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ABSTRACT

A project was undertaken to develop a means of simplifying instruction in postsecondary vocational-technical programs in practical nursing and auto/truck maintenance and repair and to identify related patterns of student achievement, retention in a program, and transfer of learning. Information obtained from a literature review indicated that a whole-to-part instructional approach supplemented with detailed task analysis offered a possible solution to the problem of simplifying the technical complexities in the content of postsecondary vocational training programs. Therefore, a pilot study was conducted to examine the effectiveness of a whole-to-part instructional approach with a study population consisting of 151 practical nursing and auto-track mechanics students and 13 teachers participating in three programs at a postsecondary vocational technical institute in Minnesota. Data obtained using the California Achievement Test and the Hidden Figures Test and data on student characteristics were analyzed by means of correlation and regression procedures. Because no clear patterns of intervariable relationships emerged, it was impossible to establish conclusive linkages between the whole-to-part instructional approach and the measures of achievement, retention, and transfer used in the pilot study. However, most of the students completed the program successfully, and the instructors indicated a belief that the whole-to-part instructional approach contributed to this success. (Appendixes include charts for whole-to-part instruction and correlation and regression analyses.) (MN)

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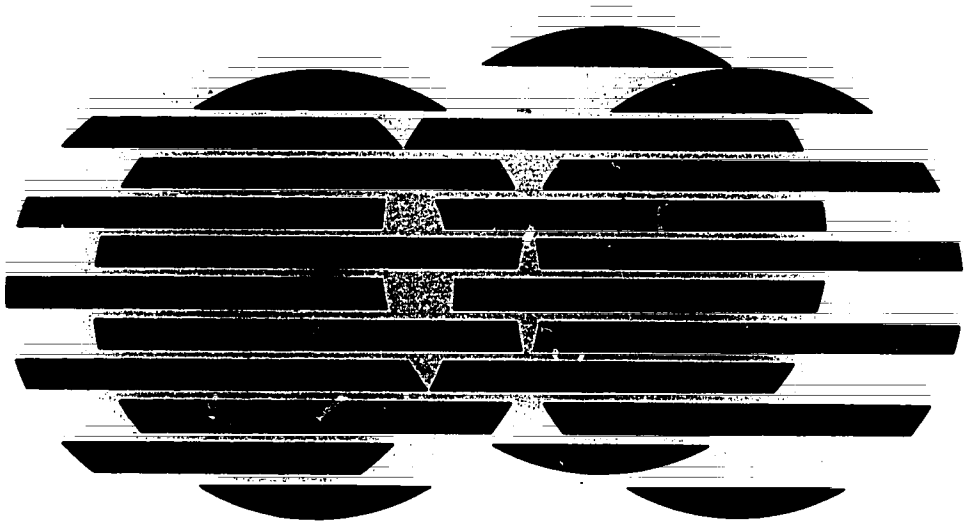
Whole-to-Part Instruction in Vocational Education

An Exploratory Study of Student Characteristics and Structure of Knowledge in Postsecondary Programs

prepared on behalf of
DR. BRANDON B. SMITH
by
Jeanette Daines, Project Assistant



MAY 1, 1985

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PREFACE

This report is unfortunately, but truly an unfinished agenda. The work reported represents the preliminary test of the application of the whole-to-part instruction concept which our beloved colleague Brandon B. Smith had developed. Brandon's untimely death caused all who were associated with him in his role as Director of the Minnesota Research and Development Center for Vocational Education to reflect on the many lessons that we were taught as a result of his commitment to research relative to vocational education.

We are thankful and in debt to Jeanette Daines who graciously accepted the difficult task of writing this report. While it is a difficult task to prepare reports for research that one conceptualized and directed, it is a tremendous task to write a report for a project that one entered as a project assistant. Jeanette was asked to prepare a report that reflected Brandon's thinking and work on this application project. The reader must recognize that technical problems such as balance in the review of literature result from an effort to report the history of the project as it was documented primarily in written form. Unfortunately, the many subtle facts not recorded, but in Brandon's memory are lost. We elected not to project what Brandon thought or did when Jeanette prepared this report.

We hope that this report fairly represents the Brandon Smith that we were fortunate to know.

Gary Leske
Interim Director

ABSTRACT

The purposes of this exploratory study were to develop and introduce a means of simplifying instruction in postsecondary vocational technical programs and identify related patterns of student achievement, retention in a program, and transfer of learning. Student characteristics such as reading ability and learning style were also assessed in order to determine the degree to which they influenced the outcomes. It was believed that, given the increasingly technical nature of subject matter in vocational programs, students would benefit from instructional procedures that made the conceptual structure explicit and related particular units or topics to prior learnings. This could be particularly important if the reading ability or learning style of students reflected a need for additional referents.

Students and teachers associated with the practical nursing and auto/truck maintenance repair programs at one postsecondary institute in Minnesota participated in the study. The procedures were conducted in two phases: (a) planning and development, and (b) assessment and implementation. The investigator worked cooperatively throughout the study with administrators and instructors to develop a graphic means of depicting program content. As this evolved, the reading ability and field independence/dependence of students were assessed using the reading scales of the California Achievement Test and the Hidden Figures Test, respectively. Instructors utilized the whole-to-part methodology in accordance with their personal teaching style throughout the study.

The data related to student assessment were analyzed using descriptive statistics. Correlations based on Pearson's r and regression procedures were used to determine relationships of the student characteristics and criterion measures of achievement, retention in program, and transfer of learning. Findings reflected the predominance of a field dependent learning style and reading ability appropriate for grade level in most cases. Significant correlations among the variables were not consistent throughout the sections involved; reading ability and learning style showed some correspondence in several sections, but no patterns emerged. Grades and learning style were not related. Regression analysis showed a similar lack of congruence; learning style made a significant contribution to transfer of learning in one health section and to achievement in one truck section. Most of the students completed the programs successfully, however. Instructors' perceptions of the treatment (whole-to-part instruction) were that it did contribute to student success.

Further study appears warranted on the basis of the investigation, particularly in regard to (a) alternative ways of conducting whole-to-part instruction for students with specific learning characteristics, and (b) effects that implementing a whole-to-part approach had on staff development.

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Chapter I.
INTRODUCTION

NATURE OF THE PROBLEM

As new technologies continue to make dramatic changes in jobs addressed by civilian and military training programs, the systems involved appear increasingly more complex and overwhelming to the prospective learner. The training process is complicated by the many different dimensions learners must consider; these include factors such as the continual development of new applications of technology, the emergence of new concepts with related terminology and techniques, and the relationship of innovations to existing approaches or conditions. The rapidity and scope of technological change makes comprehending the subject matter a constant challenge.

When confronted with this situation, students are likely to experience difficulties in completing a training program successfully and in transferring the knowledge gained in that program to an occupational setting. Specific units or skills may not be perceived as being directly related to the broad purposes of the program or the problem-solving situations found on the job. If such fragmentation occurs, the learner's understanding of the total program content may be distorted. The knowledge of interrelationships which is crucial to achievement in an instructional program or effective performance on a job may not be adequately developed. In particular, problems that are systemic in nature are difficult to identify and resolve with any clear sense of the subsequent effects.

SIGNIFICANCE OF THE PROBLEM

Although educational programs at all levels are affected by technological change, the impact is accentuated in vocational technical instruction. The need to provide timely and appropriate curricula is especially important in occupational areas that are incorporating technological advances into their service functions. In such situations, the viability of the program depends heavily on the ability of those involved to assimilate and synthesize new information as it appears on the scene. Students who are unable to develop this understanding are not likely to be successful in accommodating the ongoing expansion of knowledge in their field of work.

The growing diversity of the student population in vocational programs also makes the choice of an instructional approach especially critical. An expanding adult population will be looking toward retraining opportunities as some occupations decline in importance and others take their place; increasing cultural and ethnic pluralism will mean that a more heterogeneous mix of persons will be enrolling in training programs; and the expectation that a relatively low proportion of total jobs will be in the highly technical, skilled occupations suggests that competition will be keen for those few positions. Vocational instructors will need--perhaps more than ever before--instructional approaches that are sensitive to a broad spectrum of learner characteristics.

It seemed necessary, then, given the growing sophistication of technology, that students be helped to simplify the perceived complexities of various systems. Consequently, a study was designed to develop and introduce a method of structuring and processing content that could accomplish the goal of simplification.

PURPOSE OF THE STUDY

The major purposes of the study were to (a) develop and introduce a means to simplify instruction in the postsecondary vocational technical programs of practical nursing and auto/truck maintenance repair, and (b) identify related patterns of student achievement, retention in a program, and transfer of learning. In addition, because it was recognized that student characteristics such as reading ability and learning style could influence the outcomes of the instructional approach used, it seemed important to determine the nature of these factors also.

In order to accomplish the purposes, the following objectives were addressed:

Objective 1: Are vocational students more field independent or dependent in learning style?

Objective 2: Are vocational students above or below average in reading ability?

Objective 3: Did the instructional approach improve student achievement and retention in the auto maintenance repair program?

Objective 4: Did the instructional approach improve student achievement and retention in the truck maintenance repair program?

Objective 5: Did the instructional approach improve student achievement, retention, and transfer of learning in the practical nursing program?

It was expected that, if an appropriate means of simplifying instruction were developed and utilized, more students would complete the program successfully, the dropout rates would be reduced, and transfer of learning would be facilitated. It was also expected that student reading ability and learning style would influence these outcomes differentially, but that these differences would be minimized if the approach were effective.

Chapter II.
BACKGROUND INFORMATION

Development of an instructional approach that would simplify the learning of complex systems necessitated study of a broad base of research related to learner characteristics and instructional approaches. It also required that a holistic perspective be utilized so that the resulting framework would be an open one capable of accommodating contextual change.

The following summary focuses on selected ideas from the research and theoretical framework that contributed to the study of alternative approaches to vocational technical instruction. General information on factors to consider when developing instructional approaches is presented, followed by more specific discussion of the importance of the structure of knowledge. Learning style research on field independence/dependence is also reviewed and reading ability is briefly discussed.

DEVELOPING AN INSTRUCTIONAL APPROACH

Educational researchers have long sought to identify contingencies of learner characteristics and effective instruction, but few have attempted to develop a holistic model. Emphasis has been placed on the study of specific attributes such as trait-treatment interaction or cognitive style. However, a recent comprehensive review and synthesis of learning theory literature by Smith and Currey (1983) drew extensively on the work of Cronbach & Snow (1969), Bruner (1960, 1966), Ausubel (1963, 1964), Schwab (1964), Briggs (1967), Miller (1956), and others as a basis for the development of a generic concept of learning. Nine principles of learning were explicated as a result: (Smith, 1983)

1. Learners are stimulus seeking/responding individuals without which frustration, anxiety is expected.

2. Learners must use five senses to receive/perceive stimuli.

3. Learning may occur in formal/planned or in informal/unplanned settings.

4. Learners must encode/decode assimilated stimuli/responses with those with which they are already familiar.

5. Learners differ on the rate with which they can receive, encode/decode and assimilate stimuli.

6. Learners have a finite limit on the number of stimuli they can process at a time.

7. Learners must respond to one or a combination of three forms of stimuli: enactive, iconic, or symbolic (written, spoken).

8. Learners can more readily encode/decode and assimilate stimulus content with which they are already familiar.

9. Learners build their skills and knowledge in a cumulative manner based on previously learned skills and knowledge.

The resulting theoretical model for the design and management of technical programs is shown in Figure 1.

Reflected is a two-part instructional system, the first of which emphasizes the planning process and its components of learner readiness, structure of content, goals and objectives, and instructional sequence. The second part, that of implementation, reflects variables related to individual learner differences in the rate, frequency, continuity, and practice of stimulus content; and the type and amount of reinforcement and feedback (Smith, 1983). The holistic framework of the model provides a basis for understanding the learner and for identifying instructional approaches that would facilitate development of a conceptual structure.

Conceptual structures for any field of learning typically are built or evolve through deduction, induction, or an interaction of the two approaches in

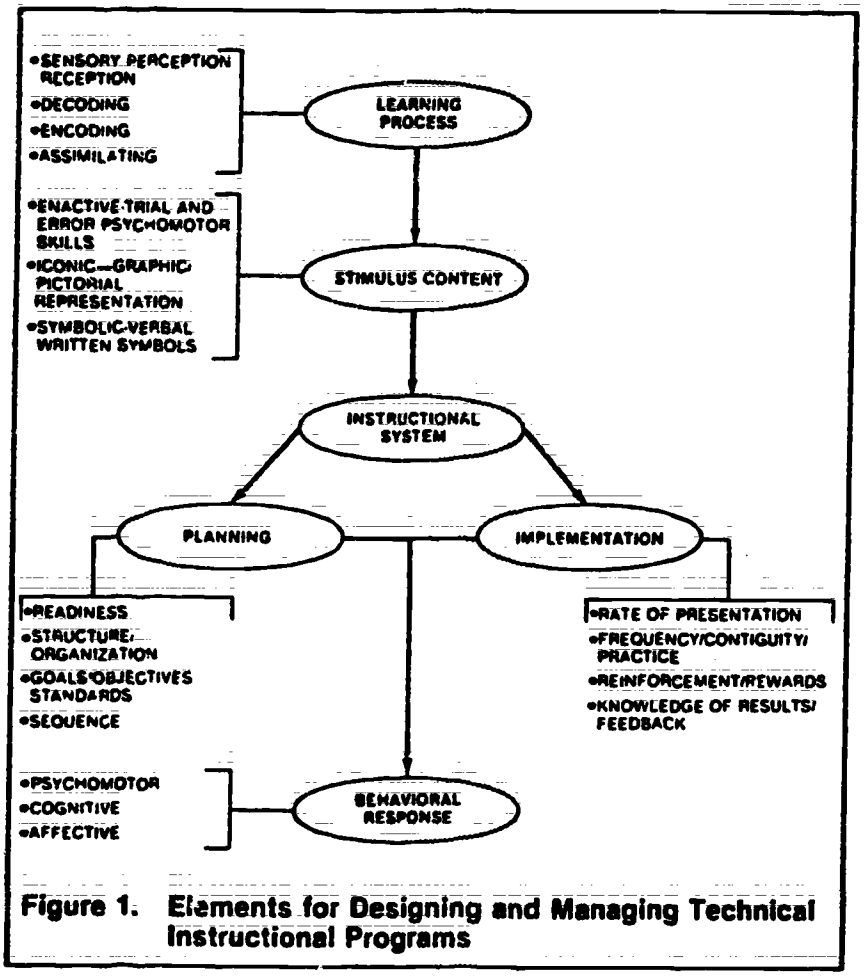

Figure 1. Elements for Designing and Managing Technical Instructional Programs

either a deliberate or intuitive way. In vocational education, inductive models of instruction have predominated (Smith, 1984), but there is a growing concern that this strategy may not help learners develop understanding of the complex interrelationships involved in technical content. Examination of learning theory suggests that the use of deductive approaches to make the structure of knowledge more explicit may be more appropriate, particularly for learners with certain information-processing characteristics. For example, if a structure can be developed that is based on content with which the learner is already familiar and that is highly abstract, subsequent instruction in specific content areas that are subsumed in the structure may be more easily understood (Smith, 1983).

DEVELOPING A STRUCTURE OF KNOWLEDGE

In a recent discussion of the cognitive structure of technical knowledge, Smith (1983) noted that cognitive psychologists Ausubel (1963, 1964) Bruner (1960, 1966), and curriculum and instruction theorists Schwab (1964), Lange (1964), Scriven (1964), and Briggs (1967) have emphasized the importance of the structure of knowledge as a variable in instructional effectiveness. Yet relatively little attention has been given to the implications of what might be included in that structure. Spencer A. Ward of the National Institute of Education spoke to this issue in a 1984 anthology on the implications of knowledge structure and use for synthesis and interpretation:

> Past studies of knowledge utilization have paid little attention or attention only at a superficial level, to the characteristics of knowledge and to the cognitive processes involved in its synthesis and use. Similarly, studies of knowledge in cognitive science have paid little attention to the use of knowledge in dissemination, staff development, policymaking and other pragmatic attempts to use knowledge and improve practice (p. 11).

Ward also compared the emergence of a structure of knowledge with the concept of synthesis. He characterized "adequate knowledge" or "adequate

synthesis" according to four criteria: (a) inclusiveness, or the degree to which significant variables and interactions are addressed so that available data makes sense, (b) unequivocalness, or the use of terms in such a way that equivocal meanings are avoided, (c) practicality, so that there is guidance for practice, and (d) consensus for the purpose of acceptability and relevance. (p. 32) Activities identified as necessary to produce synthesis over time include interaction with experts as an initial phase, study and review of literature, development of a framework and development of detail and implication. (p. 39) The change process was viewed by Ward as being complex, time consuming, and difficult.

Nevertheless, Smith (1983) pointed out that theorists such as Lange (1964) and Scriven (1964) have developed structures of knowledge for mathematics, and social sciences, respectively. In the vocational technical fields, however, few--if any--such frameworks have emerged. Smith saw the structure of knowledge in these fields as being based primarily on task analysis (Gagne, 1964; Christal, 1970; Fryklund, 1943)--an inductive procedure which, while helpful in identifying components of a particular skill or technique and in guiding training in the performance of such a task, was viewed by Smith as being an insufficient methodology in and of itself for comprehending the relationship of a task to the functioning of a whole system. Instructional approaches evolving from task analysis tend to guide learners in the performance of the simple to the complex (Gagne, 1965), but not to view each task as being part of a more inclusive structure of knowledge (Shoemaker, 1967).

The assumption that certain content is prerequisite to learning higher order concepts seems intuitively logical and based on sound principles of learning theory, but as Capra (1983) suggested, the world does not exist as

separate pieces. Rather, it is a system composed of elements working in harmony with one another. Learners who are exposed to only "pieces"--however "logical" the sequence might be--may consequently develop a different sense of the relationships involved than if these were made explicit through depiction of the content as a structure of knowledge expected to be learned. This could be done through the use of whole-to-part instruction, an approach which gives greater emphasis to deduction than does task analysis.

Several authors (Gagne, 1964; Christal, 1970; Fryklund, 1943) have discussed the use of task analysis as the basis for technical instruction (part-to-whole), but fewer studies (Shoemaker, 1967; Brown, Zaynor, Berstein and Shoemaker, 1959) have systematically examined whole-to-part instruction in different technical areas. Other cognitive psychologists (Ausubel, 1963, 1964; Bruner, 1960, 1966; Miller, 1956; Schwab, 1964) have conducted research and developed theories which generally support the basic idea of whole-to-part instruction or what has been referred to as the functional context method of instruction. The method has been tested with the military, but it has not been tested in vocational education.

CONSIDERING LEARNING CHARACTERISTICS

Among the many factors influencing the learning process are (a) the characteristic ways that the learner perceives, processes, and uses information (i.e., learning style), and (b) the ability of the learner to comprehend the written symbols that give meaning to language. Individual differences related to both of these factors could be reflected in the outcomes of instruction designed to broaden the learner's perspective by including and emphasizing the abstract relationships of subject matter "parts." The following review describes one dimension of learning style and discusses reading ability.

Field Independent–Field Dependent Learning Styles. Although learning style is but one aspect of individual differences that teachers must consider when planning instruction, it has attracted considerable interest on the part of researchers since study began more than 30 years ago. Defined as "information processing habits which represent the learner's typical modes of perceiving, thinking, remembering and problem solving" (Claxton, 1978), at least nine characteristics of cognitive style, as it is sometimes called, have evolved. (Messick, 1972, 1976; Kagen, 1970; Cawley, 1976) Included are dimensions such as field independence/dependence (analytical versus global), scanning, breadth of categorizing, conceptual differentiation, complexity/simplicity, reflectiveness/impulsivity, leveling/sharpening, flexibility and tolerance for unusual experiences. Of these orientations, the articulated (or analytical) versus the global (or relational) dimension has generated the greatest amount of research. Cawley, et al. (1976), summarized the early findings of Kagen and his associates in this regard:

1. There are stable individual differences in cognitive functioning.
2. There are blatant and individual differences in cognitive products (skills) among children of adequate I.Q. at any one age.
3. There are qualitative differences in intellectual performances among school age children and adults who have no organic deficit.
4. There is consistency of cognitive style across learning situations.
5. Cognitive style is independent of intelligence.
6. Although the tendency to analyze a stimulus into its differentiated components increases with age, children and adults have a clear preference hierarchy with respect to the stimulus characteristics to which they initially attend, that is the way in which they process information. No matter what age, some people are splitters and some people are lumpers.

7. An analytic attitude is related to Witkin's notion of field independence, and a global-relational attitude is related to his notion of field dependence.

8. Relational and analytic cognitive styles are mutually incompatible. When the cognitive styles used between groups and individuals are mutually incompatible, culture conflict is said to exist.

9. Relational and analytic cognitive styles of cognitive organization appear to be developed and reinforced through socialization in shared-function or formally organized primary groups.

10. People with mixed analytic and relational responses have experience in both types of primary groups.

11. Cognitive style will be affected by life style change. When the direction of change is from shared-function family membership to formally organized friendship groups, cognitive functioning is more like that of the polar relational.

12. Research findings suggest that field embeddedness and a desire for social embeddedness have reciprocal effects.

13. People who know both types of conceptual styles and experience membership in both shared-function and formal primary groups and make a choice of preferred style have mixed or conflicting skills. (pp. 102-3)

Within the analytical-relational framework was the work done by Witkin and his associates (1973, 1977) on field independence-field dependence (FI-FD). This perceptual factor is reflected in the degree to which an individual's perceptions are influenced by a context or surrounding field. If perceptions are highly influenced, the person is said to be field dependent; if they are relatively uninfluenced, the person is described as field independent. Findings associated with research on FI-FD have been noted by Daines (1977).

1. Behavioral differences. The behavioral differences in FI-FD which reflect personality have been studied by Witkin (1972, 1977). Field dependent persons tend to be more easily influenced than FI persons by the opinions of authority figures or role models, and rely heavily on the opinions of others in their definition of self. Likewise, they appear to be more sensitive to the interactions between individuals in their environment. Because of this they remember more clearly than FI persons those messages which have a high social content. They are affected to a greater degree by praise or criticism. Their social skills are usually highly developed, and consequently they often

become involved in occupations that require interactions with people. Field dependent persons find it more difficult to make choices regarding occupations than those who are FI, and tend to move from analytically oriented, less social vocations to those where they can work with and for people.

In contrast, FI individuals make career choices earlier in life, and change these choices less often, than do the FD. Field independent persons favor the less social, analytically oriented vocations such as science, mathematics, or technology, although they can be found in the analytical components of most vocations. Once an occupational choice is made by an FI individual, it is rarely changed. In addition, FI persons appear to be more self-referent; they seem to have a greater sense of separate identity as shown by the stability of their responses when asked to give a self description related to four situations (Witkin, 1972; 1973, p. 28; and Messick, 1972, p. 107).

Certain factors of interests and attitudes have been aligned with FI-FD. After completing studies of engineering students, Arbuthnot and Gruenfeld (1969) contended that educational-vocational interest can be predicted by FI-FD as measured by the RFT. Victor (1976) examined prospective teachers of emotionally disturbed children to ascertain their judgments of professional competence and interpersonal-social factors of their peers. It was found that teachers who were both FD and dogmatic (relatively closed to new ideas) tended to be viewed as less professionally competent.

The tendency to be FI or FD has implications for mental health, for while Messick (1972) pointed out that no general relationships have been found between an individual's cognitive style and his/her socio-emotional adjustment or mental health (p. 107), Witkin believed that FI is the cognitive component of a deeply engrained personality syndrome (Kogan, 1972). His studies of the form of the defense mechanisms used when confronted by conflict or stress, and the type of expression of pathology show that there is a variance on these factors according to the cognitive style of the individual. Articulated (FI) persons tend to intellectualize or isolate as defenses, and their pathologies usually involve overcontrol or delusions. Global (FD) subjects are more likely to deny or repress, and their pathology is expressed through dependence and related psychosomatic illness as well as hallucinations (Messick, 1972). Thus, the impact of any particular style extends to the realm of personality and colors one's perception of life experiences.

2. Relationship to ability. The relationship of FI-FD to intelligence remains unclear, although it appears that in those areas which are influenced by one's ability to isolate items in context, there is a substantial overlapping with the factor as measured by traditional aptitude tests. In Kogan's summary of the work of several investigators on this issue (1972, pp. 250-1), a significant relationship between FI and general intelligence was noted. Particularly, correlations among analytic style and mathematical abilities are described. Witkin believed that FI-FD exists apart from general intelligence, and that any correlation with verbal comprehension mathematical or spatial skills

only indicates the degree to which an individual's style permits him or her to overcome embeddedness. Kogan proposed that it is a spatial property, rather than analytical orientation, that overlaps the above components of intelligence. Thus, an FI individual could have an advantage when working with tasks requiring analytical ability, but this does not necessarily indicate a superiority in general intelligence. This is illustrated by Witkin's study of retarded children in 60-80 I.Q. range who were shown to be only slightly below the average of their age in analytical abilities.

If general intelligence is viewed as being potential adaptability to the environment, it can be argued that the advantage of one particular style over the other depends on its suitability for a given situation. For example, the FD individual might have greater difficulty in driving an automobile through a heavy flow of traffic when multi-lanes and interchanges are involved, but yet be very competent in understanding and pacifying an irate customer in a supermarket on a busy afternoon. The FI individual might function superbly when confronting an income tax form, but be less patient in a committee meeting that was run democratically.

3. Relationship to achievement. Achievement is associated with both FI and FD cognitive styles, but the orientation varies for each; it also appears that the degree to which an individual possesses other cognitive factors which interact with style is an important influence. Witkin (1972), in integrating the results of numerous studies which show the relationship of FI-FD to high achieving students in either a particular subject or in a designated professional area, and to persons already working in professions, reported that FI individuals tend to be found in analytical-skilled areas such as engineering, mathematics, mechanics, etc. Field dependent individuals are more likely to be successful in areas requiring interpersonal relations skills such as teaching, social work, etc. Of the two styles, FI is the most versatile in that FI persons can be successful in typically FD-oriented occupations, whereas the reverse is not true.

Certain combinations of cognitive style and verbal comprehension result in patterns which can also project individual ability and functioning. The notation that culturally deprived individuals often have a "cognitive split" composed of FD and low verbal comprehension suggests that a synergistic effect might result from various combinations that could relate to achievement (Witkin, 1972, pp. 10-15). This also could perhaps explain apparent contradictions which are manifest when an individual selects an anaytical aspect of a typically FD occupation such as psychology, or vice versa.

4. Sex differences. Whether or not consistent sex differences exist for a particular cognitive style remains unclear. Cognitive style development is related to socialization, a process which may be different for girls or boys. Witkin (1972, 1977) asserted that sex differences in FI-FD are evident, but other reports are inconsistent. The disagreement could stem from myriad cultural factors such as different expectations and opportunities for males than females, and from different child-rearing practices. Witkin's studies have reported

a greater tendency toward FD in females than in males despite cultural differences, a conclusion similar to the findings of Kagan, Moss and Sigel (1970, pp. 73-124) in their investigations of analytic-descriptive, inferential-categorical, and relational conceptual styles. These orientations appear to be somewhat similar to Witkin's FI-FD, in the sense that they differentiate degrees of analytical ability. In looking at the greater variability of responses for females, Kagan, et al also found that girls tend to give fewer analytic responses than boys.

Measurement of FI-FD is accomplished through assessing either an individual's ability to (a) position a rod within a luminous frame while seated in a darkened room (Rod and Frame Test-RFT), (b) position one's body in a chair within an environment that tilts (Body Adjustment Test-BAT) or (c) locate a simple figure within a more complex figure (Embedded Figures Test-EFT). Responses indicate the degree to which an individual may be more FI or FD, since the dimension is conceptualized as being bipolar, on a continuum. Among the variations of the above test is the Hidden Figures Test (HFT-form Cf-1), a relatively difficult paper and pencil instrument originally developed by French, Ekstrom and Price (1963) and later revised (Ekstrom, French, Harmond, Derman, 1976). Initially the test was designed for use with subjects in the 6th through the 16th grades, but the revision is for grades 8 through 16. The task for each item is to identify which one of five simple figures is hidden or embedded within a complex pattern. In addition to illustrated examples, there are two parts to the timed test, each with 16 items; the subject is allowed 10 minutes to complete each part.

The HFT purports to measure flexibility of closure, a factor which is defined as "the ability to hold a given visual percept or configuration in mind so as to disembed it from other well defined perceptual material" (Ekstrom, et al, 1976, p. 19). Although it is questionable whether or not flexibility of closure and FI-FD are identical constructs, these measures are increasingly used

by investigators of FI-FD due to an apparent relationship demonstrated in research. For example, the HFT has been shown to be related to individual peformance on the EFT or the RFT. Weissenberg (1973) reported an approximate median correlation coefficient of .51 when used with a variety of populations. Greater relationships were evident when males were the subjects. Despite the fact that the population included more groups of males than females and that the correlation coefficient was particularly low for one of the two female groups, Weissenberg concluded that "...given limitations of time and money and the need to test large number of Ss at one time, the HFT, Cf-1 appears to be a reasonably efficient and effective instrument" (p. 462).

Norms for the HFT, Cf-1 are based on an unpublished study of 300 males and 330 females in the 11th and 12th grades. The data are shown below as published by the Educational Testing Service (Ekstrom, et al., 1976, p. 11).

Mean	S.D.	Reliability	Sample
15.8	7.4	.82	males
14.2	6.6	.80	females

Data compiled by other investigators reflects variances in administrative procedures. Davis (1967) found a range of 1.00-37.00 using a correction factor for scoring, and determined the mean for 310 male high school seniors to be 18.59 when subjects were allotted 15 minutes to complete each part. Frederick (1968) used Part I of the HFT to study 256 sixth, eighth, and tenth graders. Twelve minutes were allowed for completion, and work on each item was paced. Scores showed a mean of 5.75 with a standard deviation of 2.60. Hoyt's reliability was .496. Persons who scored 6 or above were considered to be significantly analytical. Weissenberg cites data compiled by Gruenfeld (unpublished study,

1972, cited in Weissenberg, 1973, p. 462) which indicated that individuals who have a total score of 15 or above on the HFT Cf-1 invariably are scored as FI on the RFT. It was also noted that the reverse is not true, for individuals rated FI on the RFT do not always score on the HFT.

Reading Ability. One of the most frequently used and accepted forms of presenting stimulus content to learners is through symbols or language, i.e, the written word. Textbooks, manuals, charts and graphs are common resources in technical programs. However, in order for symbolic stimuli to be used effectively, learners must be able to receive, encode, decode, and assimilate them in a meaningful way. If these processes are disrupted, the information will not be retained and made available for use in subsequent learning tasks. Holland and Kogasigawa (1980) have credited the "vastly superior variability and flexibility of human behavior" as compared to the behavior of other species to the ability to acquire symbolic representations of external events (p. 378). Once these symbolic representations are developed, they become major factors in areas of functioning such as perceptions, problem solving, and motivation. Consequently, the degree to which they are valuable to an individual depends on their accuracy and the efficiency with which they are developed. Studies of success in problem solving have consistently shown that a key factor is the ability of the learner to decode the language in which a problem is stated (Hudgins, 1977, pp. 243).

Assessment of reading prowess can be accomplished through the completion of various standardized instruments. One extensively used measure is the reading component of the California Achievement Tests (CAT). The CAT was first developed in 1934 and most recently revised in 1977. Forms are available which measure achievement of students in reading, mathematics, spelling, and language

from kindergarten through twelfth grade. Two tests are included in the CAT's content area of reading: vocabulary and comprehension. The vocabulary test contains 30 items. Students are asked to identify similar meanings, opposite meanings, and the meaning of multimeaning words according to context. The comprehension test contains 40 items requiring the reading of a variety of material to measure skills in literal, interpretive, and critical comprehension. Ten minutes is allowed for the completion of the first test (vocabulary) and 35 for the second (comprehension). Norms are available for converting a raw score to grade equivalent, scale score, percentile rank, and stanine. For example, a raw score of 40 out of a total possible of 70 would refect a grade equivalent of 11.0 (Form D).

SUMMARY

The preceding discussion briefly reviewed several aspects that were foundational to the study of whole-to-part instruction in vocational technical programs: factors that influence learning and two special cases of learner characteristics--learning style and reading ability. The importance of a structure of knowledge was specifically addressed as it relates to learning technical content.

Chapter III.
PROCEDURES

RATIONALE

The review of research related to the importance of a structure of knowledge suggested that an explicit frame of reference would aid in the conceptual development of the learner. Therefore, a whole-to-part instructional approach supplemented with detailed task analysis appeared to offer a possible solution to the problem of simplifying technical complexities in the content of post-secondary training programs. In this approach, each component part of a content area is systematically described as it relates to the overall conceptual structure. Basically deductive in nature, whole-to-part teaching gives the learner an opportunity to gain a sense of the scope and relationships involved in the "whole" before moving to detailed, more in-depth study of a "part." It also permits the abstraction of content to general levels that are more likely to be familiar to the learner, thus providing a bridge from the known to the unknown.

A basic premise of the study, therefore, was that utilizing a whole-to-part framework could have the effect of simplifying the complex conceptual structure underlying the program for the student. The following assumptions provided a theoretical foundation for the research:

1. Individuals have some finite number of concepts that they can remember at a time.
2. Each subject matter field has an implicit structure of skills and knowledge which can be made graphically explicit to learners.
3. Making the structures of knowledge explicit to learners makes learning "look" easier.
4. Explicit structures of knowledge facilitate initial learning, retention, and transfer.

5. The process of encoding, decoding, and assimilating tasks and knowledges is facilitated by providing a structure of task/knowledges functionally related to some total system of component.

6. The structure of knowledge enhances learner readiness and ease of understanding.

7. The structure of a discipline/field can be translated into goals and objectives and placed into a hierarchical sequence for instruction.

Given the above premise and assumptions, it seemed necessary to determine whether the structure used in organizing the content would be particularly important to learners who characteristically experience and process information in certain ways. For example, field independent and field dependent students may respond differently to the degree and explicitness of structure in a learning situation. It seemed possible that an individual might develop the competence needed to accomplish a given task, yet not be able to comprehend the relationship of that task to the functioning of a whole system or to a similar one. Because of this possibility, task analysis was viewed as a necessary, but insufficient methodology for designing the technical instruction of relatively naive learners first enrolling in a training program. In fact, it was believed that presenting each task within a technical field separately to the learner without making the larger, more subsuming context of the total system explicit could be counterproductive to effective technical instruction. What appeared to be needed was a systematic way in which content in various technical training programs could be graphically structured so that it could (a) become more familiar to the learner and (b) be more easily related to the larger system or structure. Theoretically this would enhance the process of encoding, decoding, and assimilating new material tasks with those learned previously, as well as facilitate initial learning, retention in the programs, and transferability of skills and knowledges.

POPULATION SAMPLE

The population for this pilot study consisted of students and teachers participating in three programs at one postsecondary area vocational technical institute in Southern Minnesota. A purposive selection of programs at that location was made to assure contrast of subject matter and to maximize possible differences in the characteristics of students. Included were two sections of practical nursing, two of truck mechanics, and four of auto maintenance and repair. Table 1 reports the distribution of participants in the various programs.

Table 1

Programs, Teachers, and Students Who Participated Throughout the Study

Program and Group Number	Teachers (N)	Students (N)
Health (1)	7	29
Health (2)	(7)	18
Truck (3)	1	20
Truck (4)	1	11
Auto (5)	1	19
Auto (6)	1	19
Auto (7)	1	18
Auto (8)	1	17
Total	13	151

All students and teachers within the programs agreed to participate in the study. Thirteen teachers were involved. Data reflecting the characteristics

and achievement of 151 students from throughout the eight sections were included in the final analysis of the study.

PROCEDURES

The study was conducted in two major phases: (a) planning and development and (b) assessment and implementation. Throughout the study, the approach used was to work cooperatively with administrators and instructors to accomplish the project goals. It was recognized that the process of conceptualizing--or reconceptualizing--the content structure of a program would require extensive examination, clarification, reflection, and consensus on the part of all concerned. Because of this need, it was also recognized that flexibility would be important to the completion of the project. It would be difficult to predict, for example, a realistic time schedule or to specify common instructional procedures. The unique contributions and styles of the instructors involved were accepted as part of the framework of the study.

During the first phase, the investigator met with the administrators and instructors of these vocational programs to discuss the purpose of the research project and the characteristics of whole-to-part instruction. Subsequent meetings were held with participating staff to identify relevant content for each subject area, and to seek input and advice regarding ways that the technical content, goals and objectives might be graphically conceptualized and displayed to students. The latter aspect was critical because a chart or graph format was determined to be the way that the conceptual structure would be communicated to students. The investigator's role in the construction of the charts was to assist in the clarification of meaning and organization of the categories or topics named. Responsibility for final preparation of the charts

was also assumed by the investigator.

The procedure resulted in the develoment of one large 2' x 3' chart depicting the content of the truck and auto programs, and a series of six 2' x 3' charts with similar information for the health program. The charts were subject to ongoing review and critique by the staff involved. The charts, together with their use in the classroom, constituted the treatment in the three respective programs. Appendix A includes the charts developed throughout the study.

The second phase began with the assessment of the student characteristics of reading ability and field independence/dependence. This was accomplished by administering the reading scales of the California Achievement Test, Level 19, Form D, and the Hidden Figures Test--Cf-1. Both instruments were completed by students in group testing situations and administered according to publishers' specifications. Feedback regarding the reading test score and grade equivalency was later provided to instructors, and through them to their students as requested. Scores on the HFT were not disseminated, however, since the instrument was not designed for counseling purposes.

Implementation of whole-to-part instruction also ensued at this time. Students in the health occupations program and the truck and auto mechanics program were given 8½" x 11" copies of the larger charts to use as references and study guides. The larger charts were displayed in the respective classrooms of the three programs as a visual reminder to students. The instructors were encouraged to refer to them regularly in their lectures or discussions with students, but they were not required to follow a specified procedure in their use. Throughout the semester of implementation, the investigator was available for consultation as necessary. Several meetings were held with participating staff

to communicate and interpret test results, review content of the charts, and address problems or questions.

DATA ANALYSIS

The developmental nature of the study indicated a need for descriptive data that could serve as baseline information for more in-depth research. Because the population consisted of intact groups of students who were not randomly selected, a modified quasi-experimental covariance design guided the data collection and analysis in the study so that individual learner differences could be potentially controlled. The covariates were the reading test scores on the California Achievement Tests and the scores on the Hidden Figures Test. Criterion measures were (a) final grades in the respective programs, (b) number of students dropping the program, and (c) test of transfer for students in the health program. No comparable test of transfer was available for students in the truck or auto mechanics program. Table 2 shows the design matrix illustrating the relationship of the covariates and criterion measures.

Table 2

Research Design

	Health		Truck		Auto			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
California Reading Test	Y1	Y1	Y1	Y1	Y1	Y1	Y1	Y1
and	Y2	Y2						
Hidden Figures Test	Y3	Y3	Y3	Y3	Y3	Y3	Y3	Y3

Y1 = Achievement
Y2 = Transfer
Y3 = Retention Rate

Descriptive data were gathered on each of the variables. Simple frequency distributions were used to describe the field independence-dependence characteristics of students, reading scores were interpreted as grade equivalencies, and correlations of these two factors with the measures of achievement, transfer of learning, and retention in the program were the bases for determining the relationships influencing performance in the programs. Multiple regression as applied by the SPSS statistical program was used to analyze the contributions made by each variable.

SUMMARY

Students and teachers associated with the practical nursing and auto/truck maintenance repair programs at one postsecondary institute in Minnesota participated in the study. Procedures were conducted in two phases: (a) planning and development and (b) assessment and implementation. In the first phase, the investigator worked cooperatively with administrators and teachers to depict program content in the form of a chart and plan its use; in the second phase, the reading ability and field independence/dependence of students were assessed using the California Achievement Test and the Hidden Figures Test. Data related to student characteristics were analyzed using descriptive statistics. Correlation and regression procedures were used to determine relationships among the variables.

Chapter IV.
FINDINGS AND CONCLUSIONS

The purpose of the study which was addressed by data collection and statistical analysis concerned the identification of patterns of student achievement, retention in a program, and transfer of learning, and the study of ways in which these patterns were influenced by or related to a field independent or field dependent learning style and reading ability. The means and standard deviations of learning style, reading ability, and achievement are discussed in this section, followed by a summary of findings related specifically to the objectives. Conclusions associated with each of the findings are also discussed.

CHARACTERISTICS OF THE GROUPS

Descriptive data concerning the characteristics of the students in each section were gathered for the independent variables and the achievement measure of grades in the course. These are displayed in Table 3. Table 3 illustrates that each of the sections in all programs compiled a mean score above the possible midpoint of the vocabulary test, achieving the mean of at least 17.26 on a 30 point scale. Comprehension score means ranged from 21.16 to 29.61 of a possible 40 points, with total reading score means moving from a low of 39.0 to 52.94 of 70 points. On the Hidden Figures Test, performance was lowest on Part I, with scores averaging from 2.48 to 5.36; averages increased in all sections on the second part, with the low-high range being 3.69 to 7.78. All total HFT averages were within the range of field dependence as determined by a score under 15, but at least three sections were of relatively low field dependence. Achievement measures were not comparable across program areas, but four to five

Table 3

Means and Standard Deviation of Variables by Program

Program	N	% Total	Vocabulary $\bar{x}$	Vocabulary SD	Comprehension $\bar{x}$	Comprehension SD	Reading Total $\bar{x}$	Reading Total SD	HFT-I $\bar{x}$	HFT-I SD	HFT-II $\bar{x}$	HFT-II SD	HFT-TOTAL $\bar{x}$	HFT-TOTAL SD	ACHIEVEMENT $\bar{x}$	ACHIEVEMENT SD
Health (1)	29	.19	22.90	5.61	28.41	6.42	51.28	11.44	2.48	2.29	3.69	3.62	6.17	5.29	58.09	8.06
Health (2)	18	.12	23.33	4.43	29.61	4.78	52.94	8.81	3.44	2.63	6.0	3.93	9.44	6.02	53.06	8.36
Truck (3)	21	.14	18.29	4.85	25.43	6.53	42.76	10.76	4.90	2.61	5.43	2.98	10.33	4.79	82.10	7.60
Truck (4)	11	.07	19.64	5.14	28.82	5.71	48.45	10.42	5.36	3.35	6.91	3.73	12.27	6.74	87.18	7.78
Auto (5)	19	.13	18.37	5.43	21.16	8.22	39.00	10.35	5.05	2.93	7.53	4.19	12.58	6.20	82.42	7.08
Auto (6)	19	.13	17.26	9.33	22.63	10.65	39.89	18.96	3.47	3.41	5.16	4.39	8.63	7.57	86.11	6.12
Auto (7)	18	.12	20.06	8.86	26.72	10.11	46.78	18.46	4.78	2.60	7.78	3.25	12.56	5.07	86.94	7.22
Auto (8)	17	.11	19.18	6.06	25.24	7.00	44.41	12.43	4.65	2.62	6.18	3.59	10.82	5.59	82.94	11.74
Maximum Possible			30.00		40.00		70.00		16.00		16.00		32.00			

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point differences emerged within programs.

When the data related to individual sections within the three programs were examined, variations in characteristics were evident. For example, the two health program sections had the highest mean scores in vocabulary and total reading score on the California Achievement Test; both were ranked in the top three on the comprehension test. On the other hand, one of the health sections had the lowest mean on the Hidden Figures Test, signifying that this was the most field dependent group. The other health section was somewhat less so, but still highly field dependent. The reading ability of students in the two truck sections showed more contrast, with one section ranking third in total reading score (second in comprehension) and the other ranking sixth. In both cases, performance on the comprehension test was higher than on the vocabulary portion. The auto program sections reflected the greatest differences: two sections ranked lowest in the total group on total reading score, yet one of these sections ranked highest in field independence and the other was second highest in field dependence. The other two showed mid-ranges (ranking of fourth and fifth) in total reading score; the section ranking fourth was the second highest in field independence and the other could be described as mid-range within the total program.

Although distinctions were not made in the analysis, part of the variability in the auto section scores could be attributed to the proportion of students who--because they were part of a group of refugees just beginning to be familiar with the language and educational system--experienced difficulty with the CAT. Perceptual ability, rather than language, was the focus of the HFT. The instrument used figure grounds as a basis for testing, so bias was more likely to have been reduced on the assessment of learning style. Given the

student characteristics described above, however, instructors of the various sections would face somewhat different challenges in implementing a whole-to-part instructional approach.

The most homogeneous group insofar as reading ability was concerned was the class designated health (2), and the most heterogeneous were two sections in the auto program (6 and 7). Likewise, truck (3) was the most homogeneous in learning style, and auto (6) the most heterogeneous. Auto (6) was the most variable.

FINDINGS ASSOCIATED WITH THE OBJECTIVES

Five objectives formulated as questions addressed the purpose of the study. The findings and conclusions associated with each of the objectives are reported below.

Objective 1: Are vocational students more field dependent or independent in learning style?

According to the performance of students on the Hidden Figures Test, the majority were identified as field dependent learners. Of the 151 students participating in the final analysis, 34 were described as field independent. Most of these scores fell in the low ranges of field independence. The remainder were field dependent in learning style, although the scores reflected moderate to low ranges of field dependence for many of the students. This indicates that a substantial number of the participants were in the range of FI-FD that is most problemmatic in terms of predicting subsequent effects. For example, this range could embody a flexibility of style that is different than that of more extreme orientations. It is of interest, too, that all Sections increased their mean performance between Part I and II of the HFT. In making determinations of

teaching style, a conservative standard was used in designating a particular score (in this case, 15 of a possible 32 points) as the basis for differentiating between the bipolar characteristics of FI-FD.

The range of HFT scores for each section is illustrated in Table 4.

Conclusions drawn from the literature in FI-FD indicate that field independent learners tend to need less structure and are able to develop their own psychological structure of knowledge with relatively few guides or aids. On the other hand, field dependent learners tend to need more structure because they are influenced by the context and environment to a greater degree. Thus, the structure, goals, and objectives of instruction need to be made more explicit for them. Since most students tested were field dependent learners, the use of the reconceptualized, highly structured diagrams was determined to be an appropriate treatment to help develop and integrate an understanding of the content of their respective technical program.

Objective 2: Are vocational students above or below average in terms of reading ability?

The reading sections of the California Achievement Test were administered to the students to ascertain status of reading ability. Scores were then interpreted as grade equivalencies using the Norms tables provided by the publisher. Table 5 illustrates the performance of each section of students on the CAT using a frequency distribution relative to grade level.

A majority of students tested at the 12.0 grade reading level or above. Only a few students were below grade 10 and of those who were, most were individuals who had difficulty reading and speaking the English language. On this basis, it would not be expected that comprehension or vocabulary problems would affect the learning of most of the students continuing in the program.

Table 4

Frequency Distribution of HFT Scores

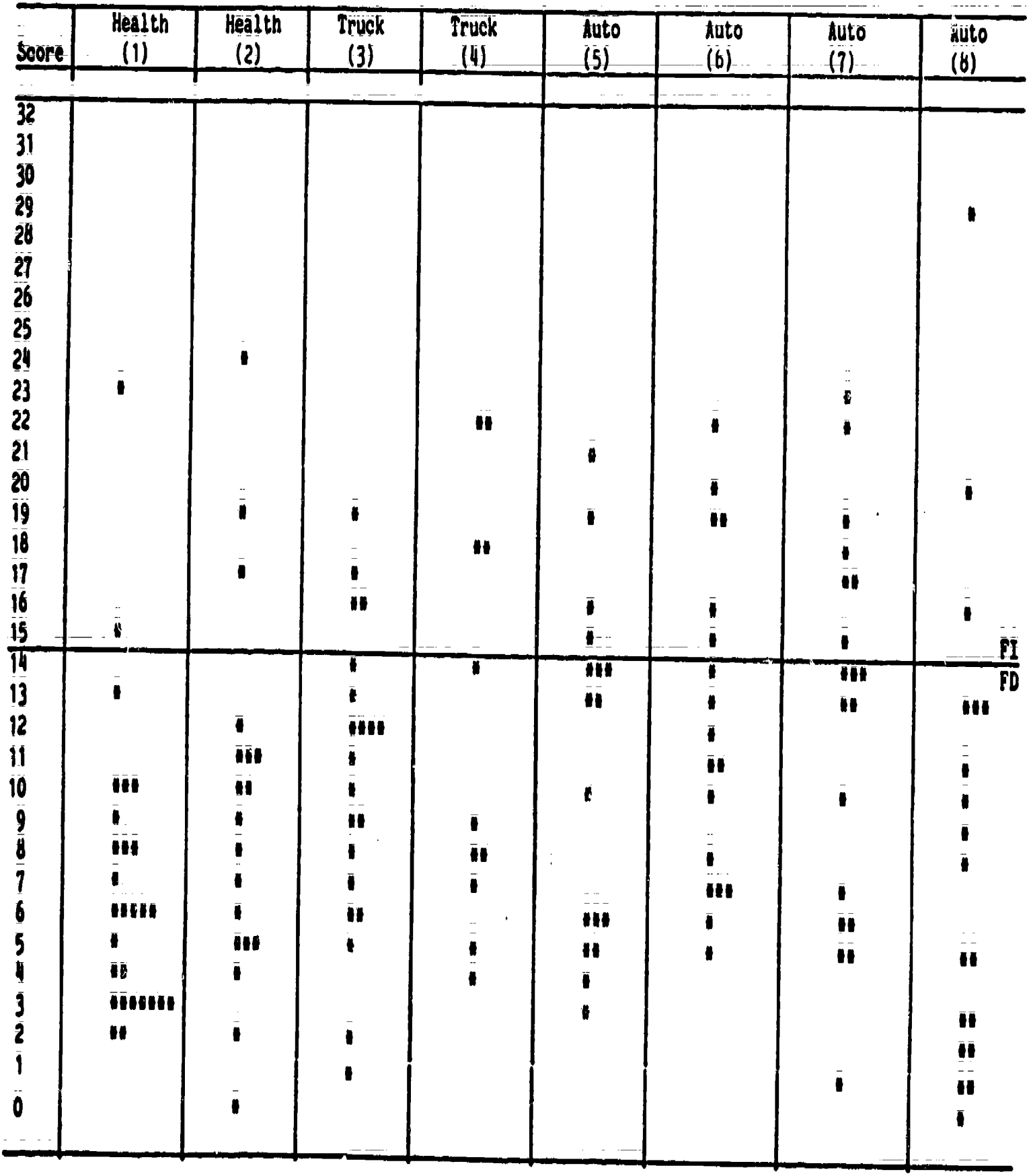

Table 5

Frequency Distribution of CAT Scores Related to Grade Equivalencies by Program Area

Grade Equivalent	Health (1)	Health (2)	Truck (3)	Truck (4)	Auto (5)	Auto (6)	Auto (7)	Auto (8)
2.0 - 2.8	0	0	0	0	0	0	1	0
2.9 - 3.7	0	0	0	0	0	2	0	1
3.8 - 4.6	0	0	0	0	0	0	1	0
4.7 - 5.5	0	0	1	0	0	0	0	0
9.6 - 6.4	0	0	0	0	1	0	1	0
6.5 - 7.3	1	0	0	0	0	0	0	0
7.4 - 8.3	0	0	1	0	4	2	0	0
8.4 - 9.2	2	0	1	1	2	0	0	1
9.3 - 10.1	1	0	3	2	4	2	2	2
10.2 - 11.0	1	3	3	0	0	4	1	5
11.1 - 11.9	4	0	2	2	2	2	2	0
12.0 - 12.8	0	3	1	0	1	1	0	0
12.9	20	13	9	6	5	6	10	8
N =	29	19	21	11	19	19	18	17

Objective 3: Was the treatment effective in improving achievement and retention in the auto mechanics progam?

Objective 4: Was the treatment effective in improving achievement and retention in the truck program?

Objective 5: Was the treatment effective in improving the achievement, transfer of learning, and retention in the health program?

The assessment of treatment effectiveness was based on three factors: student achievement, transfer of learning, and retention in the program.

However, the data collected regarding these factors varied somewhat throughout the programs because of the distinctive nature of the subject matter, differences in the structure of the programs, and availability of convenient measures. Achievement measurements were based on grades of the students as these were described in Table 3. Transfer of Learning was assessed only for students in the health programs; here the measure used was performance on a form of the State Board Examination published by the National League for Nursing and administered by the program instructors. Comparable measures were not available for the other program areas. Retention in the program determinations were based on information provided by the instructors in the program, data which also reflected failures and transfers as well as dropouts.

Of the three measures, the retention data was most difficult to assess. Table 6 describes roughly the configuration of program attrition as reported. It should be noted, however, that the sections are not necessarily comparable.

A summary of the retention data shows that 47 students were enrolled in the health program. Of this group, four failed the program. In addition, 21 others had withdrawn earlier for personal reasons not related to the program (e.g., change of career goal, drugs, marriage, etc.). Thirty-two students enrolled in the truck program; four dropped out or transferred before completing it. The auto mechanics program had 73 students, of which ten dropped or transferred. Only one student failed the program.

Correlational analysis using Pearson's r revealed minimal correspondence among the variables. Table 7 summarizes the statistically significant relationships identified among the variables studied for specific sections. In addition to those listed, expected relationships between test components (e.g., vocabulary, comprehension, and total reading score; HFT-1, HFT-2, and

HFT-Total) emerged--these reflected the internal consistency of the instruments. A complete report of these analyses is included in Appendix B.

Table 6

Retention in the Program Estimates

Program	Report dropouts, failures and transfers
Health (1)	4
Health (2)	21a
Truck (3)	4
Truck (4)	0
Auto (5)	2
Auto (6)	3
Auto (7)	1
Auto (8)	4

aThis reflects attrition from the beginning enrollment of that group of students. The dropouts resulted from personal problems and career change. Eighteen members continued in the advanced class.

As shown in Table 7, significant relationships of the variables did not emerge consistently across sections. In sections (6) and (8), which were both auto mechanics classes, and in section (4), a truck mechanics class, field independent learning style and reading ability were moderately related. Section (3), also an auto class, showed a relationship between field dependence and reading ability. Grades, the measure of achievement, were not related to learning style, but were moderately related to either vocabulary, comprehension, or both in three sections [(5), (7), (8)]. An exception was truck section (4);

here there was a moderately strong negative relationship. There were no significant relationships between the HFT-scores and grades.

Table 7

Significant Correlations of Test Scores as Related to Program Sections[a]

	HFT-1	HFT-2	HFT-Total	Grades
Vocabulary	(1) .3956*	(1) .4245*		(7) .5926**
	(3) -.4499*			(8) .4321*
	(8) .7278***	(8) .6296**	(8) .7454***	
Comprehension	(1) .3448*	(1) .4593**	(6) .4004*	(4) -.5312*
	(4) .7693***	(6) .4078*	(6) .4106*	(5) .3897*
	(8) .6721**			(7) .4941*
Reading Total	(3) -.4108*	(6) .4236*	(6) .4106*	(7) .5551**
	(4) .6973**	(8) .5260*	(8) .6817***	
	(8) .7338***			
Grades				
(Achievement)				

*.05 level of significance
**.01 level of significance
***.001 level of significance

[a] Numbers in parenthesis refer to program section.

Regression analysis also revealed few notable findings. Appendix C contains data showing the proportion of variance accounted for using full and restricted restricted regression models for each of the sections. A summary of the significant findings from this analysis is reported in Table 8.

Table 8

Significant Findings: Proportion of Variance Accounted for Using Full and Restricted Regression Models

Program	R^2 Full Model	R^2 Reduced Model	Criterion	F
Health (1)	.655	.392 (HFT-1)	Transfer	3.287*
Truck (4)	.923	.655 (HFT-1)	Grades	8.09**

*$F_{.95}(4,17)=2.96$
**$F_{.95}(3,7)=4.35$

In the health program, contributions of vocabulary, comprehension, and field dependence toward student achievement, retention in the program, and transfer of learning were examined. Table 8 shows that of these factors, only learning style made a significant impact, and this was the case in one section only. Transfer of learning was not a variable in the analysis of the auto and truck sections. On the other criteria, learning style influenced grades in one truck section. No one factor accounted for variance in grades or retention in the auto program.

Because clear patterns of inter-variable relationships did not emerge across sections, and because significant proportions of variances could be identified in two cases only, it is not possible to establish conclusive linkages between the whole-to-part instructional treatment and the measures of achievement, retention, and transfer used in this pilot study. Reading ability and

learning style were reflected in some of the outcomes, yet because the great majority of students completed the programs successfully (only five of this group failed) the treatment could be assumed to be effective. In the truck and health programs, in particular, instructors attested to the contributions of the instructional approach and in the case of the truck program, attributed the high retention rate to the use of the charts. On this basis, further study appears warranted.

SUMMARY

Analysis of the data on student characteristics of reading ability and learning style indicated that students in the practical nursing and auto/truck maintenance programs were primarily field dependent in learning style and that most were capable of reading at grade level 12. Significant relationships among the variables of learning style, reading ability, achievement, retention in the program or transfer of learning did not emerge consistently throughout the sections, although reading ability and learning style did show some correspondence. Grades and learning style were not related. Regression analysis was similarly inconclusive. Most of the students completed the programs successfully, however, and instructors indicated that in their view this success was facilitated by the instructional approach.

Chapter V.
IMPLICATIONS

The study of whole-to-part instruction in this research suggested several different types of implications; two of the most evident relate to additional research and staff development. In the area of additional research, questions such as the following warrant further study:

1. What other ways of communicating whole-to-part relationships would be effective, and to what degree?
2. What specific uses of whole-to-part frameworks are most effective? Should teachers use a conceptual model at a particular point in an instructional strategy, and what factors should be considered when determining their use?
3. What differences in opportunities exist when the individual characteristics of learners are considered in the use of the framework? For example, if instruction emphasizes whole-to-part relationships in a certain way for field dependent learners, how does it affect the achievement of field independent learners? If whole-to-part instruction is effective when reading skills are adequate, what happens to individual learners whose skills are not fully developed?

   Also, the particular characteristics of field dependence imply a different response in cooperative, individualistic, or competitive situations. How do these instructional variables influence the achievement, retention, and transfer of learning of field independent or field dependent students in technical vocational programs?

At what degree of field independence or dependence does an individual present a different challenge to an instructor using whole-to-part methodologies? Is there a range wherein one's flexibility of strategy is maximized? What specific techniques in whole-to-part approaches are most appropriate for field dependent students in vocational programs? What techniques are most appropriate for those who are in the mid-ranges of field dependence or independence?

In what ways can cultural differences be accommodated by whole-to-part instruction?

4. What corresponding characteristics of teachers influence the instructional situation? Does the field independence-field dependence of teachers influence their use of media such as a chart when utilizing whole-to-part approaches to learning?

The study was not primarily concerned with questions related to staff development, but since one of the purposes of the study concerned the simplification of instruction, implications can also be drawn in this area as a result of working with the participating instructors.

1. The research and development process provided opportunities for staff to discuss the conceptions they held of their respective content areas, and to explore various ways of describing the structure to students. This appeared to result in a clarification of meaning and direction that was helpful to the instructors as well as the students, for it made explicit the necessity of coordinating their approaches to communicating the intents of the program. It also helped them identify "gaps" or "overlaps," as well as problem areas where student learning could be facilitated in different ways.

2. Undertaking a task as difficult as conceptual analysis of program content is a challenging intellectual and professional undertaking. It can be as frustrating as it is rewarding. Nevertheless, the process appeared to encourage collegiality and to result in renewed interest in the program. Different uses for the whole-to-part orientation began to emerge as the use of the chart as a discussion tool for purposes such as recruitment, guidance, placement, and evaluation were identified. For example, in the auto and truck programs different career paths could be traced that would clearly reflect a particular depth and breadth of preparation.

3. The study also appeared to stimulate interest in student characteristics such as learning style or competence in basic skills. The feasibility of further assessment and study of these factors was considered so that the instructional approach might be adapted as necessary in the future.

Although the study was essentially introductory in nature, the implications that emerged for further research and staff development were interesting ones. Comparative data is needed to provide a verification of the assessments, and the long-term implications of staff involvement in a project such as this need to be examined.

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APPENDIX A:
CHARTS FOR WHOLE-TO-PART INSTRUCTION

ROCHESTER A.V.T.I.

(Auto/Truck Maintenance Repair Program)

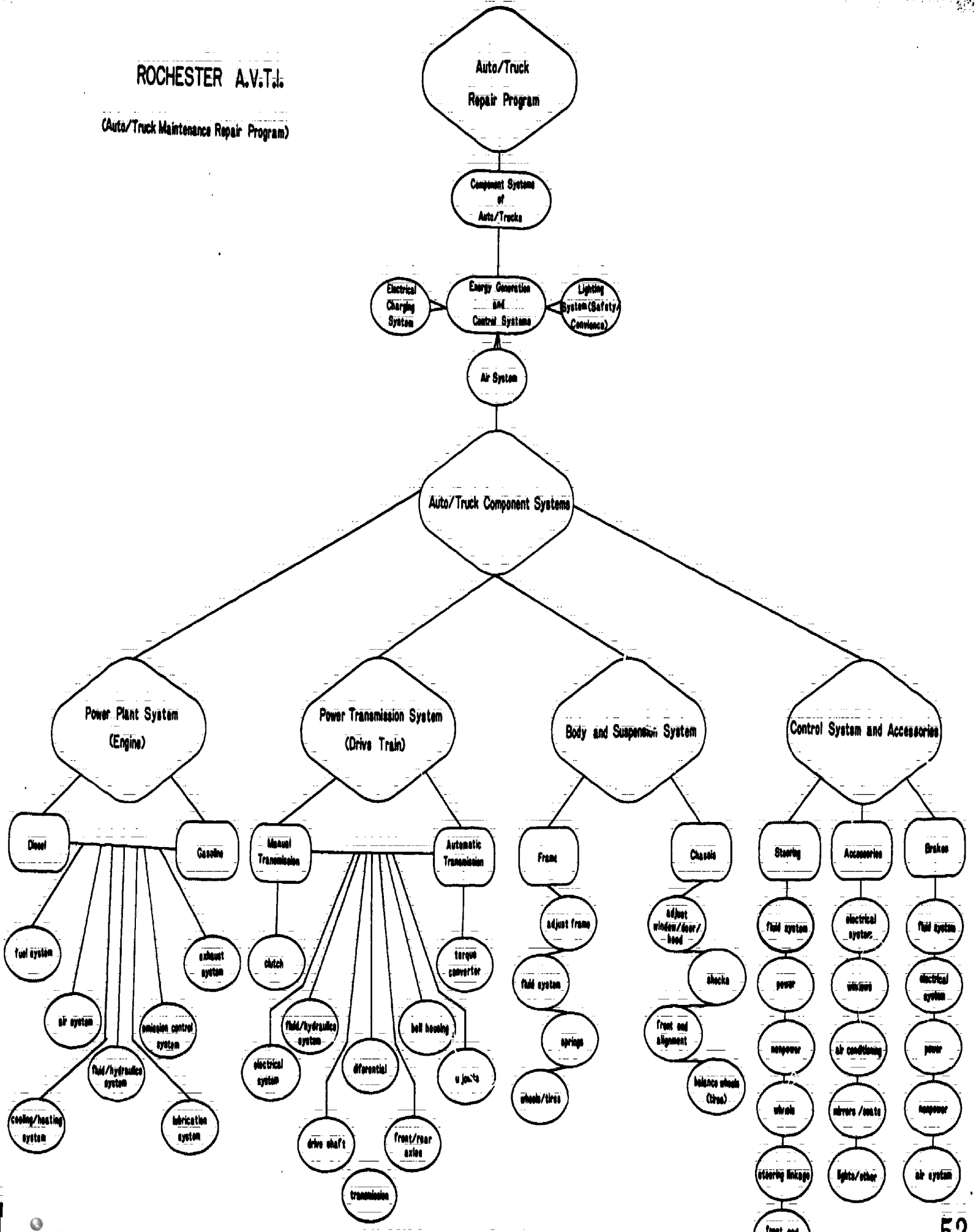


Figure 2.

BEST COPY AVAILABLE

ROCHESTER A. V. T. I. PRACTICAL NURSING PROGRAM CURRICULUM FRAMEWORK

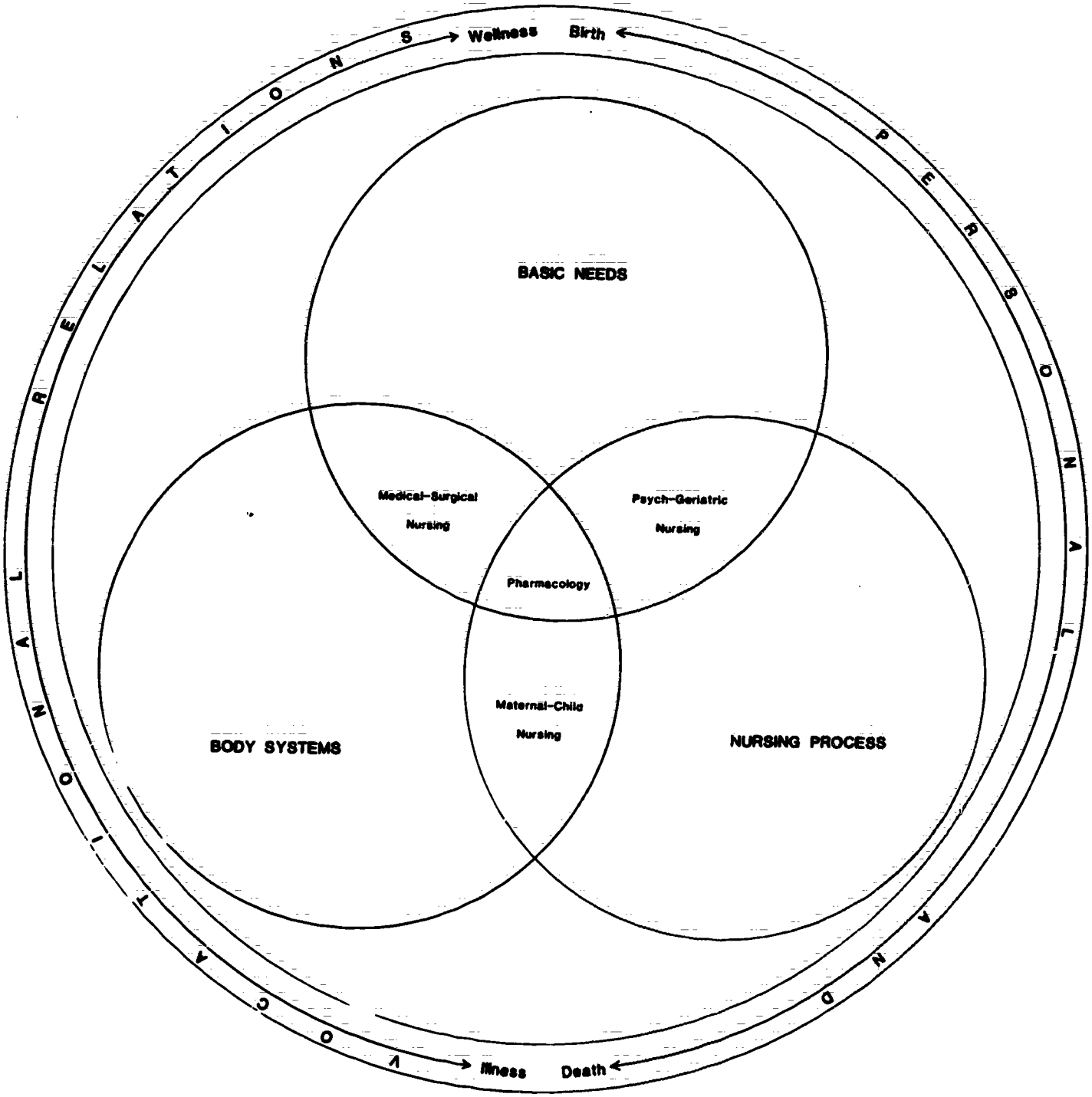


Chart 1

BUILDING BLOCKS TO BE ABLE TO UTILIZE THE NURSING PROCESS

TO MEET THE BASIC NEEDS OF MAN IN ANY CARE SETTING

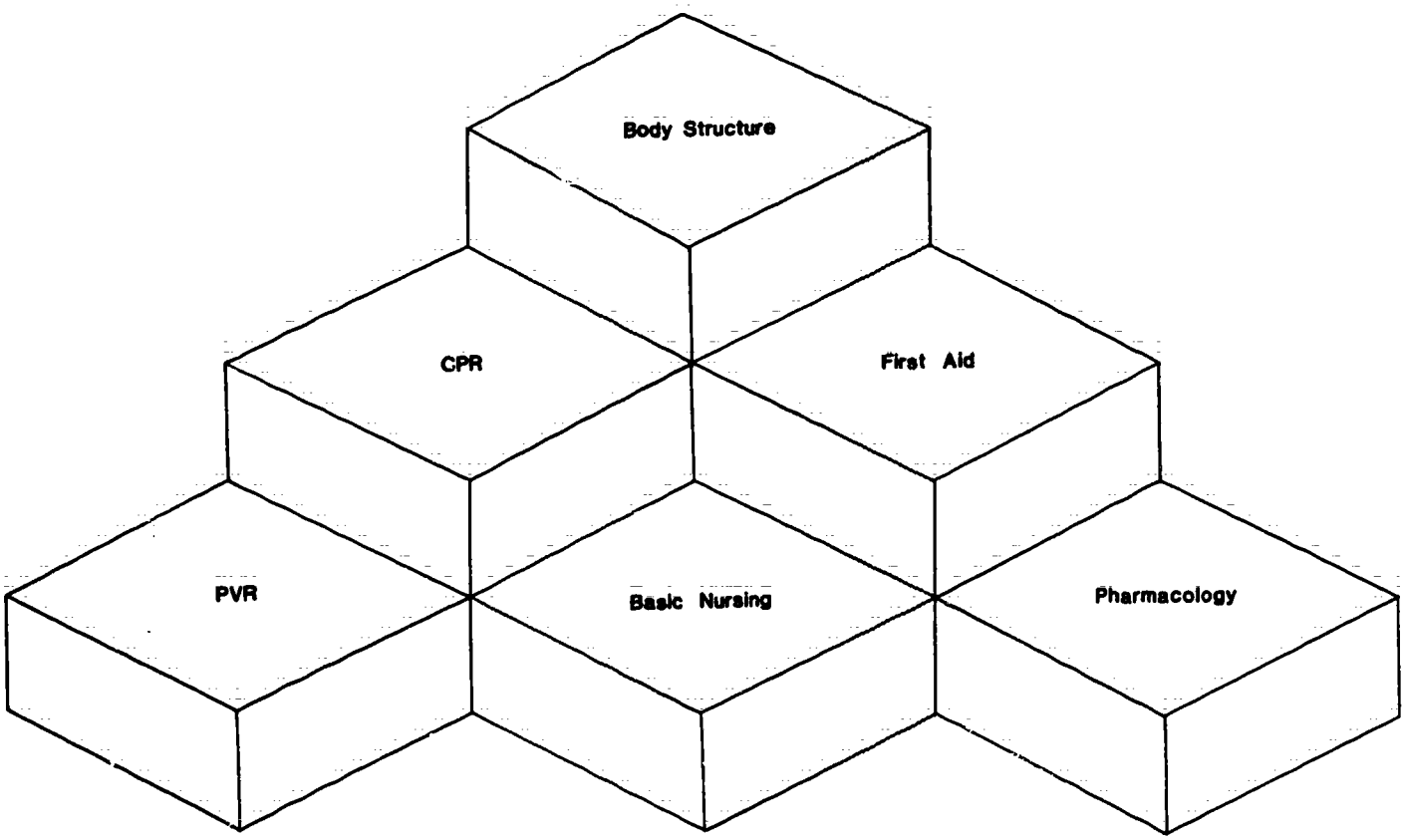


Chart 2

THE NURSING PROCESS

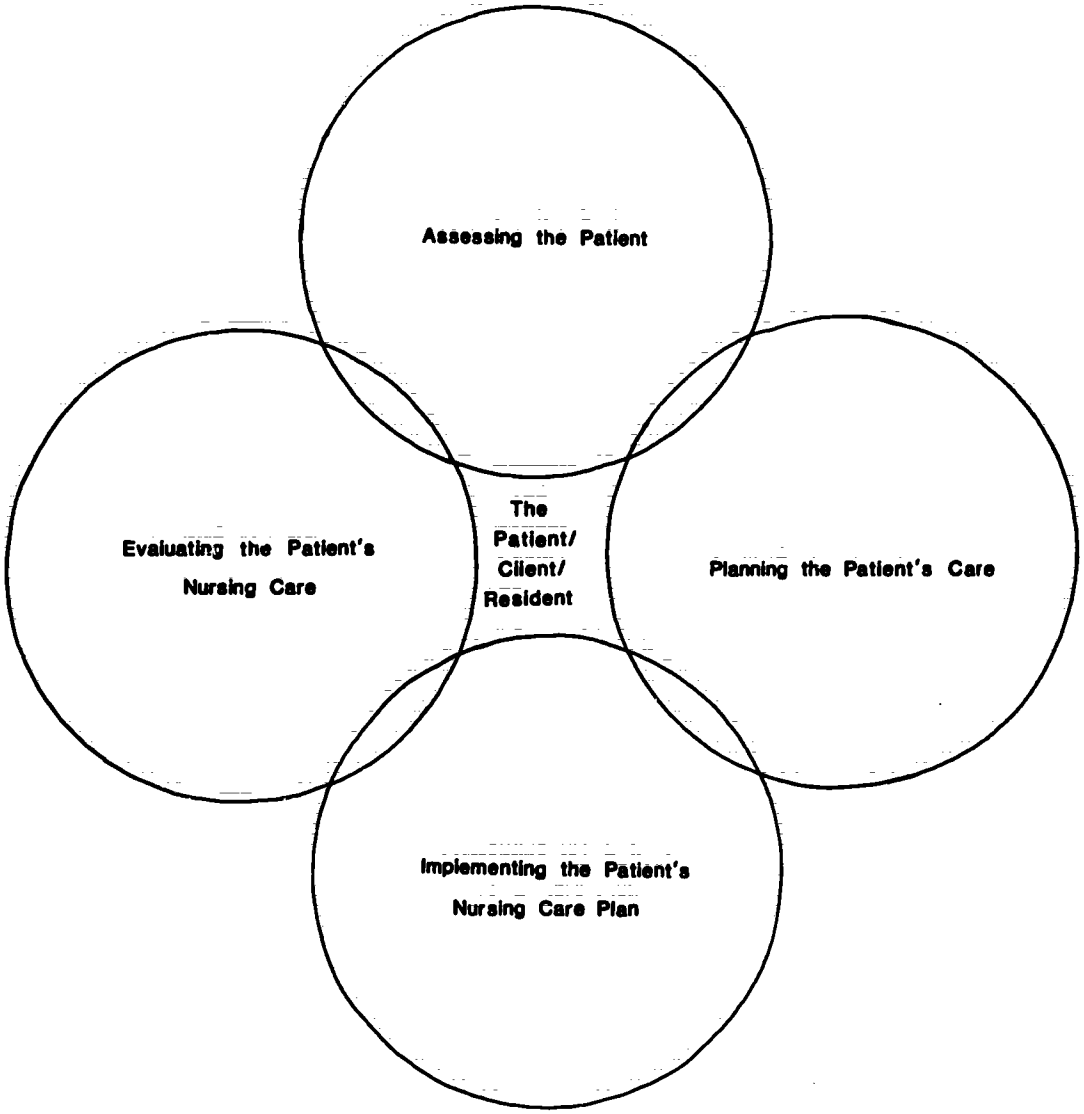
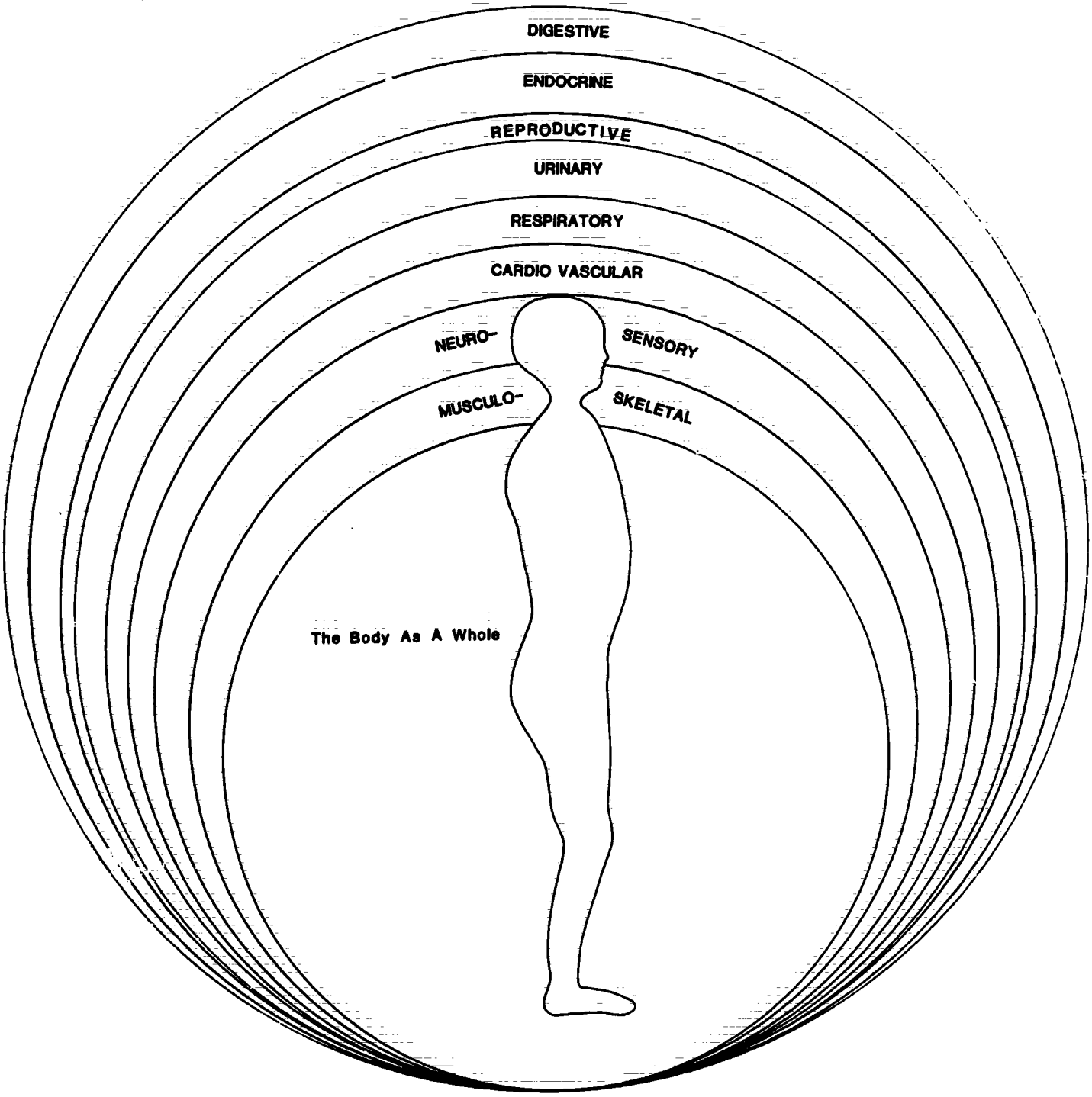
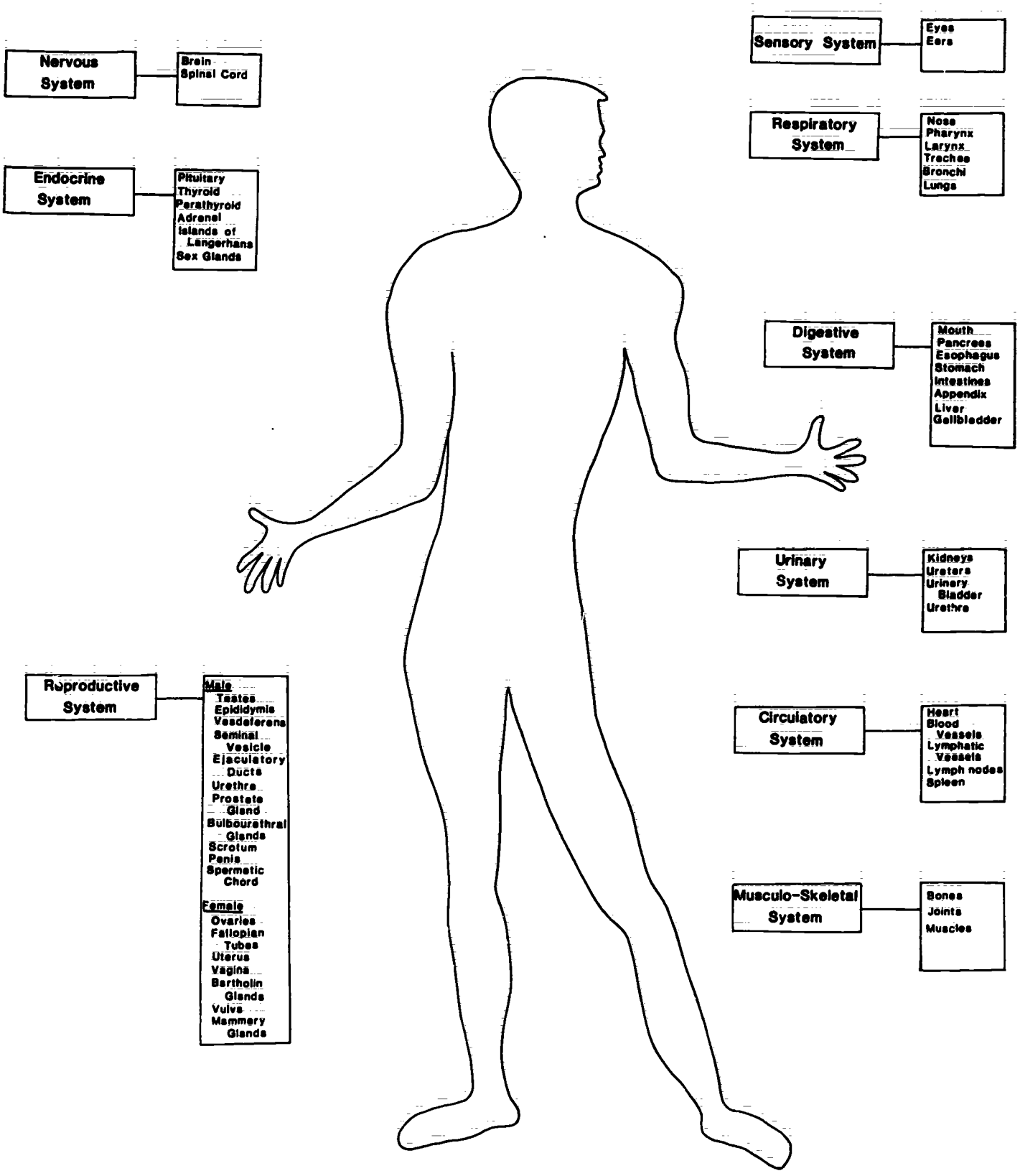


Chart 3



BODY SYSTEMS

Chart 5



BODY SYSTEMS AND ORGANS COMPRISING THEM

Chart 6

CONCEPTUAL FRAMEWORK

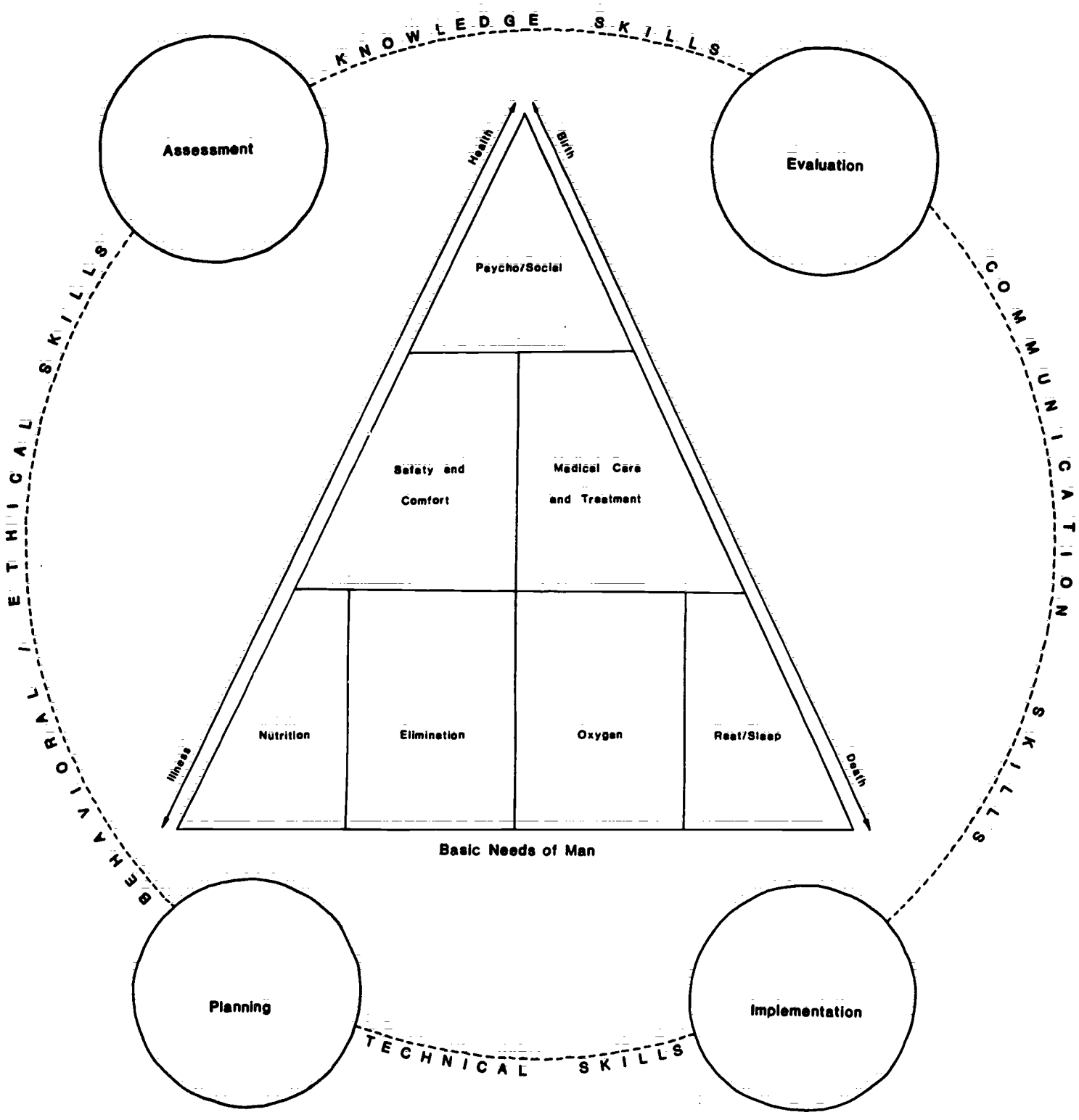


Chart 7

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APPENDIX B:
CORRELATION ANALYSES

Relationship of Learning Style (HFT-Total Score) and
Specific Component Test Scores by Program

Program	N	Vocabulary	Comprehension	Reading Total	HFT-1	HFT-2
Health (1)	29					
Health (2)	18					
Truck (3)	20	-.3433	-.2663	-.3232	.8221***	.8775***
Truck (4)	11	.3620	-.0029	.1700	.1803	.9566***
Auto (5)	19	.2606	.1614	.2180	.8102***	.9121***
Auto (6)	19	.3772	.4004*	.4106*	.9636***	.9782***
Auto (7)	18	.2461	.1489	.1997	.8262***	.8919***
Auto (8)	17	.7454***	.5643**	.6817***	.8611***	.9287***

* Significant at .05
** Significant at .01
*** Significant at .001

Relationship of Reading Total Score and Specific Component Test Scores by Program

Program	N	Vocabulary	Comprehension	HFT-1	HFT-2	HFT-Total
Health (1)	29					
Health (2)	18					
Truck (3)	20	.8763***	.9457***	-.4108*	-.1613	-.3232
Truck (4)	11	.9159***	.9515***	.6973**	.0332	.1700
Auto (5)	19	.6839***	.8855***	.1536	.2149	.2180
Auto (6)	19	.9414***	.9553***	.3673	.4236*	.4106*
Auto (7)	18	.9692***	.9764***	.0503	.2917	.1997
Auto (8)	17	.9433***	.9578***	.7338***	.5260*	.6817***

* Significant at .05
** Significant at .01
*** Significant at .001

Relationship of Comprehension Score and Specific Component Test Scores by Program

Program	N	Vocabulary	Reading Total	HFT-1	HFT-2	HFT-Total
Health (1)	29	.8133***		.3448*	.4593**	
Health (2)	18	.8312***		.1591	.0941	
Truck (3)	20	.7035***	.9457***	-.3286	-.1413	-.2663
Truck (4)	11	.7485**	.9515***	.7693**	-.1201	-.0029
Auto (5)	19	.3208	.8855***	.1607	.1262	.1614
Auto (6)	19	.7996***	.9553***	.3650	.4078*	.4004*
Auto (7)	18	.8931***	.9764***	-.0025	.2436	.1489
Auto (8)	17	.8081***	.9578***	.6721**	.3882	.5643**

* Significant at .05
** Significant at .01
*** Significant at .001

Relationship of Vocabulary Score and Specific Component Test Scores by Program

Program	N	Compre-hension	Reading Total	HFT-1	HFT-2	HFT-Total
Health (1)	29	.8133***		.3956*	.4245*	
Health (2)	18	.8312***		.0922	.1555	
Truck (3)	20	.7035***	.8963***	-.4499*	-.1598	-.3433
Truck (4)	11	.7485***	.9159***	.5144	.2206	.3620
Auto (5)	19	.3208	.6839***	.1173	.3033	.2606
Auto (6)	19	.7996***	.9414***	.3298	.3971*	.3772
Auto (7)	18	.8931***	.9692***	.1077	.3297	.2461
Augo (8)	17	.8081***	.9433***	.7278***	.6296**	.7454***

* Significant at .05
** Significant at .01
*** Significant at .001

Relationship of Grades and Specific Component Test Scores by Program

Program	N	Vocabulary	Comprehension	Reading Total	HFT-1	HFT-2	HFT-Total
Health (1)	29	.1093	.1669		-.0287	-.0982	
Health (2)	18	.1717	.3007		.3033	-.1856	
Truck (3)	20	-.0816	.1205	.0378	.4035	.1450	.3089
Truck (4)	11	-.0135	-.5312*	-.3185	-.7229**	.5045	.4897
Auto (5)	19	-.0707	.3897*	.2227	.2663	.0838	.1826
Auto (6)	19	.0063	.0680	.0413	.2001	.0945	.1448
Auto (7)	18	.5926**	.4941*	.5551**	.2844	.0773	.1995
Auto (8)	17	.4321*	.3186	.3904	.1252	-.0398	.0332

* Significant at .05
** Significant at .01
*** Significant at .001

APPENDIX C:
REGRESSION ANALYSES

Proportion of Variance Accounted for Using
Full and Restricted Regression Models for Health (1) Program

	Criteria								
	Grades			Retention			Transfer		
	R^2	Drop	F	R^2	Drop	F	R^2	Drop	F
Full Model	.067			.761			.655		
Reduced Model-- Vocabulary	.066	.001	.006	.717	.044	.785	.605	.050	.625
Reduced Model-- Comprehension	.037	.030	.200	.761	.000	.000	.650	.005	.050
Reduced Model -- HFT-1	.067	.000	.000	.749	.012	.214	.392	.263	3.287(*)
Reduced Model -- HFT-2	.037	.030	.200	.752	.009	.225	.545	.110	1.375

General Equation $y = a + b_1 \text{ voc} + b_2 \text{ comp} + b_3 \text{ HFT-1} + b_4 \text{ HFT-2}$

(*) $F_{.95}(4,17)=2.96$

N = 29

Proportion of Variance Accounted for Using
Full and Restricted Regression Models for Health (2) Program

	Criteria								
	Grades			Retention[a]			Transfer		
	R^2	Drop	F*	R^2	Drop	F	R^2	Drop	F**
Full Model	.427						.439		
Reduced Model-- Vocabulary	.426	.001	.0075				.367	.072	.391
Reduced Model-- Comprehension	.411	.016	.1212				.431	.008	.043
Reduced Model -- HFT-1	.149	.278	2.106				.398	.041	.217
Reduced Model -- HFT-2	.172	.255	1.931				.373	.066	.358

General Equation $y = a + b_1 \text{ voc} + b_2 \text{ comp} + b_3 \text{ HFT-1} + b_4 \text{ HFT-2}$

[a] Since there were no drops or failures, there was no variance to be reported.

*$F_{95}(4, 12) = 3.26$

**$F_{95}(3, 13) = 3.41$

N=18

Proportion of Variance Accounted For Using
Full and Restricted Regression Models for Truck Repair (3) Program

	Criteria					
	Grades			Retention		
	R^2	Drop	F*	R^2	Drop	F*
Full Model	.243			.248		
Reduced Model-- Vocabulary	.236	.007	.037	.199	.049	.260
Reduced Model-- Comprehension	.177	.066	.351	.233	.015	.079
Reduced Model -- HFT-1	.090	.153	.813	.209	.039	.207
Reduced Model -- HFT-2	.241	.002	.010	.078	.170	.904

General Equation $y = a + b_1 \text{ voc} + b_2 \text{ comp} + b_3 \text{ HFT-1} + b_4 \text{ HFT-2}$

N=20

*$F_{.95}(3, 16)=3.24$

Proportion Variance Accounted For Using
Full and Restricted Regression Models for Truck Repair (4) Program

	Criteria					
	Grades			Retention[a]		
	R^2	Drop	F*	R^2	Drop	F
Full Model	.923					
Reduced Model-- Vocabulary	.865	.058	1.75			
Reduced Model-- Comprehension	.920	.003	.090			
Reduced Model -- HFT-1	.655	.268	8.09*			
Reduced Model -- HFT-2	.787	.136	4.12			

General Equation $y = a + b_1 \text{ voc} + b_2 \text{ comp} + b_3 \text{ HFT-1} + b_4 \text{ HFT-2}$

[a] Since there were no drops or failures, there was no variance to be reported.

N=11

*$F_{.95}(3,7)=4.35$

Proportion of Variance Accounted For Using
Full and Restricted Models for Auto Repair (5) Program

	Criteria					
	Grades			Retention		
	R^2	Drop	F*	R^2	Drop	F*
Full Model	.243			.084		
Reduced Model-- Vocabulary	.200	.043	.280	.063	.021	.114
Reduced Model-- Comprehension	.082	.161	1.073	.071	.013	.071
Reduced Model -- HFT-1	.203	.040	.266	.068	.016	.087
Reduced Model -- HFT-2	.243	.000	.000	.035	.049	.267

General Equation $y = a + b_1 \text{ voc} + b_2 \text{ comp} + b_3 \text{ HFT-1} + b_4 \text{ HFT-2}$

N=19

*$F_{.95}(3,15)=3.29$

Proportion of Variance Accounted For Using
Full and Restricted Regression Models for Auto Repair (6) Program

	Criteria					
	Grades			Retention		
	R^2	Drop	F*	R^2	Drop	F
Full Model	.078			.473		
Reduced Model-- Vocabulary	.073	.005	.016	.473	.000	.000
Reduced Model-- Comprehension	.072	.006	.032	.444	.029	.276
Reduced Model -- HFT-1	.018	.060	.327	.217	.256	2.438
Reduced Model -- HFT-2	.048	.030	.163	.158	.315	3.00

General Equation $y = a + b_1 voc + b_2 comp + b_3 HFT\text{-}1 + b_4 HFT\text{-}2$

N=19

*$F_{.95}(3,15)=3.29$

Proportion of Variance Accounted for Using
Full and Restricted Regression Models for Auto Repair (7) Program

	Criteria					
	Grades			Retention(1)		
	R^2	Drop	F*	R^2	Drop	F*
Full Model	.473			.313		
Reduced Model-- Vocabulary	.374	.099	.891	.293	.020	.122
Reduced Model-- Comprehension	.472	.001	.009	.266	.047	.319
Reduced Model -- HFT-1	.375	.098	.882	.023	.290	1.97
Reduced Model -- HFT-2	.401	.072	.648	.212	.101	.687

General Equation $y = a + b_1 voc + b_2 comp + b_3 HFT\text{-}1 + b_4 HFT\text{-}2$

N=18

*$F_{.95}(3,14)=3.34$

Proportion of Variance Accounted For Using
Full or Restricted Regression Models for Auto Repair (8) Program

	Criteria					
	Grades			Retention		
	R^2	Drop	F*	R^2	Drop	F*
Full Model	.389			.128		
Reduced Model-- Vocabulary	.134	.255	1.808	.085	.043	.213
Reduced Model-- Comprehension	.375	.014	.099	.125	.003	.014
Reduced Model -- HFT-1	.374	.015	.106	.111	.017	.084
Reduced Model -- HFT-2	.262	.127	.893	.115	.013	.064

General Equation $y = a + b_1 \text{ voc} + b_2 \text{ comp} + b_3 \text{ HFT-1} + b_4 \text{ HFT-2}$

N=17

*$F_{.95}(3, 13) = 3.41$