement test served as the criterion. Where significant differences at the .05 level or beyond were found, Duncan's multiple range test for ordered means was employed.

Results

The analysis of covariance test indicated that when adjustment was made for any existing differences in general mental ability, two of the measured personality variables (General Activity and Friendliness) were still found to interact significantly ($p < .05$) with method of instruction.

The programmed learning environment tended to favor those who were inclined to be slow and methodical and/or who could be characterized as agreeable and easy to get along with, while those who were more likely to be characterized as aggressive appeared to perform better under the more conventional type of instruction.

Analysis of two other personality variables (Restraint and Emotional Stability) indicated that students who scored high on these scales tended to perform significantly better ($p < .05$) when exposed to either programmed or conventional instruction than did their counterparts who scored in the low or middle range on these variables. Thus, students who were found to be serious minded and persistent and who were cheerful and reasonably well composed performed better regardless of the instructional method to which they were exposed. Consequently, these two personality variables should be useful for predicting academic achievement.

Finally, no statistically significant difference was found between the mean achievement test scores of subjects who received programmed or conventional instruction. However, the mean achievement test scores of both of these treatment groups were found to be significantly higher ($p < .001$) than the mean achievement test score of the control group.

Summary and Discussion

The purpose of this study was to investigate the relationship between selected personality variables of learners and their academic performance under two specific methods of instruction using industrial education content. The interaction between instructional method and levels of the personality variables of General Activity and Friendliness which was found suggested that the effectiveness of the method of instruction utilized will vary as a function of certain student personality characteristics. Programmed learning, which occurred in an essentially solitary environment allowing students to progress independently at their own pace, was contrasted with conventional instruction, which permitted a considerable amount of student-teacher interaction, required students to "perform" in front of classmates by making either oral responses or written responses on the chalkboard and was teacher-paced. The results of the present study indicated that these two learning environments differentially affected student academic performance. This finding suggested that the characteristics of students could be specified in such a way that one could increase the effectiveness of learning by prescribing the instructional method to which the learner would be exposed.

The relationships between individual learner characteristics and the educational milieu are highly complex. At the theoretical level, the idea of individualizing instruction by prescribing instructional methods for students who differ in important ways seems to be fairly sound. The experimentation that has been undertaken recently at the Learning Research and Development Center at the University of Pittsburgh represents a bold attempt at applying the concept of prescribing instructional methods and materials for individual learners in a practical situation (Bolvin and Glaser, 1968) (Lindvall and Bolvin, 1967). Research results have been encouraging, although data are not available on the long range effectiveness of this experimentation.

Practical educational and/or administrative considerations may yet make the task of prescribing instructional methods quite impractical. There are many questions still unanswered and many problems still unresolved. As Briggs recently pointed out:

> One problem in applying the results of such research might be difficulty in incorporating all of the kinds of differences found into manageable media packages. In short, one may find unique sources of variance by intensive study of individuals, but one may not be able to vary media programs for each unique person characteristic (1968, p. 173).

Indeed, the task of prescribing instruction may create more problems than it solves. However, the development of such instructional devices as the cartridge loading tape recorder, the single concept film projector, and programmed instruction, among others, should provide much encouragement to industrial educators who are concerned with making the educational environment more responsive to individual needs and differences. The computer also may contribute in significant ways to this individualization by making specific instructional modifications feasible.

Whether the educational environment can or cannot be restructured to take into account the many and varied differences of individual learners seems to be a prematurely formulated worry, however. The many implications of individualizing instruction in order to make learning maximally effective are indeed imperfectly understood. Moreover, researchers have only begun to identify the vast array of possible relationships between learner characteristics and the instructional environment. At the present time, it seems more important to examine further the complexity of interrelationships between individuals and the learning milieu. Current research findings are sketchy and much more information is needed.

Research evidence and/or practical considerations eventually may dictate abandonment of the idea that the individual prescription of instructional methods is possible or warranted. Yet, providing for such individual learner differences may be a first step toward making industrial education experiences more meaningful and rewarding to students. Hopefully, this research has contributed, in some small way, to the idea that individualizing instruction may indeed be warranted.

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THE EFFECTIVENESS OF SELECTED SELF-INSTRUCTIONAL APPROACHES IN TEACHING DIAGNOSTIC PROBLEM SOLVING[1]

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American Educational Research Association
Annual Meeting
March 2-6, 1970
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[1]This research was partially supported by the Bureau of Vocational, Technical, and Continuing Education, Pennsylvania Department of Education.

THE EFFECTIVENESS OF SELECTED SELF-INSTRUCTIONAL APPROACHES IN TEACHING DIAGNOSTIC PROBLEM SOLVING

Although a number of investigations have indicated that equipment simulators can be used as effectively as actual equipment in teaching diagnostic problem solving or troubleshooting (8,10), simulator use in public education has been limited. The reason for restricted utilization of simulators in troubleshooting instruction can be generally traced to their characteristics. Hardware of this type is usually oriented toward specific instructional objectives and may command a high purchase price. A possible alternative to teaching troubleshooting via equipment or equipment simulators might involve the use of programed instruction. Several studies have indicated that certain aspects of problem solving can be taught successfully with programed instruction (1,2,6). Additionally, programs are relatively low in cost and could be made readily available for each student. The question which may be raised, however, is whether or not programed instruction can simulate student-equipment interaction.

This study examined the effects of three different approaches of teaching troubleshooting. Two of the approaches were designed to simulate student-equipment interaction via programed and text instruction. A third approach provided instruction on actual equipment. More specifically, the study investigated treatment effects relative to (a) troubleshooting knowledge, (b) troubleshooting performance, and (c) student attitude toward instruction received.

SUBJECTS

The subjects utilized in the study consisted of forty-five post-high school male students enrolled in an automotive curriculum at a community college. The group was comprised of first and second year students and had a mean age of nineteen years, five months. The student sample had a mean of 48.089 with a standard deviation of 9.865 on the Otis Mental Ability Test which was above the established norm for adults. All students had some familiarity with basic automotive tools and test equipment.

PROCEDURE

The study was based upon the post-test only control group design specified by Campbell and Stanley (3). This design is indicated as follows:

R	X_1	O_1
R	X_2	O_2
R	X_3	O_3

The design specifies that subjects are randomly assigned (R) to three separate treatment groups and are exposed to different experimental variables (X_1, X_2, X_3) in each of the treatments. At the conclusion of instruction, common post-tests (O) are administered to each of the treatment groups. In this study, X_1, X_2, and X_3 constituted the equipment, textbook, and program treatments. The common post-measures included performance, knowledge, and attitude toward instruction.

In order to make a more precise analysis among treatments, two additional measures were administered which served as control variables in the covariate analysis of data. Based upon the results of several research studies (7,9), it was felt that a system knowledge examination and a mental ability test would serve best in this capacity. These investigations indicated that specific technical knowledge and aptitude are closely related to success in troubleshooting.

Prior to actual administration of experimental treatments a pre-experimental instructional phase was conducted. Initially, the subjects received a film strip and record presentation dealing with principles of the ignition system. Immediately after this instruction was given, an ignition system knowledge examination was administered. This was followed by administration of the Otis Mental Ability Test.

Students from the entire sample were then randomly assigned to one of the three instructional treatments: equipment oriented (n=15), textbook oriented (n=15), and programed instruction (n=15). Content of the three treatments was similar in that each presented students with the same three practice troubles to locate. Additionally, a common troubleshooting strategy was taught in each of the respective treatments. In all cases, the instruction presented was individualized in nature and allowed each student to proceed through the treatment at his own pace. The equipment oriented instruction was conducted using operational equipment for each student. An instructor assisted the student if he had questions about troubleshooting or problems with the engines. The programed instruction consisted of a booklet which utilized both linear and intrinsic programing techniques. The booklet allowed students to "find" three different troubles in each of three different hypothetical engines. The troubles were identical to those which were used in the equipment oriented instruction. The textbook oriented instruction also provided students with troubles to locate. Content comparable to the programed instruction treatment was used without including any reinforcement principles.

After each student completed his instructional treatment he was asked to fill out an attitude inventory (4). Following completion of this instrument, a multiple-choice troubleshooting knowledge examination was administered. After all class members had completed the knowledge examination, a performance examination was administered. The performance examination required each student to locate troubles which had been placed in otherwise operational automobile engines. The troubles included in the criterion measure were different from those used in the three instructional treatments. Detailed information regarding examination development and administration is presented elsewhere (5).

RESULTS

Single factor analysis of covariance was performed to ascertain if treatment group means differed with respect to the troubleshooting knowledge variable. A summary of this analysis together with a listing of control variable means, criterion variable means, and adjusted criterion variable means is presented in Table I. Adjusted means for the equipment, program, and text treatment groups were 19.95, 21.28, and 21.51. The resultant F-ratio for treatment effects did not exceed the critical value of the .05 level ($F<1.00$).

Troubleshooting performance was examined using the two factor analysis of covariance. A balanced three-by-three factorial design was

TABLE I

ANALYSIS OF DATA FOR SOURCES OF VARIATION FROM TROUBLESHOOTING KNOWLEDGE EXAMINATION SCORES

Means and Adjusted Means

Factor	Level	X1 Mean	X2 Mean	Y Mean	Y Adjusted Mean
Grand		16.07	48.09	20.91	
A	1	15.67	47.47	19.73	19.95
A	2	16.33	48.93	21.47	21.28
A	3	16.20	47.87	21.53	21.51

Analysis of Covariance

Source of Variation	df	Sums of Squares	Mean Square	F Ratio	Significance
Treatments	2	20.91	10.46	0.93	n.s.
Error	42	451.85	11.30		
Total	44	472.76			

employed. The factors consisted of treatments and dimensions (performance sub-scores). The analysis of data for sources of variation from troubleshooting performance examination scores is given in Table 2. Means and adjusted means are followed by an analysis of covariance summary. Results showed an F-ratio for treatment effects statistically significant at the .01 level (F = 6.24). The equipment group adjusted mean score was 54.14 while program and text group adjusted mean scores were 47.60 and 48.25 respectively. Adjustment to means based upon control variable disparity did not exceed 0.45 for any one mean.

An additional factor in the 3 x 3 design was indicated as dimensions of troubleshooting performance. The three dimensions which were specified as sub-scores on the performance examination consisted of information checks made, non-information checks made, and sequence followed. Since test sub-scores were fitted to a mean of 50 with a standard deviation of 10, it was not considered appropriate to test a hypothesis for dimension effects. An analysis of interaction between treatments and dimensions resulted in an F-ratio which was not significant at the .05 level ($F<1.00$).

Single factor analysis of covariance was conducted to determine if treatment group means differed with regard to the attitude variable. Analysis of attitude data as measured by the attitude inventory is presented in Table 3. Adjusted means scores for the equipment, program, and text treatment groups were 182.81, 186.43, and 182.35. The analysis resulted in an F-ratio which was not significant at the .05 level ($F<1.00$).

Correlational analyses were conducted in order to determine possible relationships among attitude, knowledge, and performance variables. Correlations among the criterion variables are presented in Table 4.

TABLE 2

ANALYSIS OF DATA FOR SOURCES OF VARIATION FROM TROUBLESHOOTING PERFORMANCE EXAMINATION SCORES

Means and Adjusted Means

Factor	Level	X1 Mean	X2 Mean	Y Mean[a]	Y Adjusted Mean[a]
Grand		16.07	48.09	50.00	
A	1	15.67	47.47	53.69	54.14
A	2	16.33	48.93	47.95	47.60
A	3	16.20	47.81	48.34	48.25
B	1	16.07	48.09	49.98	49.98
B	2	16.07	48.09	50.00	50.00
B	3	16.07	48.09	50.00	50.00
AB	11	15.67	47.47	54.00	54.35
AB	12	15.67	47.47	55.88	56.32
AB	13	15.67	47.47	51.29	51.74
AB	21	16.33	48.93	47.13	46.77
AB	22	16.33	48.93	46.24	45.89
AB	23	16.33	48.93	50.48	50.13
AB	31	16.20	47.87	48.91	48.82
AB	32	16.20	47.87	47.89	47.80
AB	33	16.20	47.87	48.22	48.13

Analysis of Covariance

Source of Variation	df	Sums of Squares	Mean Square	F Ratio	Significance
Treatments	2	1143.82	571.91	6.24	.01
Troubleshooting Performance Dimensions	2	0.01	0.00	0.00	
Treatments X Dimensions	4	316.54	79.13	0.86	n.s.
Error	124	11361.10	91.62		
Total	132	12821.46			

[a]in terms of standard scores

TABLE 3

ANALYSIS OF DATA FOR SOURCES OF VARIATION
FROM ATTITUDE INVENTORY SCORES

Means and Adjusted Means

Factor	Level	X1 Mean	X2 Mean	Y Mean	Y Adjusted Mean
Grand	:	16.07	48.09	183.87	
A	1	15.67	47.47	182.67	182.81
A	2	16.33	48.93	186.67	186.43
A	3	16.20	47.81	182.27	182.35

Analysis of Covariance

Source of Variation	df	Sums of Squares	Mean Square	F Ratio	Significance
Treatments	2	148.60	70.30	0.27	n.s.
Error	40	10826.25	270.66		
Total	42	10974.86			

TABLE 4

ANALYSIS OF DATA FOR CORRELATIONS AMONG
SELECTED CRITERION VARIABLES

r	Treatments Equipment	Program	Text
Attitude and Troubleshooting Knowledge	.547*	-.100	-.347
Attitude and Troubleshooting Performance	.140	-.348	-.680**
Troubleshooting Knowledge and Troubleshooting Performance	.126	.633*	.372

*P < .05
**P < .01

The relationship between troubleshooting knowledge and attitude was positive and significant at the .05 level for the equipment group (r = .547). The program and text treatment groups attained negative but non-significant correlations. Troubleshooting performance and attitude correlated negatively for the text group. The relationship was significant at the .01 level (r = -.680). A positive correlation for the equipment group and a negative correlation for the program group were not significant at the .05 level. The correlation between troubleshooting knowledge and troubleshooting performance was positive and significant at the .05 level for the program group (r = .633). Correlations for the other two groups were also positive but not significant.

CONCLUSIONS

The results suggest that non-equipment simulation is a questionable means of providing diagnostic problem solving instruction when performance outcomes are specified. Differences among respective treatment means indicated that the equipment group was superior to the two other groups with regard to the performance variable. The lack of significant interaction between instructional treatments and performance dimensions indicated that differences between treatment means were the same for each of the dimensions. It is, therefore, contended that performance dimensions specified in the present study were additive in nature and would logically contribute to a composite criterion measure.

The positive and significant correlation between attitude and troubleshooting knowledge obtained by the equipment group suggests that students who received troubleshooting instruction via equipment tended to validly perceive the value of their instruction as applied to a knowledge criterion. The lack of significant correlations between attitude and knowledge for program and text groups indicates that these groups did not perceive their instruction in a meaningful manner as related to troubleshooting knowledge.

The high negative correlation between attitude and performance which was obtained by the text group indicated an inverse relationship between the text student's perception of instruction and his performance based upon that instruction. The results suggest that students who studied text material in a superficial manner reacted favorably to the instruction presented. On the other hand, students who studied the text material in a more diligent manner and subsequently scored higher in troubleshooting performance felt that the text method was a poor way to learn. The fact that a student studying by equipment or program methods reacted favorably or unfavorably to his instruction did not indicate that he would perform any better or worse on the troubleshooting performance examination.

The positive and significant correlation between knowledge and performance which was obtained by the program group implies that the treatment had a relatively constant effect with regard to knowledge and performance variables. Programed troubleshooting instruction as specified in the present study may, in effect, provide students with relatively equal development of knowledge and performance capabilities. The contribution which this instructional approach can make is important if a constant relationship between knowledge and performance outcomes is desired.

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A Factor Analysis of the Common
Training Needs in Teacher Education Programs
for Occupational Education

by
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March, 1970

*(The present materials were prepared to supplement a presentation to the Special Interest Group in Vocational Education of the American Educational Research Association at its Annual Meeting Held at the Radisson Hotel in Minneapolis on March 5, 1970.)

Introduction

Many persons in teacher education have recently been active in determining what should be contained in the training program. Several approaches, including emphases on both content and process, have been forwarded for review and testing. The future undoubtedly will bring much improvement to the present curricula with both content and process elements which are more relevant and more behaviorally directed than those of previous eras. The present paper is one which does not provide answers to all of the problems of content; however, it does present an empirically-based approach to the problem of developing common curricula for teachers of vocational subjects.

Traditionally, vocational education has been concerned with content as it presently applies to the world of work. To obtain such information, you go out to the field and look or ask. The present study is a present-oriented approach to the identification of content.

Background of the Study

The inception of the idea for the present study was formulated bzck in the early 1960's when John Coster and I sat over coffee on the Purdue Campus. At that time we were concerned about the common training elements among agriculturally-related jobs. During the decade which followed, we and others tackled the problem of designing and conducting pilot studies which essentially built upon the original idea that a common core of training experiences could be identified for vocational teachers.

In 1967, in cooperation with the Center for Occupational Education at North Carolina State University, a position paper was prepared which provided the theoretical basis for the present study. During 1968, at Oregon State University, the statistical analysis procedure was tested. The resulting matrix formulated the ultimate mold for meshing the theoretical framework and the analysis technique. In essence then, this has been a cooperative venture which has bridged the coastlines and which has utilized the interdisciplines.

Statement of the Problem

The central problem of the present study was to determine the common training needs and requirements for teachers of vocational education. For the present study, the major interest was directed toward determining the common training requirements of secondary level vocational teachers including those in vocational agriculture, trade and industry, home economics, business, and distributive education.

Commonality of Content

The suggested basis for curriculum planning in occupational education programs is to search for a common core of training experiences which will lead to the de elopment of competent teachers of vocational subjects. Using the centripetal approach, (show plate #2), curriculum planning is centered in identifying the elements of the common core. The elements are likely to resemble fragments of abilities or knowledges and are apt to be general rather than specialized except as specialization may relate to the entire field of vocational education. This approach may appeal to educators who see the need for cooperative training programs of teacher education.

A summary of the literature validates this approach as the theoretical framework under shich this problem may be studied. According to this premise, the following resumes may be used as guiding principles in the organization of an empirically-based procedure for determining vocational teacher curricula content.

1. Factor identification may be accomplished using as a base an occupational groups classification system. Such identifications reveal areas of commonality and differentiation among workers.

2. Job requirement components provide for large spectrum analysis descriptions of worker (teacher) populations. Through such descriptions, components of training program preparation needs may be studied.

3. Subject matter content may be descriptively grouped for analysis purposes. From such groupings, patterns of training may be established forworkers in vocational teaching so that the basic common elements and necessary common experiences among training programs can be identified.

As content is identified, behavioral objectives associated with the curricula for training teachers of occupational subjects can be specified. Using the sequences of behavioral objectives, instructional strategies may then be identified for the training programs of occupational teachers.

The Teacher Model

Recently, under a USOE grant, the American Industry Project at Stout State University developed a teacher model which structured the available research into a form which provides guidance for curriculum development. The classification system presented for the various teacher dimensions is found in your handout and you may inspect it later if you wish.

The Dependent Variable

The dependent variable for this study was a rating which was assigned by teachers of vocational subjects to denote their judgements about the necessity for various behaviors in their work. A total of 130 items were included in the study with the assignment of ratings being based upon a Likert-type (five-point) scale (show plate #3)

The Experimental Design

A factor analysis design was used for the study with an orthogonal (Varimax) rotation method being employed.

Ten states were used for the study (show plate #4) with fifteen vocational teachers being randomly selected from each state. Hence, a total of 150 respondents were used for the study.

The Results

The orthogonal analysis which generated six interpretable factors accounted for 44% of the common variance. Means for the 130 randomly-ordered items ranged from 2.4667 to 4.7200 on the five-point scale. The factors and items arranged themselves as shown in Table I in your handout materials.

A seventh factor which was generated was not interpretable. Subfactors within each of the six interpretable factors were intuitively described when items with factor loadings of .40 or greater were compared with the theoretical model. Spurious items, which had low loadings across factors or which did not seem to fit the model, were not included in the factor clusters.

Table I shows the resulting factor pattern for the 98 items which were included in the six interpretable factors. The thirty-two spurious items are listed at the end of the table. Means and pure Scores* are included within the Table.

Means were considered as an indication of the importance which the respondent attached to the item. Generally, means were high for those items with large factor loadings. Means were expected to be high for all items which were included for the study because of their relative importance within the structure of the theoretical model. However, Factors II and VI had several items with low means. Factor II stood out with its high loadings and low means.

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* The Pure Score is the percentage of the total common factor loading which is contributed by the particular factor. An example of this computation is shown below:

Factors			Sum of the Squares of Loading			Communality	Pure Score
I	II	III	I	II	III		
.60	.10	.10	.36	.01	.01	.38	$\frac{.36}{.38}$ = .95 or 95

Discussion

There was a distinct stability in the array of factors which the analysis produced in the study and the generated clusters tended to correspond to large segments of the theoretical framework. Only in isolated instances did items tend to migrate from the model. Undoubtedly more factors may have been generated had the computer been permitted to exceed the maximum iterations included in the program criteria. Common variance accountability was projected and would have continued to increase to 53% with 10 factors.

However, by being conservative in the use of fewer factors, those which were generated were logical and made sense from a physical point of view. From an education point of view, it is important to understand what these factors mean. It is logical to evaluate them in terms of curriculum development and to recommend practices as a result.

Regarding this, we now can take these elements and say that we have an objective rationale for stating why a student teacher should learn how to do these things. (This, of course, is contingent upon the premise that we accept the teacher's response in the field as being valid.) Hence, we now have a valid reason for transforming these knowledges and skills into competencies and including them in the educational program for teachers.

Additionally, we have the responsibility of taking these items and reorganizing them into a learning system. I would caution against using each cluster (factor) or sub-factor as a course in itself, even though this may be the initial inclination. Instead, I would suggest that the implementation be to either (1) fit the items into existing courses, (2) individualize them via instructional packages, or (3) develop a series of mini-courses which would use them as competencies stated in behavioral form. My bias would tend to favor one of the last two options.

The implications of this study are far-reaching and include both pre-service and in-service education for teachers of occupational subjects. The problem here was centered on content definition which has applications to teachers both in training and in the field. The present bases for competency identification is empirically founded and valid in terms of the common elements of teacher activities.

Supplement to A.E.R.A. Paper
(E. Wayne Courtney)

Table I

FACTOR PATTERNS FOR ITEMS

Factor	Sub-Factor Name	Mean	Item Number	Item Description	Factor Loading	h^2	Pure* Score
I	Teaching Strategies (A)	4.6067	30	maintain discipline in the shop or laboratory	.532	.330	.859
		4.5000	101	maintain discipline in the classroom	.606	.469	.783
		4.1933	130	evaluate teaching effectiveness through student achievement	.571	.419	.778
		4.5267	105	motivate the student in the shop or laboratory	.627	.508	.774
		4.5067	100	maintain attention during the presentation of classroom lessons	.650	.551	.765
		4.4667	75	maintain attention during the presentation of demonstrations	.561	.418	.754
		4.5333	128	be stimulating in your work as a teacher	.509	.347	.745
		3.4733	87	use progress charts	.493	.338	.719
		3.8200	99	develop performance tests to measure achievement	.577	.481	.692
		4.4000	60	provide appropriate practice for skill learning experiences	.607	.552	.667
		4.1533	96	summarize the classroom lesson	.593	.576	.609
		4.1933	129	conduct follow-up studies for purposes of determining the effectiveness of instruction	.474	.376	.598
		4.2467	110	select instructional materials for the shop or laboratory	.518	.553	.486
		3.9400	68	develop related instruction sheets	.429	.389	.473
		4.2600	70	maintain a clean, orderly laboratory or classroom	.604	.540	.688
		4.0600	73	control your desire to work at a faster pace when dealing with students	.455	.256	.811

Factor	Sub-Factor Name	Mean	Item Number	Item Description	Factor Loading	h^2	Pure* Score
I	Teaching Strategies (A) (cont.)	3.6067	81	assess the difficulty of teacher-made tests	.408	.491	.338
I	Course Construction	3.9733	114	understand the social class structure of the local community as it relates to students enrolled in vocational classes	.452	.356	.574
		3.8067	118	use the information contained in professional journals for the improvement of instruction	.404	.366	.447
		4.3267	33	conduct periodic up-dating of the course of study in accord with recent occupational trends	.427	.421	.434
II	Test Use and Analysis	2.6333	18	use sociograms	.521	.344	.789
		2.9267	83	interpret the "norming" data associated with standardized tests	.604	.515	.710
		3.6600	78	assess the reliability of teacher-made tests	.544	.554	.535
		3.2267	57	use the results of standardized tests for instructional purposes	.526	.565	.490
		3.7533	69	assess the validity of teacher-made tests	.470	.507	.435
		3.0200	61	select standardized tests to measure achievement	.461	.531	.400
II	Special Program Development	2.4667	46	provide special education training for the mentally handicapped	.662	.452	.968
		2.4400	76	provide special education training for the physically handicapped	.702	.532	.927
		3.0200	125	provide special education training for the gifted	.592	.425	.825
		3.6867	5	promote and maintain adult vocational programs	.507	.352	.730
		2.9400	47	make use of the State Plan for Guidance in securing reimbursement for vocational programs	.535	.408	.702

Factor	Sub-Factor Name	Mean	Item Number	Item Description	Factor Loading	h^2	Pure* Score
III	Active Community Participation	3.2800	95	take responsibilities for leadership in civic community activities	.544	.579	.511
		3.7400	108	take the initiative when dealing with other teachers	.418	.387	.452
		3.2267	4	involve yourself in civic community activities not related to the school	.422	.446	.399
IV	Teaching Strategies (B)	4.6200	6	use questions during classroom presentations to aid student learning	.622	.424	.913
		4.5400	10	use questions during demonstrations to aid student learning	.574	.363	.908
		4.3067	44	relate the daily lesson plan to the course of study	.668	.541	.823
		4.2267	28	develop visual materials for instructional purposes	.732	.672	.796
		4.3333	71	select appropriate audio-visual materials for instructional purposes	.719	.652	.794
		4.1200	107	develop audio-visual materials for instructional purposes	.601	.574	.630
		4.7200	3	make a shop or laboratory demonstration meaningful to the individual student	.527	.445	.624
		4.2067	86	change your teaching style (i.e., teacher-centered to student-centered) during a classroom lesson	.479	.416	.551
		3.9133	90	review a demonstration	.539	.540	.538
		4.1467	120	change your teaching style (i.e., teacher-centered to student-centered) during a demonstration	.485	.449	.524
		4.6000	58	make a classroom lesson meaningful to the individual student	.479	.449	.511
		4.3400	31	select appropriate visual materials for instructional purposes	.528	.575	.486

Factor	Sub-Factor Name	Mean	Item Number	Item Description	Factor Loading	h^2	Pure* Score
IV	School Community Relations	4.1600	13	arrange for and conduct field trips	.556	.529	.584
		3.6667	29	obtain the cooperation of available communications media personnel	.418	.359	.485
		4.1000	63	interpret the vocational program to other teachers	.403	.461	.352
IV	Produce and Select Instructional Materials	4.0667	72	produce and use resource units	.692	.626	.766
		4.4867	37	select instructional materials for the classroom	.640	.584	.702
		4.3867	65	develop appropriate course objectives	.487	.540	.439
V	Organizing Vocational Programs	3.4933	26	secure appropriate on-the-job training positions for students	.733	.562	.956
		3.4667	49	organize local vocational advisory committees	.714	.634	.805
		3.9667	98	break down an occupation or job into its component parts for instructional purposes	.664	.594	.743
		3.4800	93	use the services of local vocational advisory committees	.604	.499	.731
		3.4800	127	develop articles for news releases	.525	.412	.668
		4.1733	45	interpret the vocational programs to administrators	.530	.424	.663
		3.5867	66	conduct community surveys for purposes of improving instruction	.558	.517	.601
		3.8533	48	take the initiative when dealing with administrators	.458	.363	.577
		3.7733	106	develop job sheets to aid instruction	.479	.404	.567
		4.0933	17	use the existing local school administration system to initiate and maintain the vocational program	.460	.380	.558

Factor	Sub-Factor Name	Mean	Item Number	Item Description	Factor Loading	h^2	Pure* Score
V	Organizing Vocational Programs (cont.)	3.8333	62	relate the vocational instruction program to other areas of curriculum	.437	.343	.556
		3.8267	27	know the special state requirements for vocational facilities	.484	.506	.463
		3.1067	126	make use of programmed learning materials	.484	.506	.463
		3.9600	89	interpret the vocational program to the community	.425	.466	.387
		3.7200	104	lead a conference	.456	.550	.377
V	Providing Vocational Guidance	3.9600	121	provide specific information to groups of students concerning the nature and requirements of occupations	.712	.619	.819
		3.5000	19	aid the student in obtaining work placement after training	.672	.498	.906
		3.9733	113	provide specific information to individual students concerning the nature and requirements of occupations	.593	.535	.658
		3.7533	97	aid the student in entering educational training programs at the post high school level	.693	.566	.849
		3.7400	64	break down an occupation or job into its component parts for guidance purposes	.560	.489	.642
		3.5267	94	use directive counseling techniques to help students solve personal and social problems	.404	.306	.534
		2.8333	91	use the results of standardized tests for job placement	.473	.504	.444
		3.5400	32	interpret the results of vocational interest inventories	.644	.613	.677
VI	School Administration	3.7467	22	understand state teacher certification requirements	.569	.355	.912
		3.8933	40	understand the legal provisions of teacher liability	.531	.344	.818

Factor	Sub-Factor Name	Mean	Item Number	Item Description	Factor Loading	h^2	Pure* Score
VI	School Administration (cont.)	3.3533	117	understand the reasons for compulsory school attendance laws	.632	.561	.712
		3.8467	34	make use of school student record-keeping procedures	.480	.345	.668
		2.6800	2	interpret the provisions of teacher tenure laws	.500	.388	.642
		3.7133	124	interpret local school policies	.596	.570	.623
		3.1133	59	maintain anecdotal records as a part of the student's cumulative folder	.444	.332	.594
		3.5267	24	make use of school budget-keeping procedures	.429	.334	.551
		3.6333	92	utilize the services of state and local agencies responsible for vocational education	.488	.478	.498
		3.9400	82	maintain the necessary report forms required by state agencies	.474	.462	.486
		3.7867	9	make use of the innovative provisions of the Vocational Act of 1963	.432	.467	.400
		3.7067	23	aid in the development of the total school program	.489	.419	.570
		3.6267	79	know the special state requirements for vocational shops and laboratories	.478	.457	.500
		3.1667	84	use anecdotal records for informational purposes	.506	.485	.528
		3.6533	54	make use of the State Plan for curriculum guides	.400	.418	.382
VI	History and Philosophy of Vocational Education	3.5133	35	interpret statements of ethics as set forth by your professional organizations	.549	.467	.645
		3.0400	50	understand the history of education	.529	.469	.597
		3.2867	20	understand the history of vocational education	.488	.399	.596

Factor	Sub-Factor Name	Mean	Item Number	Item Description	Factor Loading	h^2	Pure* Score
VI	History and Philosophy of Vocational Education	3.3067	80	understand similarities and differences between two or more educational philosophies	.505	.514	.496
		4.0267	56	understand the similarities and differences between the goals of general and vocational education	.490	.534	.449
		4.3133	36	understand the role of the school in providing vocational preparation for the student	.474	.515	.437
		3.6800	119	understand the similarities and differences between vocational and technical education	.452	.497	.411
VI	Community Conformity	3.8467	115	conform to acceptable community social behaviors for teachers	.409	.559	.300

SPURIOUS ITEMS

Factor	Mean	Item Number	Item Description	Factor Loading	h^2	Pure* Score
VI	2.9867	1	participate in the direction of non-vocational extra-curricular activities	.264	.210	.333
II	3.6867	7	use formalized criteria in the selection of textbooks	.415	.388	.535
VI	3.4933	11	utilize your background in general or liberal studies to advantage while participating in community activities	.449	.378	.533
IV	4.6200	14	understand the goals of vocational education	.288	.285	.291
III	2.8667	25	locate available standardized tests	-.448	.527	.381
VI	3.6667	42	understand the student informal social groups	.408	.322	.516
II	3.4333	43	make use of the provisions of the Smith-Hughes, George-Deen, and George-Barden Acts	.363	.396	.332
VI	3.8267	51	use non-directive counseling techniques to help students solve personal and social problems	.353	.313	.399
I	4.0800	53	interpret your own educational philosophy	.395	.420	.372
IV	3.8267	67	use the information contained in professional journals for personal improvement purposes	.395	.438	.357
I	3.8933	74	utilize prescribed shop, classroom, and laboratory equipment organizational plans	.394	.245	.632
II	3.9267	88	conform to local standards of dress and appearance for teachers	-.431	.578	.322
II	3.2000	102	understand the history of industrial and agricultural development	.326	.325	.326
V	3.8733	41	direct the student's participation in competitive events related to vocational education	.385	.344	.432
V	4.0933	85	interpret the vocational program to parents	.367	.436	.309
VI	4.3133	15	understand the goals of general education	.358	.214	.599

Factor	Mean	Item Number	Item Description	Factor Loading	h^2	Pure* Score
VI	4.1400	8	adapt your physical appearance to acceptable standards of the school	.311	.412	.235
VI	4.0800	103	interpret the vocational program to students	.487	.460	.516
IV	3.7000	109	develop subjective tests to measure achievement	.357	.423	.301
II	2.8000	111	evaluate your subject matter teaching performance compared to college grades obtained in that subject	.442	.272	.717
IV	3.9600	112	relate current events to classroom instruction	.314	.286	.344
II	3.6267	122	operate duplicating equipment	-.290	.235	.359
VI	3.8733	123	make use of the guidance and counseling services which are available to the school	.483	.481	.486
IV	4.3933	12	purchase appropriate equipment and supplies for instructional purposes	.396	.280	.560
IV	3.8000	77	make a daily lesson plan	.250	.165	.379
IV	3.7800	52	build a display	.303	.245	.376
I	4.5400	39	motivate the student in the classroom	.384	.297	.495
I	4.3933	38	develop objective tests to measure achievement	.398	.346	.459
I	4.0600	21	relate technological advances to laboratory instruction	.361	.309	.425
III	3.4267	116	control your desire to work at a faster pace when dealing with people in the community	.380	.381	.378
IV	4.5667	16	provide appropriate practice for classroom learning experience	.381	.348	.417
IV	4.1733	55	draw from personal vocational interests to enrich instruction	.361	.363	.359

*The Pure Score is the percentage of the total common factor loading which is contributed by the particular factor. An example of this computation is shown below:

Factors			Sum of the Squares of Loading			Communality	Pure Score
I	II	III	I	II	III		
.60	.10	.10	0.36	0.01	0.01	.38	$\frac{.36}{.38} = .947$ or 95%

H-948

A MULTI-DIMENSIONAL APPROACH TO THE GUIDANCE CONCEPT AMONG SECONDARY SCHOOL PERSONNEL

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September 1969

A MULTI-DIMENSIONAL APPROACH TO THE GUIDANCE CONCEPT AMONG SECONDARY SCHOOL PERSONNEL

Vocational Education people have voiced the feeling that students at the elementary and high school levels have been shunted away from Vocational courses as a result of the educational orientation of the people with whom they counsel. Even though there are qualified individuals namely guidance counselors assigned to do the counseling, others such as principals, general teachers, and Vocational teachers exercise certain responsibilities in the counseling of students. If these four groups (guidance counselors, principals, general teachers and vocational teachers) are varied in their views toward the educational and career concepts, their respective counseling may be expected to vary. Hence it is necessary to investigate whether these four groups hold differing views on education and career concepts in order to plan in-service education appropriate to changing behavior designed to raise the level of validity of counseling in relation to the wide world of work.

Purpose of the Study:

The purpose of this study was to determine if a difference exists in selected educational and career concepts as perceived by the four groups of professionals in the faculty of the Brevard County of Florida secondary schools. To test whether these four groups were different in their views, one had to get the structure of views held by each group. Multi-dimensional scaling techniques recently developed by psychometricians (Shepard, 1962; Kruskal, 1964; Torgerson, 1958; Young, 1968) appeared to be well-suited to analyze the structure of concepts.

Multi-Dimensional Scaling Technique:

The outcome of multi-dimensional scaling is a geometric representation of a set of items so that the inter-item distance between the items in the space corresponds to the empirical measure of psychological relatedness. The space may be one-dimensional or multi-dimensional. The basic datum required for multi-dimensional scaling as a number for each pair of items in the set reflecting how closely (or how far away) the two items are related in one's mind.

In our study, the items were the educational and career concepts. What was required in the form of data, were measures of similarity (or dissimilarity) between any two concepts, i.e., how similar (or dissimilar) one concept was to another concept. The outcome of multi-dimensional scaling would tell how the concepts in a space were located in relation to each other. If such a configuration of concepts was obtained for each group, comparison of these configurations would help us to determine if differences exist between groups.

Table 1. 12 concepts and 12 bi-polar items used in the study

	Concepts		Bi-Polar Items
1	Junior College (E)*	1	Timely-untimely
2	Aerospace Technician (O)*	2	Important-unimportant
3	Four Year College (E)	3	Successful-unsuccessful
4	High School (E)	4	Harmonious-disrupting
5	University (E)	5	Easy-demanding
6	Area Vocational High School (E)	6	Rigid-flexible
7	Technical Education (E)	7	Permissive-prohibitive
8	Vocational Education (E)	8	Uncertain-reliable
9	Building Teacher Training (E)	9	Impulsive-deliberate
10	Electronics Engineer (O)	10	Fixed-dynamic
11	Electronic Technician (O)	11	Motivated-aimless
12	Space Technology (O)	12	Complex-simple

* E = Educational, O = Occupational

Method:

An instrument consisting of twelve concepts was prepared. Eight of these concepts were in the organizational structure of education and four were career concepts. They are listed in Table 1. Each of the concepts was evaluated using twelve selected semantic differential items. They are listed in Table 1. Each of the 12 bi-polar items was rated on a seven point scale. Each subject assigned a total of 144 values (12 concepts x 12 bi-polar items).

Subjects:

There were 15 guidance counselors (Group 1), 9 principals (Group 2), 293 general educational teachers (Group 3), and 66 vocational educational teachers (Group 4). They were obtained from the 12 secondary schools in the Brevard County public school system in Florida.

Dissimilarity Measure:

Two steps were required in computing dissimilarity measures. In step 1, for each group a 84 x 12 frequency matrix (F) was constructed. One could consider that there were seven categories--each one of the seven possible values serving as a category--in each one of the 12 bi-polar items. The seven categories of the first item were followed by the seven categories of the second bi-polar items then by the seven of the third item, and so on. Thus, there was a total of (7 x 12) or 84 categories. These 84 categories formed the 84 rows, and the twelve concepts formed the 12 columns of the matrix. Thus, there were (84 x 12) or 1008 entries in an F matrix. An entry (f_{gj}) where g refers to row number (category) and j

Table 2. Portions of F Matrix of the Guidance Counselors

CATEGORIES	CONCEPTS 1	2	3	4	5	6	7	8	9	10	11	12
1	0	0	0	0	0	0	0	1	0	0	0	0
2	0	0	0	0	0	0	0	2	0	0	0	0
3	0	0	0	0	0	0	0	0	0	0	0	0
4	1	1	1	0	0	0	0	0	0	1	0	0
5	0	1	0	2	0	0	0	0	0	0	0	0
6	2	4	3	0	5	1	3	0	6	3	5	1
7	12	9	11	13	10	14	12	12	9	11	10	14
8	0	0	0	0	0	0	0	0	0	0	1	0
9	0	0	0	0	0	0	0	0	1	0	0	0
10	0	0	0	0	0	0	0	0	1	0	0	0
11	0	1	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	1	1	0	0	0	0
13	2	2	2	0	2	0	1	1	2	2	4	2
14	13	12	13	15	13	15	13	13	11	13	10	13
.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.	.	.	.
82	2	1	0	2	2	4	3	7	1	0	3	1
83	2	5	6	4	5	2	3	1	0	0	4	1
84	2	5	6	2	7	3	4	2	2	9	5	9

refers to column number (concept), is a frequency of how many subjects gave a particular value on a bi-polar item for a concept. A portion of the F matrix for the guidance counselors is given in Table 2. In Table 2, the first seven rows represent scores assigned by the subjects for bi-polar item #1 (timely-untimely) across the 12 concepts. Other bi-polar items follow in the order given in Table 1.

For example, in Table 2, at the intersection of row 6 and column 9 the value ($f_{6,9}$) is 6. It means that 6 of the guidance counselors gave 6 for bi-polar item 1 on concept 9. Similarly ($f_{11,2} = 1$) means that 1 guidance counselor gave 4 for bi-polar item 2 on concept 2.

The f_{gj} values were used in Step 2 in computing degree of dissimilarity ($d_{i,j}$) between concepts. A dissimilarity score between any two concepts was defined as follows:

$$d_{ij} = 1 - \frac{\sum_{k=1}^{84} f_{ki} \; f_{kj}}{\left[(\Sigma \; f_{ki}^2) \cdot (\Sigma \; f_{kj}^2)\right]^{1/2}}, \quad i = 1 \, . \, . \, 12, \; j = 1 \, . \, . \, 12$$

where f_{ki} is as previously defined in Step 1. By definition, then, $d_{ii} = 0$ and $d_{ij} = d_{ji}$. Thus, a 12 x 12 symmetrix matrix with zero on the diagonals was obtained for each group.

The values of d_{ij} can range from 0 to 1. When $d_{ij} = 0$, it indicates that there is no dissimilarity between concept i and concept j. (Intuitively one can see that there is no dissimilarity between a concept with itself.) That means for

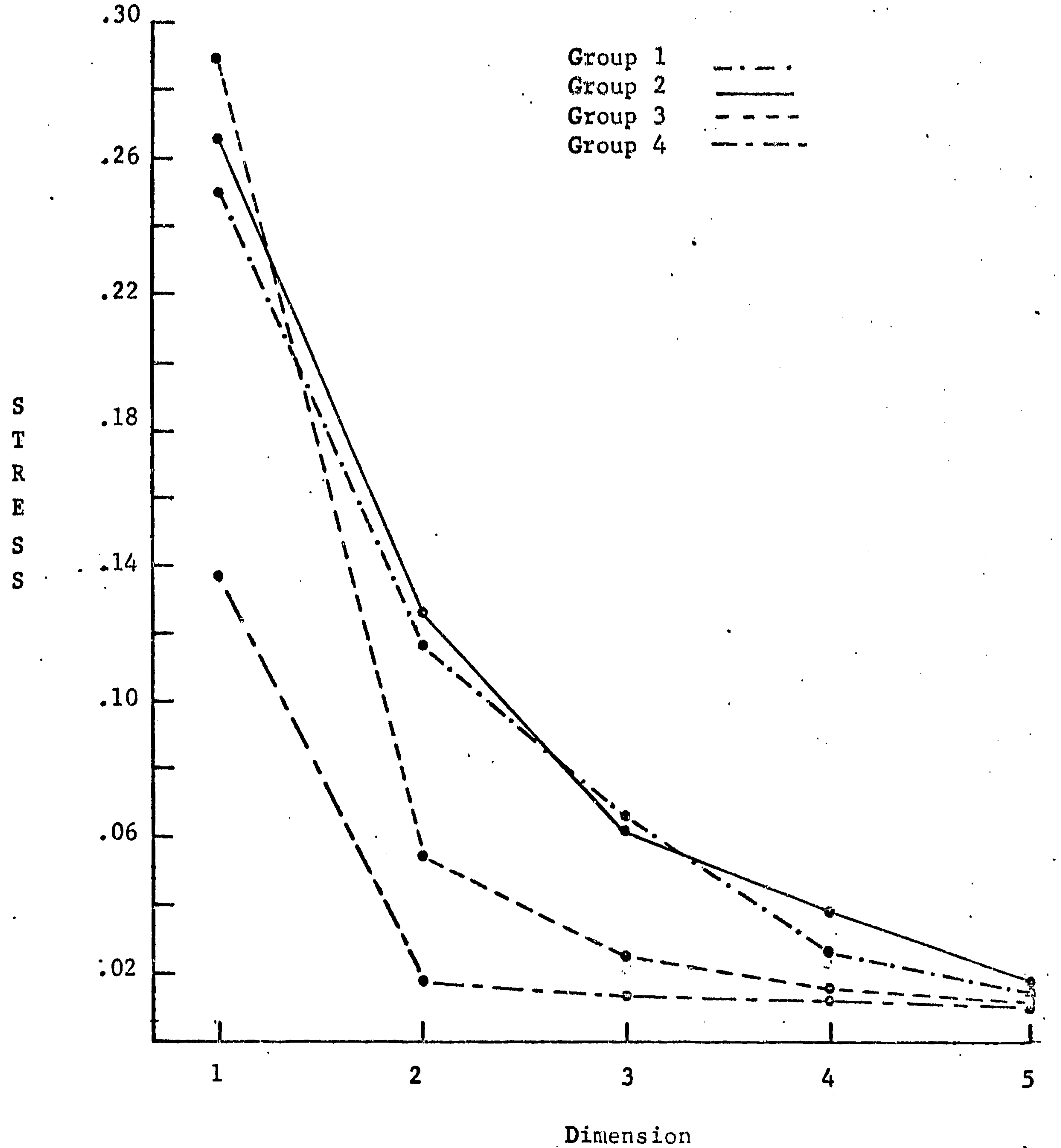

Figure 1 Stress values for each dimensional solution for the four groups

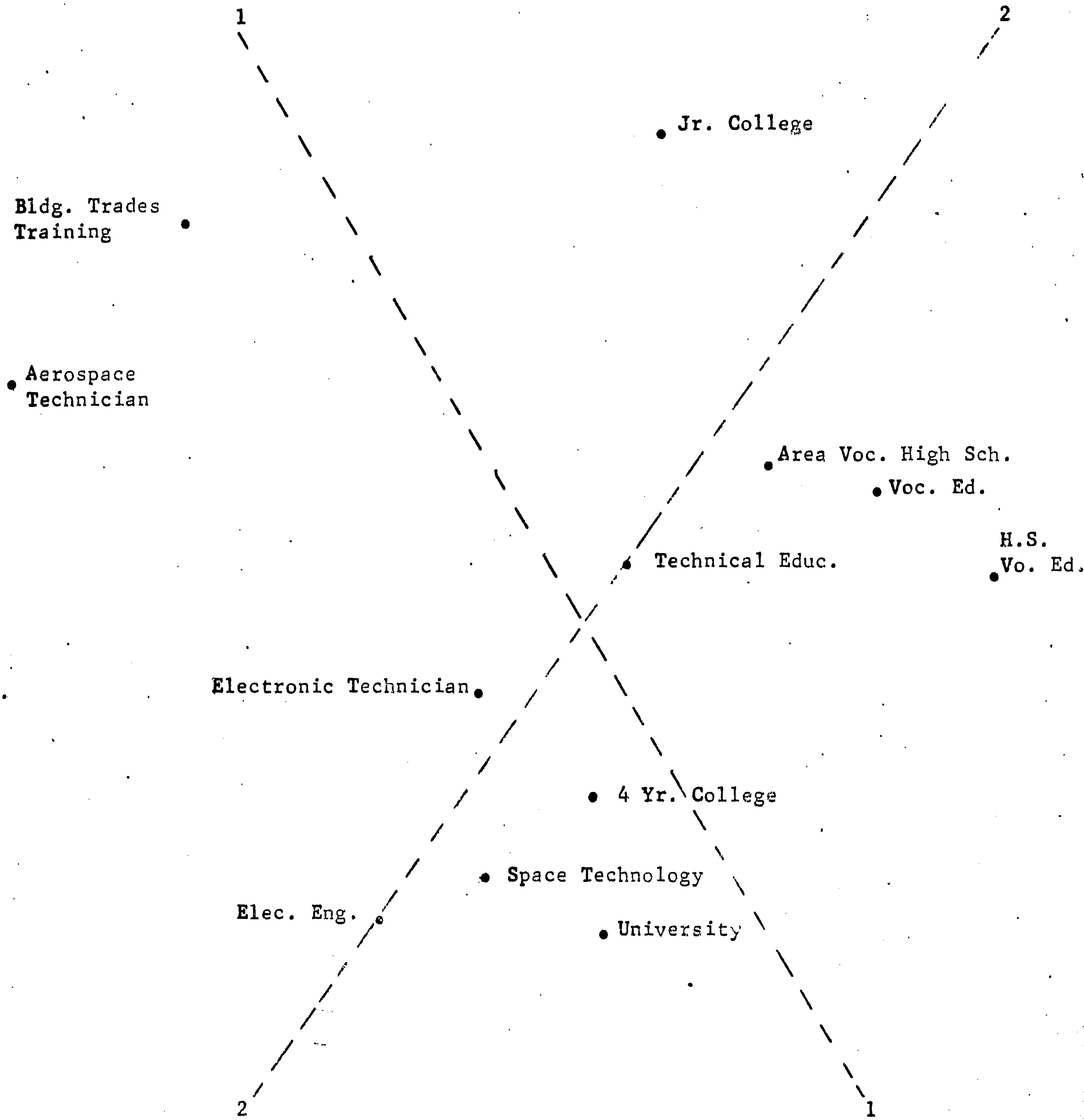

Figure 3 - Two dimensional configuration of 12 concepts showing intutively fitting axes for group 4.

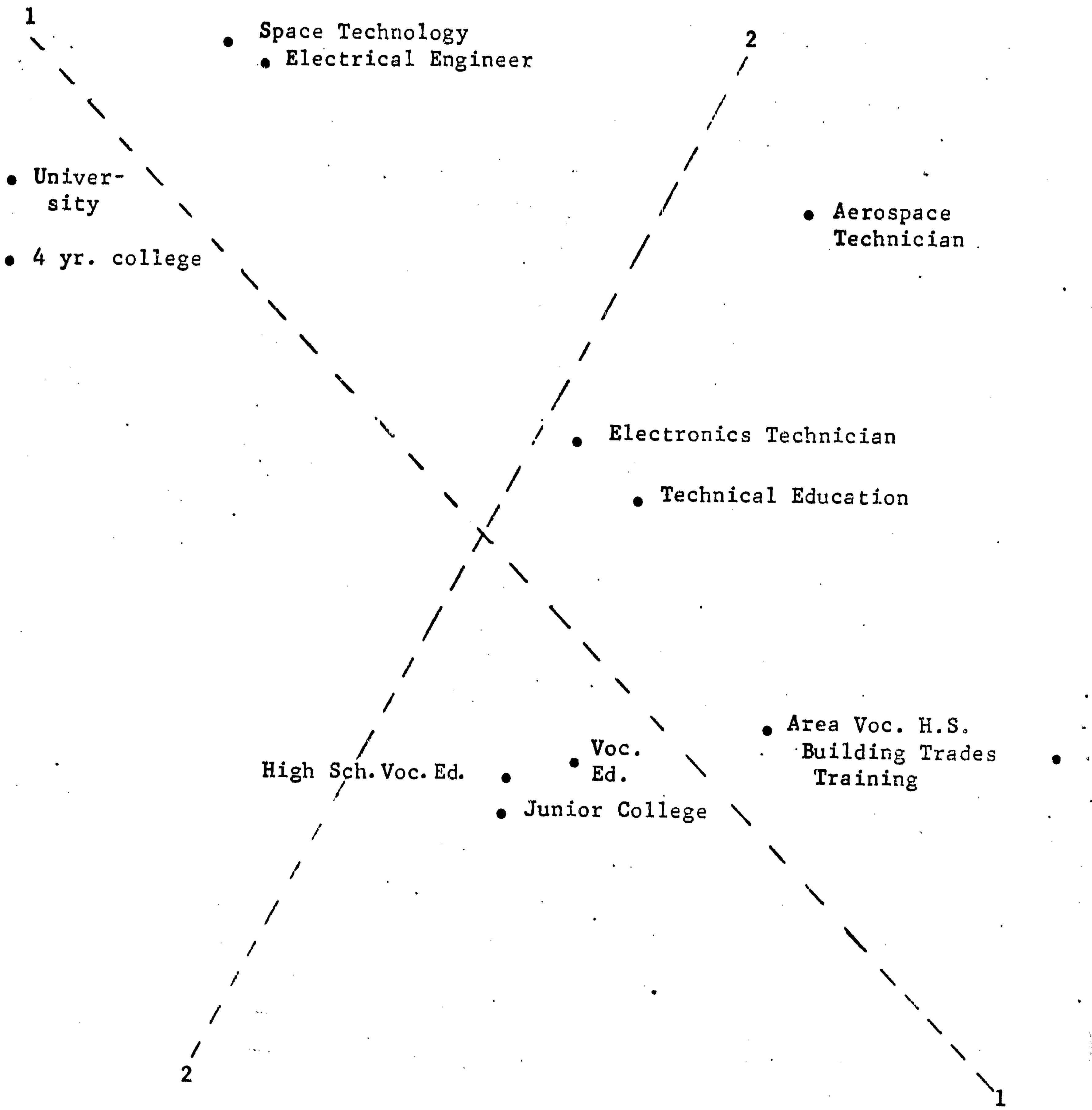

Figure 2 - Two dimensional configuration of 12 concepts showing intutively fitting axes for group 3.

Table 3 - Three coordinates of the 12 concepts for the four groups

CONCEPT	Group 1			Group 2			Group 3			Group 4		
	X	Y	Z	X	Y	Z	X	Y	Z	X	Y	Z
1	.566	.194	.065	.108	.448	.637	-.112	-.488	.086	-.077	.823	-.101
2	.070	.057	.480	.083	-.252	.485	-.206	.561	.328	1.056	.061	-.168
3	-.465	-.247	.148	-.530	-.696	.065	.779	.089	-.261	-.154	-.298	.205
4	.161	.716	-.373	.959	.263	.141	-.129	-.474	.018	-.723	.010	-.338
5	.520	-.112	-.124	-.107	-.620	-.156	.838	.192	-.224	-.225	-.354	.484
6	.135	.357	.030	-.410	.221	.111	-.562	-.224	.055	-.224	.095	-.490
7	.007	-.056	-.273	-.089	.228	-.060	-.101	-.000	.342	-.154	.015	-.094
8	.140	.142	-.365	.062	.452	-.101	-.207	-.417	-.008	-.548	.260	-.152
9	.850	-.145	-.080	.693	.019	-.055	-1.030	-.104	.356	.732	.551	-.031
10	-.401	-.240	.381	-.330	-.099	-.166	.368	.413	-.463	.220	-.556	.323
11	.006	-.599	-.148	.087	.035	-.240	-.045	.039	.269	.083	-.071	.287
12	-.550	-.067	.259	-.527	.000	-.660	.408	.413	-.497	.014	-.536	.075

example, there is no dissimilarity between concept 1 with itself and the value of d_{11} should be zero. This is true by definition. When $d_{ij} = 1$, it means that the concept i and concept j are completely dissimilar. Thus, the higher the value, the farther apart are the two concepts.

Results:

A computer program developed by Young (1968) was used for multi-dimensional scaling. Kruskal (1964) suggests a procedure for estimating the appropriate dimensionality of the solution space. The procedure is to obtain a one-dimensional solution, a two-dimensional solution, and so on until a satisfactory fit is obtained, and there is little or no improvement by adding dimensions. A measure of the "goodness of fit", termed "stress" is calculated for each solution. The stress measure is essentially a normalized sum of squared residuals. Kruskal suggests that a stress of 5% is "good", and 10% is "fair".

For each group one through five dimensional solutions were obtained. The dimensional solutions versus the respective stresses are plotted in Figure 1. Following Kruskal's criteria, it can be seen in Figure 1 that the two-dimensional solution is "good". The three through five dimensional solutions did not improve much of the solution. The two groups configurations of the concepts in the two-dimensional space are respectively given in Figure 2 and 3. For Group 1 and Group 2 three dimensional solutions fall between "good" to "fair" range. For all the four groups, three

Table 4

Intercorrelations of Perceptual Space Between Groups

Groups	2	3	4
1	.5393**	.6405**	.6420**
2		.4184**	.3194**
3			.5445**

** Significant at 1% level

dimensional solutions give at least "fair" fit. Hence the three dimensional solutions were used to compare the structure of the four groups. Since it is difficult to print the three dimensional configurations, the coordinates of the 12 concepts in the three dimensional configurations are given in Table 3.

One easy way to compare the four configurations of the four groups is by calculating the correlation coefficient between two groups. This method has been suggested by Kerlinger (1967). For each group using the coordinates, the inter-concept (Euculidean) distance can be computed in the following way:

$$S_{ij} = [(x_i - x_j)^2 + (y_i - y_j)^2 + (z_i - z_j)^2]^{1/2}$$

Where S_{ij} = Euculidean distance between concept i and concept j; x, y and z are the three coordinate values. For each group there were 66 (i.e., 12 x 11÷2) values. Using these values, the intercorrelations between the groups were computed. They are presented in Table 4

Discussion:

The level of correlations between the four group-configurations of the concepts indicate that each group holds the inter-relations between any pair of concepts in the same way as any other group. It is clear then that the four configurations are identical. This means that the perception of concepts held by one group is like the perception held by any other group. One implication from this is that since the four groups are essentially the same with regard to their perceptions of concepts, their guidance views may not vary much. This conclusion is supported by the findings by Farley (1965) and Fredrick (1962).

Farley's investigation differed from the present study in that his study dealt with role perception. He found that no significant differences of counselor's duties were found between the responses of: (a) counselor and principal, and (b) counselor and teachers. The findings of the present study have similar implications.

The study done by Fredrick (1962) is more relevant to the present study. The purpose of his study was to identify and compare the concepts of the actual and ideal roles of the secondary school counselor as held by counselors, principals and teachers. In our study, though, we were not dealing exactly with the perceptions of an ideal counselor, indirectly we were measuring the different perceptions of ideal counseling from the point of view of different groups. That is, if each group, namely guidance counselors, principals, general teachers and vocational teachers, thought that they were ideal counselors, how would they perceive the given 12 concepts? The results showed that there was no difference between the groups with respect to the perceptions. Fredrick (1962) obtained similar findings. His results indicated that when the ideal role of the secondary school counselors were perceived by counselors, principals, and teachers, there was substantial correlation in their perceptions of the ideal role of the counselors.

Interpretations of the Two-Dimensional Configuration:

Attempts at interpretation are limited to the two-dimensional configurations of groups 3 and 4. Obvious reason is that only these two groups obtained "good" solutions in two-dimensional space. Secondly, two-dimensional configuration is easier for interpretations. That is, the authors could find two intuitively meaningful axes (dotted lines) that cut across the configurations. Rosenberg, Nelson and Vivekananthan (1968) showed how the axes could be fitted empirically rather than intuitively. Since the interpretation of the configurations was not primary purpose of the study. It was decided that the data did not require such a rigorous treatment.

For the general teachers, (figure 2) Building Trades Training, Junior College, etc., are at one end and at the other end are Space Technology, Electrical Engineering, University, etc. Electronic Technician, Aerospace Technician, etc., are in the middle. University, Space Technology, etc. carry relatively more prestige, but also require longer years of education. At the other end, Building Trades Training, etc., are less prestigious and require a lesser number of years of education and training. Hence, the first axis was termed as prestige-cum-education axis. The same was true with the group of vocational teachers but with a slight variation particularly with respect to the concept of Aerospace Technician.

One may view the second axis as a continuum on technical-know-how. At one end of this continuum were concepts such as Electrical Engineering and Space Technology which require a higher level of sophistication in technical "know-how." At the other end were the concepts such as junior college where meager technical "know-how" appeared to be required. In the middle was technical-education, Building Trades Training which would require intermediate levels of technical "know-how."

The findings indicated that the two groups viewed the concepts for which they counseled falling basically under two categories: (a) prestige-cum-education, and (b) level of sophistication on technical "know-how."

CONCLUSIONS:

The multidimensional technique looks promising because it gives a graphic representation of impressions. Osgood, Suci, and Tannenbaum (1957) suggest that the semantic structure is "plottable." To quote them, "The set of distances representing the semantic structure are 'plottable' in a space having the same (or fewer) dimensions as the number of dimensions represented in measuring instrument (p. 94)." The multi-dimensional scaling technique does precisely that. Thus, this technique extends the semantic-differential technique.

The concepts used in this study, particularly the career concepts covered a limited area of occupations. It is suggested that future studies should include more concepts covering a wide area of occupations, so that empirically meaningful rather than intuitive interpretations can be made of the multi-dimensional solutions. Empirical fit of properties to the solutions has many uses. One obvious use is in the area of counseling. The counselors can be made aware of the basic dimensions that encompass the occupations. This awareness may raise the level of validity of counseling in relations to the wide world of work.

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