THE DEVELOPMENT OF INDICIES FOR THE USE OF GATB SCORES IN PREDICTING STUDENT SUCCESS IN ELEVEN OKLAHOMA AREA VOCATIONAL-TECHNICAL SCHOOL PROGRAMS

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CHAPTER I

PURPOSE AND DESIGN OF THE STUDY

Introduction

A student making a vocational career choice has made a decision that will affect not only his future but in addition will place demands upon vocational education institutions that will provide the student with the necessary skills to realize his vocational career goals. With the vocational decision making process of students having such a large effect on the vocational education process in terms of student demands for particular training areas and allocation of educational resources to supply training demands, it is beneficial that student choices be made as accurately as possible to insure the best possible allocation of those scarce vocational education resources used by students (30).

The best way for a student to determine whether or not his vocational choice has been a wise one is to allow him to attempt the training necessary to obtain the skills needed for employment in his chosen profession. If, however, the choice has been an incorrect one, the training resources used by the student have been lost and additional training resources must be provided, hopefully in an area which will provide the student with a skill. This process, even though effective, is very inefficient in that limited training resources have been lost and a student must spend additional time in a school. An alternative to students randomly selecting a career is to provide them

with information concerning their aptitudes that will allow them to make a vocational decision which is more likely to lead to successful training and employment. Concurrently, if we can identify relevant aptitudes for training success in a vocational area, then we can determine if a student should seek additional training before entering an area where he has been determined to have a low aptitude rating. This type of guidance can overcome the prediction of failure by providing the supplemental training necessary to acquire needed abilities.

STATEMENT OF THE PROBLEM

In many instances, students have GATB scores available but are unable to use them for vocational program selection or for identifying low aptitude areas that need to be upgraded prior to entering vocational programs due to an absence of GATB norms for training success. The problem exists as to what aptitude score should a student look at for a particular training program and at what level should he score before attempting to undergo the training. The additional problem also occurs as to what should be the criteria of success in a vocational training program, where the student is not only faced with completing cognitive tests but also must perform psychomotor tests satisfactorily in order to complete the training program. Is it possible for students who complete all cognitive tests to complete all psychomotor tests and are the aptitudes necessary for cognitive testing in a trade area the same as those necessary for the psychomotor testing? These questions must be answered in order for aptitude testing to provide the guidance information necessary for students to make career decisions.

PURPOSE OF THE STUDY

The purpose of this study was to first establish that there was a strong correlation between how a student achieves in the classroom, how he performs in the practicum portion of his program, and his instructor's overall perception of the student's potential to succeed in the work for which he is being trained, thus establishing the importance of each criteria in a student successfully completing the vocational program. After determining the criteria relationships, an expectancy index was developed that would allow a student to use his aptitude scores to make decisions concerning selection and preparation for vocational programs.

OBJECTIVES OF THE STUDY

1. To determine the correlation between student rankings for (1) academic achievement, (2) skill achievement and (3) the teacher's overall perception for success in order to establish the importance of each criteria in a student successfully completing a vocational program.

2. To determine the aptitudes that most significantly contribute to how a student ranks on the three criteria of success.

3. For the academic areas where there is a high correlation between the rankings for academic success, skill success, and the teacher's overall rating of success, develop an expectancy index for the criteria students and counselors can use to determine the probability of student success in the vocational program with the students

given aptitude ratings or identity aptitudes that they need to improve in order to increase their probability of success.

ASSUMPTIONS AND LIMITATIONS OF THE STUDY

Assumptions

For the purposes of this study, the following assumptions were made.

1. The criteria defined and included in the study were adequate measures of student success.

2. The responses by teachers participating in the study were true reflections of how the students ranked (1) academically, (2) in the lab or shop, and (3) on the teachers' perceived potential success on the job in relation to their classmates.

3. The 125 vocational classes included in the study were representative of all classes offering similar courses of instruction and would constitute an adequate sample.

4. The students involved in this study are representative of future enrollees.

Limitations

The following limitations of the study were recognized by the investigator.

1. The programs included in the study were limited to those located in area schools which were using the state vocational curriculum.

2. The students included in the study were limited to those who were enrolled in the area school for the first time and had GATB scores

available for them. An exception was made for four area schools where no GATB testing was done. In these four schools, the students were GATB tested.

DEFINITION OF TERMS

Ability--Denotes skill acquired through education or experience.

Academic Rank--How a student ranks in his class according to scores he has achieved on standardized tests from the vocational course curriculum developed by the Oklahoma State Department of Vocational and Technical Education.

Aptitude--Denotes the capacity to learn and is affected by both heredity and environment.

Area Vocational Schools--Area vocational schools are school districts formed by individual public school districts banding together to form a new unit of government with a separate board having the power to levy taxes to provide vocational training for students from each individual participating school district.

Expectancy Indicies--Indicies that will indicate a student's probability of success based on actual student GATB factors and criteria rankings.

GATB--Is the acronym for the General Aptitude Test Battery which was developed by the United States Employment Service and contains 12 aptitude tests, which are combined to measure nine different aptitudes: (1) G--Intelligence, (2) V--Verbal Aptitude, (3) N--Numerical Aptitude, (4) S--Spatial Aptitude, (5) P--Form Perception, (6) Q--Clerical Perception, (7) K--Motor Coordination, (8) F--Finger Dexterity, and (9) M--Manual Dexterity.

O.A.P.--Occupational Aptitude Patterns are indexes of Multiple Cut-Off aptitude scores which are listed for various occupations and are used to determine an individual's suitability for the occupations.

Multiple Cut-Off--When more than one aptitude is necessary for successful job performance and the aptitudes are non-compensatory in nature, a minimum score is developed for each aptitude and an individual's failure to attain any one of the scores would preclude him from being successful in the occupation.

Multiple Hurdle--The multiple hurdle scores are used when it is necessary to complete a series of criterion before being qualified to complete a task. For example, a student's aptitude scores must first indicate that he is able to perform academically, and

secondly, he must be able to learn the skills inherent in vocational training. Failure of either academic or skill requirements would preclude successful completion of the vocational course-work.

Perceived Potential Success Rank--How a teacher ranks his students on how they will succeed in the work area for which they are being trained based upon the instructor's work experience in the vocational area.

Program Success--A student will be considered successful in his vocational program if he ranks in the upper one-half of his class on the criteria.

Skill Rank--How a student ranks in his class according to his accomplishing the performance objectives outlined in the vocational subject curriculum developed by the State Department of Vocational and Technical Education.

SCOPE OF THE STUDY

The data for this study was collected from 22 area school sites. The programs studied included Auto Body, Auto Mechanics, Carpentry, Child Care, Distributive Education II and III, Drafting, Electricity, Food Services, Machine Shop, and Welding. The programs used were selected because they each had course curriculum developed for them that would allow for uniform instruction of the students and measurement in the criteria. There was approximately 125 teachers and 1500 students involved in the study. The students were limited to those enrolled in area schools for the first time. The students also represented a cross-section of the schools in Oklahoma in that they were from various feeder schools incorporated into area school districts.

INSTRUMENTATION

The data-gathering instruments used in this study included two forms. The first form was used to gather each participating student's GATB scores. The second instrument was sent to each participating

teacher and was designed to collect a ranking of their students in the areas of academic standing, skill level, and potential for work success. The data-gathering instruments were designed by the writer and examples of the instruments are included in the Appendix, along with a copy of the cover letter which included instructions for completing the forms.

PROCEDURE

The first phase of the study was to visit each area school site and orient the participating teachers to their roles in the study and to establish the use of the state vocational curriculum for standardization of the results.

The second phase was the collection of GATB scores on students which was accomplished by both school visitation and by mail.

The third phase of the study was to secure the teacher rankings of students by academic success, skill development and teacher perception of student success. This phase was accomplished by the mailing of a data-gathering instrument.

The final phase of the study was analysis of the data and construction of expectancy indicies for each criteria.

TREATMENT OF DATA

The GATB data collected was used in its raw form without conversion to a standard score because the test scores were already comparable across schools due to the nature of the standardized GATB test.

The student raw ranks were converted to continuous linear ranks and then were correlated using Spearman Rank Order Correlation to determine if there was a significant correlation between them. If the Spearman Correlations were significant, then the criteria were regressed against the students' GATB scores to determine the significant aptitudes for the particular program of instruction using multiple linear regression. The regression model for the significant aptitudes were then used to derive the aptitude score expectancy indicies for each program.

CHAPTER II

REVIEW OF RELATED RESEARCH

Introduction

In his text on Occupational Psychology, Super (26) discusses the "Division of Labor." The division of labor has evolved, according to Super, as a result of the people's realization that society had changed to the point that a person did not have to do everything for himself in order to survive. In fact, with the advent of the Industrial Revolution, it became apparent that some men were better at a given task than others. The reason for individual ability is basically a psychological one and provides the basis for Occupational Psychology. One phase of Occupational Psychology is the determination of aptitudes and how the measurement of aptitudes can help determine a person's occupational choice and success.

Super defines a student's aptitude as an individual capacity to learn. Each student is endowed with varied potentials for developing differing behavioral characteristics based upon heredity and environment. The concept of aptitudes has long been understood but very little was done to measure a person's aptitude until, with the advent of World War I, it became necessary to screen and classify men according to their ability to learn. The most successful effort by the army in aptitude testing was the Army General Classification Test and

Occupations. The AGCT established that occupations rank themselves in a hierarchy with each occupation requiring a different set of aptitudes.

After the initial work with aptitudes conducted by the military, the United States Employment Service (USES) became interested in aptitude testing as a result of the economic depression which occurred during the 1930's. Based on research conducted at the University of Minnesota, USES has conducted research which led to the development of the General Aptitude Test Battery (GATB), which has since been used extensively to measure an individual's aptitudes pertinent to civilian occupations (29). The aptitudes measured by the GATB and their definitions are as follows (32):

G--Intelligence--General learning ability. The ability to "catch on" or understand instructions and underlying principles; the ability to reason and make judgments. Closely related to doing well in school. Measured by Parts 3, 4, and 6.

V--Verbal Aptitude--The ability to understand meaning of words and to use them effectively. The ability to comprehend language, to understand meanings of whole sentences and paragraphs. Measured by Part 4.

N--Numerical Aptitude--Ability to perform arithmetic operations quickly and accurately. Measured by Parts 2 and 6.

S--Spatial Aptitude--Ability to think visually of geometric forms and to comprehend the two-dimensional representation of three-dimensional objects. The ability to recognize the relationships resulting from the movement of objects in space. Measured by Part 3.

P--Form Perception--Ability to perceive pertinent detail in objects or in pictorial or graphic material. Ability to make visual comparisons and discriminations and see slight differences in shapes and shadings of figures and widths and lengths of lines. Measured by Parts 5 and 7.

Q--Clerical Perception--Ability to perceive pertinent detail in verbal or tabular material. Ability to observe differences in copy, to proofread words and numbers, and to avoid perceptual errors in

arithmetic computations. A measure of speed of perception which is required in many industrial jobs even when the job does not have verbal or numerical content. Measured by Part 1.

K--Motor Coordination--Ability to coordinate eyes and hands or fingers rapidly and accurately in making precise movements with speed. Ability to make a movement response accurately and swiftly. Measured by Part 8.

F--Finger Dexterity--Ability to move the fingers, and manipulate small objects with the fingers, rapidly or accurately. Measured by Parts 11 and 12.

M--Manual Dexterity--Ability to move the hands easily and skillfully. Ability to work with the hands in placing and turning motions. Measured by Parts 9 and 10.

It is possible with the use of the GATB to provide the student with a profile of his aptitudes and give him an accurate measure of each aptitude. These measures, however, are meaningless numbers unless they provide an indication of how likely he is to succeed in a training program by correlating his individual scores with some criteria of performance in the training. USES has developed Occupational Aptitude profiles which provide cut-off scores below which work success is not likely but provide very little guidance as far as potential success in a training program. Although there are several multi-factor type test batteries in a study of these tests by Super, he points out that the United States Employment Service General Aptitude Test Battery is the most useful existing multi-factor test battery for vocational counseling (27). It is the purpose of this study to provide information about how individual differences can be used to predict training success; and, the GATB is one of the best methods of measuring these differences. The remainder of this review of literature will cover the development of the GATB, the use of the GATB in prediction studies, and some guidelines in the use of standardized tests as well as predictive guides

developed from them. The information presented provides guidelines for the development of the research methodology and the use of the results for the counseling of students.

Development and Use of the GATB

The General Aptitude Test Battery was developed by the United States Employment Service test research program and published for the first time in 1947. The GATB has been validated for over 500 occupations as of 1968 and the validation of the GATB for specific occupations continues to be a major objective of the USES test research program according to Bemis (2).

The nine aptitudes measured by the GATB include General Learning Ability (G), Verbal Aptitude (V), Numerical Aptitude (N), Spatial Aptitude (S), Form Perception (P), Clerical Perception (Q), Motor Coordination (K), Finger Dexterity (F), and Manual Dexterity (N). Each aptitude has a standardized mean of 100 with a standard deviation of 20, based on a general working population sample. The GATB is used in employment offices over the entire United States as a counseling tool to match people to jobs.

The method employed in determining worker suitability for occupations using GATB scores involves the use of the Multiple Cut-Off Method for occupational norms which was described in an article by Dvorak (6).

The Multiple Cut-Off Method which was developed by the U. S. Employment Service of the U. S. Department of Labor, is a series of minimum scores for aptitudes which are relevant to an occupation. The development of the minimum scores are determined by both testing and

evaluation of individuals' work who are currently employed in an occupation. The specific methodology for determining O.A.P.'s is listed in Section Three of the Manual for the General Aptitude Test Battery (31). The methodology in general has four steps. The first step is to correlate all the aptitude scores on the General Aptitude Test Battery. Secondly, with the criterion, the mean scores for all aptitudes are calculated. The third step involves computation of the standard deviations for all the aptitude score distributions and then comparing them with the standard deviations for the general working populations to get an indication of the range of abilities.

The final step is a quantitative analysis of the job information gathered on individual workers. The final results of this procedure are the key abilities necessary for the occupation being studied.

After determining the key factors, they are normed to provide the maximum possible differentiation between good workers and poor workers. An example of the use of O.A.P.'s is as follows: an individual has a G score of 101, a V score of 105, and a Q score of 85. The student desires to work in O.A.P. #9 which includes his job choice as a managerial worker. Checking the Multiple Cut-Off scores, they are a G of 100, a V of 105, and a Q of 95. In comparing the student scores with the cut-off scores, it can be noted that the student Q score of 85 is below that of the O.A.P. score of 95 needed to qualify for the managerial worker occupation. With the use of the Multiple Cut-Off scores, an individual is able to better determine his potential for job success without having to actually attempt the job.

Many studies have been conducted to determine the validity of the GATB in determining job and training proficiency. Bemis (3) determined

through extended analysis of data collected by USES that the cognitive aptitudes (G, V, N, S) are more useful for predicting training proficiency while job proficiency is best predicted by the manual aptitudes (K, F, M).

Droge (5) completed a study to determine the validity of GATB aptitude scores for predicting academic success, occupational success, differences in prediction due to sex and differences due to maturation. The study sample consisted of students who were tested with the GATB in the ninth, tenth, and eleventh grades in the spring of 1968 and then retested in the twelfth grade along with a control group using an alternate form of the GATB. The students were then followed up two years after high school graduation to obtain employment and academic proficiency data for the study. The results of the study showed that predictive validity of the GATB aptitudes was better against college than occupational criteria, but was about the same for males and females, and also about the same for initial and retest scores.

Work such as that done by Droge has contributed to the development of Occupational Aptitude Patterns for ninth and tenth grade students based on the increment increase in aptitude scores which can be expected with maturity. The predictive validity of the GATB being the same for males and females also justifies not providing differing Multiple Cut-Off scores for males and females.

The United States Employment Service test research program is continually striving to improve the GATB which is considered by many to be the best multi-aptitude test battery in existence (29). The GATB has been so widely accepted that there has been a number of studies

conducted in order to utilize the predictive potentials of the test. In the following section, many of the more relevant studies will be reviewed.

Use of the GATB for Prediction

The use of aptitude tests as a predictor of success in both training and job proficiency has been a well established practice with many researchers conducting work to correlate the various aptitudes with success criterion. Ghiselli sought to bring much of the work done in the area of validating aptitude tests as success predictors together in a form that the overall effort could be examined and the outcomes of the various research studies could be evaluated as a whole (10). The major conclusions drawn from Ghiselli's work are that aptitude tests in general predict training success and job proficiency equally as well, although some aptitude tests measure one better than the other. In Ghiselli's findings, tests of intellectual, spatial, and mechanical aptitudes can predict occupational trainability, but are far less useful in predicting job proficiency. In other words, trait and aptitude requirements vary from job to job and are likely to be very specific to each job while across training situations, traits and aptitudes may be more generalizable. As an example, verbal aptitude would apply to all training courses requiring students to read. In general, the predictive power of aptitude tests in forecasting training success is significantly different from zero in most of the studies examined by Ghiselli; however, the validity coefficients for training were in the order of .30, while for job proficiency, the validity coefficients were close to .20. These coefficients, although low, do not indicate their usefulness in

prediction. Different training programs require different traits and some traits are more predictable than others; therefore, an average validity does not describe the real practical value of aptitude tests in the prediction of success.

From the broad overview provided in the previously discussed study, let us go to some individual efforts at using aptitude tests to predict vocational success or failure. A very significant study, conducted by Samuelson at the Salt Lake Area Vocational School in Utah, was concerned with, first, identification of criteria of students' success in school and then the use of the GATB to predict success according to the criteria developed (21). Samuelson used a Spearman Rank Difference Method of Correlation to determine the reliability coefficients for the criteria of theory rank, shop rank, and instructors' personal ruling for each student. It was found that there was no difference between the three criteria; therefore, one was as good a measure of success as the other. The study further investigated the consistency with which an instructor gave personal ratings and it was found that the instructors has an average consistency at approximately the .90 level on the Spearman Rank Difference Method of Correlation. Samuelson, after selecting as his criterion a combination of the theory ranking and shop ranking as a single criteria which he found could be predicted using varying aptitude scores for each subject studied with a range of from .508 to .827 using multiple correlation. Samuelson's study provides the framework after which much of this study was structured.

In North Carolina, Shore determined through the comparison of GATB profiles to students' final grades in Industrial Cooperative Training

classes, that a cor elation coefficient of .327 existed between the grades and the aptitude scores on the Intelligence, Manual Dexterity, and Numerical portions of the GATB (25).

Another predictive study was conducted by Ingersoll in order to determine if the GATB was an accurate predictor of success in academic courses for students in grades nine and ten in selected Ohio schools (12). The results of Ingersoll's study verified that the GATB was an excellent indicator of academic success with multiple correlation coefficients ranging from .488 for Spanish I to .800 for basic Mathematics. The vocational courses, although limited in number in the schools studied, were also included in the study and a lower yet still significant correlation was found between the students' scores in these subjects and their GATB scores.

Further work studying the relationship of the GATB and achievement of eleventh grade students in vocational courses was done by Ferguson in Missouri (8). The study used means, standard deviations, and Pearson Product-Movement Correlations which were computed between each of the aptitudes and the criterion for each group. The study group consisted of fourteen courses with thirteen school sub-groups, each composed of twenty or more subjects. It was found that at least one significant correlation was obtained for eleven of the fourteen course samples and eight of the school sub-groups, establishing that there was a relationship between the GATB and achievement in vocational and technical courses for 10 of 27 course samples and sub-groups.

Most of the predictive studies using the GATB have been done in vocational areas; however, a few studies have been conducted in the academic class area in attempting to predict student success. One of the

most comprehensive of the academic subject area studies was done by Ingersoll and Peters (13). The Ingersoll study used the GATB to predict student performance of ninth and tenth grade boys and girls on various academic classes which included English, Algebra, Math, Science, Languages, and Business courses. The methodology used consisted of using as dependent variables, students' total point hour ratio and single subject grades against which the independent variables, or GATB scores, were regressed using multiple regression analysis.

Fifty separate multiple regression equations were computed and the equations used in raw score form to predict the criterion of success. The results of the study were that (1) the GATB variable that correlated most highly with the criterion was the Intelligence score, with a zero order correlation of from .59 for the total ninth grade to .62 for the tenth grade and (2) that the multiple R of the differential equations for all of the subject areas were usually in excess of .50 when multiple variable equations were used.

This study points out the high degree of use for the application of GATB for predicting student success in the academic portions of vocational programs.

In order to better pinpoint the application of the GATB for Oklahoma, it is helpful to look at two studies conducted in Oklahoma. Both of these studies used final grades in courses as criteria of success and applied correlation techniques to determine the relationship of GATB aptitude scores to the final grades. Of the two studies, Sandman's (22) is the most relevant in that it was conducted in seven Oklahoma area schools and used many of the same subject areas which this study proposed to deal with. Sandman used GATB norms to predict

each student's success or failure in the programs in which they were enrolled. A student's success or failure was measured using the student's first semester grades with a grade of C or better being considered success. After the dichotomous variables were established, they were tabulated in a 2 x 2 contingency table and the probabilities for the tabulated frequencies were calculated using chi square and Fisher probability methods. The study established that for all practical purposes, the GATB is a valid instrument for identifying students who will be successful in Oklahoma Area Vocational and Technical Schools.

Green, (11) who also used GATB in Oklahoma to predict success in Oklahoma vocational business and office programs, concluded that the GATB was a valid predictor of success in the programs studied by using a multiple regression technique.

Guidelines for the Use of Standardized Tests for Prediction and Guidance

When developing guidelines that will help students to choose training programs, one must be cautious that the guidelines are not used to simply screen students from programs but to help a student make realistic career decisions and receive supplemental training in areas where additional development is needed. Shimberg (23) covers the history of the development and use of aptitude tests from its origin where the military developed the aptitude test to select personnel for training in areas where they had a high likelihood of success without concern for the further development of individuals not selected for training. Shimberg continues by pointing out that industry, colleges, and even public schools use aptitude tests to select individuals from

large groups of available people leaving those not selected to pursue some other alternative. The usage of aptitude tests for selection, while being highly efficient as far as the use of resources are concerned, does little for the development of individuals and therefore neglects the potential of identifying aptitude areas which an individual needs to strengthen in order to pursue a particular occupation. For example, a student who displays a weakness in a numerical aptitude may take a math course which will increase his numerical ability. Shimberg states that unless teachers intervene to provide additional instruction for a student's weaker aptitude areas, the prediction of failure will come true for the student. Shimberg cites the work done by Dr. John T. Dailey of the George Washington University where Dr. Dailey successfully increased the aptitude scores of minority students through the use of additional training in areas where their scores were low as evidence that training does increase aptitude scores.

Shimberg concludes that aptitude scores should be used to help students explore career options, but that they also can be used to identify areas in which students can receive additional training in order to intervene in the prediction of failure in occupations where his aptitudes are too low at the time of testing to insure success.

Super (28) also adds a note of caution in the use of multi-factor aptitude tests in that he feels the GATB, as being one of the best for counseling, should be used for the purposes for which it was designed taking special care to interpret the results of the test.

At this point, the literature supports the use of the GATB for determination of a student's chances for success in training and work, but that additional training can help a student to become qualified for

a position which his test indicates he would otherwise not succeed in. The results of this study will therefore not only identify students who will have difficulty in completing a course of instruction but it will allow the student to locate the aptitude area which he needs to strengthen in order to overcome the prediction of failure.

SUMMARY

The large volume of data available in the literature provides substantial evidence that although the GATB correlates at rather low levels with various success criteria, the significance levels of the relationships are strong enough to substantiate the use of the GATB test for prediction of success.

The item that appears to be lacking in the literature, however, is the relation of the GATB to the accomplishment of various sets of course achievement criteria and the development of indicies that relate individual GATB scores to each set of criteria. This study proposes to provide indicies that teachers and counselors can use to relate individual GATB scores to sets of specific achievement criteria and therefore provide more detailed information on the GATB and measures of student success.

CHAPTER III

RESEARCH METHODOLOGY

Introduction

The purpose of this study was to first establish one or more criteria of success for vocational courses in area schools, and then to determine if the criteria are correlated. The degree of correlation will then determine how many of the criteria will be used as dependent variables in a regression analysis with General Aptitude Test Battery scores being used as the independent variables.

After the selection of criteria and the determination of which GATB variables contribute the most to the variation within each dependent criterion, a table of expectancy indicies will be developed which can be used as a guidance index for vocational programs.

Description of Subjects

The sample for this study consisted of over 1500 subjects who were first-year students in Area Vocational and Technical Schools across the State of Oklahoma. The students included were from Auto Body, Auto Mechanics, Carpentry, Child Care, Distributive Education II, Distributive Education III, Drafting, Electricity, Food, and Welding. The students attending area schools are mostly classified as juniors and seniors in their home schools; therefore, most first-year students in

area schools are juniors while there are, in a few special cases, seniors enrolled for the first time in the area schools.

The data was gathered as a part of a large study during the 1975-76 school year with a single data-gathering instrument mailed to the participating programs during the last eight weeks of school asking teachers to rank students on the criteria of academic success, skill achievement, and the teacher's perception of the student's success on the job for which he was trained.

In order to indicate the broad range of subjects included in the study, it is helpful to examine the characteristics of Area Vocational and Technical Schools. The area schools are located across the state of Oklahoma and are a result of the enactment of the Vocational Act of 1963. An amendment of the Oklahoma State Constitution in May of 1968, allowed for the formation of Area Vocational-Technical School Districts. Each district is a separate unit of government with its own board of education and the power to levy taxes for operational purposes. The criteria for establishing an area school includes first, a minimum scholastic population of 15,000 students or to serve a 50-mile radius from the proposed site of the school or one of the schools of the district. Secondly, the proposed school district shall have a minimum net assessed valuation of $40,000,000 after homestead exemptions. The third criterion is that the proposed school district is subject to determination of need and adequate funding by the State Board of Vocational and Technical Education. To aid the board in making such determination, an application must be filed with the board to include school district

size, population, assessed valuation, current school enrollments, estimated secondary school enrollments, estimated part-time or full-time adult enrollments, employment opportunities, and other information relating to the justification of an area school district.

Procedure

The first step in the study was to establish the availability of General Aptitude Test Battery scores for area school students. In surveying the area schools, it was found that most of them blanket-test all sophomore students in the feeder schools prior to the students' enrollment in the area school, in order to provide a student with his Occupational Aptitude Patterns for guidance purposes. Schools not providing general testing of students included Tri-County at Bartlesville, Southern Oklahoma Area Vo-Tech at Ardmore, Foster Estes at Oklahoma City, and Tulsa Area Vo-Tech at Tulsa. Only the students who were in programs included in the study were GATB-tested in the schools where no tests were administered.

GATB test scores were gathered by on-site visits to the area school campuses in order to gather as many scores as possible and to decrease the error in the data-gathering process.

The student criteria which included student rankings on academic achievement, skills, and teacher perception of success, were gathered via an instrument with a cover letter explaining the procedure for completing the instrument and the definition of the data needed.

Analysis of the Data

After collection of the data, the student rankings were converted to linear scores in order to compensate for an unequal number of students in each class being studied. The conversion allowed for the disparity of a student being ranked 5th out of 15 versus a student being ranked 5th out of 7 (9). After student rankings were converted to linear rankings, the three student criteria were correlated using Spearman Rank Order Correlation program from the Statistical Analysis System (SAS) at North Carolina State University, 1972 (24).

The selection of the Spearman Rank Order Correlation is based on the student data being ordinal in nature. The transformation of the data from raw scores to linear scores did not change the relationship of the ranks to each other and therefore is a monotonic transformation which is an allowable operation with ordinal data (26). The SAS program used to calculate the Spearman Rank Correlation coefficient between two variables first finds the rank of two variables and then computes the product-movement correlation coefficient of the two sets of ranks (24). If two or more variables are ranked the same or tie, the average of the ranks are used in the computations of the Spearman r. The SAS program also provides an approximation to the significance probability which is the probability that a value of the correlation coefficient as large or larger in absolute value than the one calculated would not have occurred by chance.

The efficiency of the Spearman Rank Correlation is 91 percent of that of the most powerful parametric correlation, the Pearson r. That

is to say that in 91 out of 100 cases, the Spearman r (r_s) will reveal any existing correlation between variables at the same significance level as the Pearson r (r).

With the use of the Spearman r, it was possible to determine the magnitude of the relationship between the ranked criteria and the direction of the relationship which can vary from -1.00 indicating perfect negative correlation to +1.00 indicating perfect positive correlation. In addition to determining the relationship, a significance probability can be computed to determine the probability of that relationship occurring as a result of chance (5).

After determining the relationships between the rank criteria, they were used as dependent variables in a minimum R^2 regression analysis which used GATB factors as the independent variables.

The regression technique is also a SAS program that computes the contribution of one or more independent variables to one dependent variable (15). The results of a regression analysis is a weighted prediction model that can use observed independent variables to predict expected dependent variables. The minimum R^2 improvement technique is a stepwise regression operation that is used to find which variables of a selection of independent variables contribute significantly to the prediction of the dependent variable. In this study, regression analysis was used only for the identification of variables that contribute significantly to the prediction of the ranked criteria and not for prediction.

After having established the correlation between the ranked criteria and the GATB factors which contributed to the prediction of the ranked criteria, it was possible then to derive expectancy indicies

to predict student criteria rankings in the vocational programs based upon the derived relationships discussed above. The procedure used in calculating the expectancy indicies for success in the ranked criteria included five steps. First, it was necessary to ascertain the criteria that were highly positively correlated in order to identify those relationships which were interdependent and as a result contributed to a student's success. The second step was to select those variables which were included in the regression model for the prediction of the ranked criteria and were significant at the .10 level. The third step was to compute frequency tables for the criteria based upon significant GATB factors. The fourth step was to then compute the mean rank of the criteria which was used as a cut-off score in order to determine a student's successful completion of the vocational program. The mean score was used because it was considered an acceptable level above which a student should try to achieve. The last step in the development of the expectancy indicies was to calculate the percentages of students ranking above the mean for each criteria given that his GATB scores fell within an established range of GATB factor scores. The method used in developing the expectancy was to first divide the frequency tables of student rankings for given GATB factor scores into ranges. For example, the GATB factor could be divided from 60-80, 80-90, and 90-100. Secondly, the total number of ranked observations within the GATB range were tabulated. The last step was to divide the number of ranked observations within the GATB factor range that exceeded the ranked criteria mean by the tabulated total to get the percentage of the students ranking above the mean for the ranked criteria within the assigned GATB range.

The expectancy indicies designed in the manner described in the preceding paragraph can be used by students as a guidance tool which will assist them in determining how their expectancy of criteria achievement will vary in relationship to differing ranges of their GATB scores.

CHAPTER IV

PRESENTATION AND ANALYSIS OF THE DATA

Introduction

The purpose of this study was to establish if there was a significant level of correlation between three different rankings of student achievement and that the rankings can be predicted using the students' GATB scores as independent variables in expectancy indicies.

Chapter IV will include three major sections. The first section will deal with the findings of the Spearman Rank Order Correlation of the three success criteria which will serve to accomplish the first objective of the study. The second section of the chapter will present the results of regression analysis which will present the GATB factors related to each criterion for each vocational subject area. The last section (which is the most important) will present the expectancy tables based upon the relationships established in the first two sections and upon frequency tables computed from actual observations.

Findings of the Study

Correlation Analyses

The following hypothesis was formulated to evaluate the significance of the correlation between the ranked criteria for each vocational program:

HO There is no positive relationship between the criteria of academic ranking, skill ranking, and success ranking for first-year students in specific vocational programs being taught in Area Vocational and Technical Schools as the α = .01 level of significance using the student's t.

The correlations and significance levels in Table I provide the data necessary to either accept or reject HO for each vocational program area. Table I contains the Spearman Rank Order Correlation (r_s) for the correlation between the ranked criteria and the student's t alpha significance levels for each correlation coefficient. The data for each vocational program area will be discussed in detail in the following text.

Auto Body

The criteria were all highly correlated and were significant at the .0001 level which exceeds the .01 level of significance needed to reject the HO for Auto Body students.

An important relationship to note is that the student's skill rankings and their success rankings were correlated at .901 while the students' academic to success rankings were correlated at .699 which indicates that while instructors rated academic work and shop work as both being important to student success, they contributed more importance to skill performance in evaluating a student's potential success in the Auto Body trade.

Auto Mechanics has the largest number of observations of any of the other occupations due to the greater frequency of Auto Mechanics programs

TABLE I

CORRELATIONS AMONG CRITERIA AND LEVELS OF STATISTICAL SIGNIFICANCE

	SKILL RANK r_s	SIGNIFICANCE LEVEL STUDENT'S t	SUCCESS RANK r_s	SIGNIFICANCE LEVEL STUDENT'S t
Auto Body N=218				
Academic Rank	.694	.0001	.699	.0001
Skill Rank			.901	.0001
Auto Mechanics N=411				
Academic Rank	.712	.0001	.669	.0001
Skill Rank			.880	.0001
Carpentry N=221				
Academic Rank	.738	.0001	.767	.0001
Skill Rank			.896	.0001
Child Care N=45				
Academic Rank	.493	.0009	.572	.0001
Skill Rank			.840	.0001
Distributive Education II N=125				
Academic Rank	.548	.0001	.585	.0001
Skill Rank			.732	.0001
Distributive Education III N=20				
Academic Rank	.568	.0037	.755	.0003
Skill Rank			.777	.0002
Drafting N=161				
Academic Rank	.904	.0001	.896	.0001
Skill Rank			.948	.0001
Electricity N=116				
Academic Rank	.652	.0001	.768	.0001
Skill Rank			.821	.0001
Food Service N=124				
Academic Rank	.637	.0001	.659	.0001
Skill Rank			.902	.0001
Machine Tool N=190				
Academic Rank	.778	.0001	.692	.0001
Skill Rank			.841	.0001
Welding N=260				
Academic Rank	.761	.0001	.780	.0001
Skill Rank			.971	.0001

in the Area Vocational Schools. All of the relationships between the criteria are highly positively correlated at the .0001 alpha level which is greater than the .01 level of significance necessary to reject HO. The difference between the size of the correlation between skills and academic ranks as compared to the student's perceived success is not nearly as large as that in Auto Body; however, the student's skill performance is still more highly correlated to perceived student success.

For Carpentry, the ranked criterion are again highly positively correlated at the .0001 level of significance which is greater than the .01 level needed to reject the null hypothesis HO. There is a greater uniformity in the size of the relationships for Carpentry than in Auto Body and Auto Mechanics indicating a better balance between contributions of the cognitive and psychomotor type rankings to the perception of student success.

The correlations for Child Care, although not as large in magnitude as those for some of the more academically oriented curriculum, are still large and positively correlated. Two of the correlation coefficients are significant at the .0001 level while the correlation between academic rank and skill rank is at the .009 level. All of the Child Care alpha levels are large enough to reject HO and the slightly lower alpha level for the one correlation could be contributed to the low number of observations. The highest correlation level for Child Care is between the skill ranks and success ranks which indicates that a student's lab performance is more highly related to perceived work success than is the classroom work.

Distributive Education II (DE II) is also an area where there is less technical information in the curriculum to assimilate; therefore,

even though all of the ranked criteria have a high correlation, the correlation between skills and success are the largest in magnitude. The significance levels for all of the correlations are at the .0001 level which is greater than the specified .01 level needed to reject HO.

Distributive Education III (DE III) is the second year of the Distributive Education program in area schools; therefore, the relationships between the criteria are very similar to those found for Distributive Education II. The alpha levels for the DE III correlations are smaller than those found for most of the other correlations found in Table I due to the smaller number of observations for the program as compared to the others listed. Even though the alpha levels are smaller than the others tabled, they are still much larger than the .01 level needed to reject HO.

Drafting has a more academically oriented curriculum than any of the other vocational programs included in the study and as a result, the correlation between the student's academic rating and how his instructor perceives he will succeed in the Drafting trade is the highest correlation tabulated for that particular relationship. The correlation coefficients are all higher than the corresponding relationships in the other areas with the exception of the Welding skill success correlation because the criterion are more comparable between students due to the nature of the curriculum objectives. The significance levels for Drafting all exceed the .01 level needed to reject HO.

The Electricity correlations are all highly positively correlated at significance levels large enough to reject HO at the .01 level of significance. As with several of the other technical curriculum, skill

is more highly correlated with success than is academic rankings; but, the disparity between skill and academics is not as great as those noted in Auto Body and Auto Mechanics.

Food Services, which has a curriculum that is more lab than classroom oriented, has a very large correlation coefficient for the relationship between a student's perceived success rank and his skill performance rank. The other correlations are also highly positively correlated at a significance level larger than the .01 level needed to reject HO and conclude that the correlations existing are significant.

Machine Tool is a curriculum that involves a great deal of information retention in order to set up the machinery for the machining of a varied number of pieces; therefore, there is a high degree of correlation between academic rank and skill rank. The precision required of a good machinist is also indicated by the very high correlation between skill rank and success ranks. The correlations for Machine Tool are all highly positively correlated at levels greater than the .01 level needed to reject HO that no correlation exists.

Welding has the highest skill success correlation of all the vocational programs included in the study. The instructors' emphasis in the necessary ability to perform in the shop before being able to succeed on the job is very clearly pointed out in the Welding programs. All of the Welding rank criteria are highly correlated at the .0001 level which is greater than that needed to reject HO.

Multiple Regression Analysis

The second objective of the study was to determine the aptitudes that most significantly contribute to how a student ranks on the three

criteria of success. Objective number two will be accomplished by using stepwise multiple regression analysis to test the following null hypothesis:

H1 There are no GATB factors that contribute significantly to the prediction of individual student rankings on the achievement criteria of academic ranking, skill ranking, and perceived success ranking at the .01 level of significance on an F test.

The data generated from the multiple regression analysis is listed in Table II. The contents of Table II includes the variables that were included in the best one-, two-, and three-variable models for predicting the ranked criteria for each program using GATB factors as independent variables, the number of dependent variable observations and the regression coefficients for each of the regression models. All of the models listed are significant at the .10 level on an F test, thereby rejecting H1 for all of the criteria listed that there are no GATB factors that contribute to the prediction of student rankings on the criteria. Not all of the program ranked criteria have a three-variable model listed for them because some of them did not have three-variable models which were significant at the .10 level on an alpha test.

The models listed in Table II have significant but low regression coefficients. The importance of the models is not in that they will be used for the prediction of success, but that they are the variables that contribute the most in determining how a student ranks on the specified criteria. As noted previously by Ghiselli (10) in the

TABLE II

THE BEST ONE-, TWO-, AND THREE-VARIABLE REGRESSION MODELS FOR CRITERIA PLUS EACH MODEL'S REGRESSION COEFFICIENT*

PROGRAM AREA	N	ACADEMIC RANK			SKILL RANK			SUCCESS RANK		
		ONE VARIABLE R^2/MODEL	TWO VARIABLE R^2/MODEL	THREE VARIABLE R^2/MODEL	ONE VARIABLE R^2/MODEL	TWO VARIABLE R^2/MODEL	THREE VARIABLE R^2/MODEL	ONE VARIABLE R^2/MODEL	TWO VARIABLE R^2/MODEL	THREE VARIABLE R^2/MODEL
Auto Body	165	.099 G	.124 GM	.136 GSM	.008 G	.115 GM	.126 GKM	.086 G	.126 GM	.141 CKM
Auto Mech	304	.089 G	.105 GF	.115 GVF	.069 S	.082 SF	.086 VSF	.065 S	.071 GS	
Carpentry	149	.088 G	.108 GP	.122 GPK	.038 G	.054 GK		.043 G	.057 GK	
Child Care	27	.209 G	.284 GS		.085 S	.157 VS		.071 S	.181 VS	.236 VSP
DE II	95	.081 Q	.123 GM		.037 M	.056 GM		.091 G	.126 GV	
DE III	20	.302 Q	.374 PQ		.304 V	.394 VS		.361 V	.418 VN	
Drafting	184	.140 G	.159 NS	.169 VNS	.168 G	.176 GS		.153 G	.164 GS	
Electricity	95	.131 N	.183 NF	.201 NPF	.096 G	.134 GF	.145 GPF	.137 N	.158 NV	
Food Service	81	.135 N	.180 VN	.205 GVN	.164 Q	.210 NQ	.225 VNQ	.102 V	.146 VK	
Machine Tool	110	.182 G	.199 GN		.096 G			.076 G	.091 GF	
Welding	161	.118 G	.131 GK			.096 GQ		.081 G	.091 GQ	

*The following abbreviations for the aptitude variables are used in the table:

General Intelligence	G	Spatial Aptitude	S	Motor Coordination	K
Verbal Aptitude	V	Form Perception	P	Finger Dexterity	F
Numerical Aptitude	N	Clerical Perception	Q	Manual Dexterity	M

Review of Related Research, that GATB variables often have a low correlation to success criteria, but the relationships that do exist are important in determining the achievement of the criteria.

The variables identified in the regression models were used in selecting the factors which were used in developing the expectancy indicies to be used as student guidance tools. The GATB G factor was the best single variable prediction model for the majority of the programs for all three of the ranked criteria indicating the importance of a student's overall general intelligence in vocational program success.

The cognitive variables of Intelligence, Verbal Perception, Clerical Perception, Spatial Perception and Numerical Perception dominate the regression models emphasizing their importance in the technically oriented vocation courses included in the study.

The psychomotor factors of Manual Dexterity, Finger Dexterity, and Mark Making (K), which indicates eye-hand coordination occur with far less frequency than do the cognitive variables due to the lower degree of variability for these factors among students.

Expectancy Indicies

The third objective of this study was to develop expectancy indicies for those ranked criteria which were proven to have strong relationships with each other and therefore were important to a student's successfully achieving his vocational goals. In the first section of this chapter, it was established that all three ranked criteria for each program were highly positively related to each other

establishing that if a student was to fail in one area, he would probably fail in the other two, making it necessary to develop indicies for all of the criteria for all of the programs.

The second section of this chapter entitled Multiple Regression Analysis identified those GATB factors that were important in determining how a student would rank on each of the three criteria. Using these factors in the order in which they entered the regression models, the expectancy indicies which are included in this study were developed. The first GATB factor listed in the expectancy indicies, for example, is the best single-variable regression variable; the second GATB factor is the factor listed in the best two-variable model in association with the first factor; and the third listing for those programs that had a three-variable model in association with the first two factors listed.

Tables III through XII contain data for each vocational program in the study. Each table will have listed the expectancy tables for the ranked criteria. The criteria ranks that were statistically treated are in the converted linear form as described in Chapter III. For each expectancy table, the simple statistics will be discussed prior to presentation of the table; and, it should be noted that the mean, range, and standard deviation do reflect the linear conversions and are the same for all three criterion.

For the Auto Body repair program, the mean of the converted ranked criteria was 51.35, with a range of 11 to 88, a standard deviation of 18.24, and an N of 155. The predetermined level of achievement for Auto Body is based on ranking equal to or greater than the observed mean rank of 51.35.

TABLE III

EXPECTANCY INDICIES OF SCORING ABOVE THE MEAN ON CRITERIA RANKINGS FOR AUTO BODY REPAIR

RANKED CRITERIA	APTITUDE FACTORS	GATB SCORE RANGES 60-79	80-89	90-99	100-↑
		(percent)	(percent)	(percent)	(percent)
ACADEMIC RANK	G	26.32	43.18	58.33	69.64
	M	33.33	40.74	57.69	66.67
	S	23.08	47.83	55.00	59.14
SKILL RANK	G	31.58	43.18	58.33	67.86
	M	26.67	48.15	50.00	65.28
	K	31.25	52.78	54.84	70.37
SUCCESS RANK	G	36.84	43.18	58.33	71.43
	M	36.67	44.44	50.00	63.89
	K	31.25	58.33	64.52	74.07

By examining the expectancy tables, it can be seen that the GATB factors of General Intelligence (G), Manual Dexterity (M), and Spatial Aptitude (S) were the factors contributing significantly to the students' expectancy of ranking above the mean on the academic rankings. For the factors G and M, scores equal to or greater than 100 increased the probability score appreciably while the percentage score for the S factor was increased only slightly for scores in excess of 90. The skill rank percentage scores were all increased 10 percentage points using the highest factor score of 100 as a cut-off point. The significant GATB factor for skill ranking were G, M, and Motor Coordination (K). The success ranks probability scores were also increased at least 10 percentage points by using factor scores equal to or greater than 100 as the cut-off points. The GATB factors of G, M, and K were the most significant factors contributing to success ranking. In general, students with scores in excess of 100 for G, M, K, and S can be reasonably assured of ranking above the mean for the three specified criteria.

Table IV contains the indicies for Auto Mechanics, which were based upon converted student criteria rankings with a mean of 51.8, a range of 8 to 92, a standard deviation of 17.2, and an N of 304. By examining the tables, it can be seen that the GATB factors of General Intelligence (G) and Spatial Perception (S) are the most important determinants of student rankings on the criteria, while the factors of Finger Dexterity (F) and Verbal Aptitude (V) are also significant.

For the criteria of academic ranking, the percentages of students ranking above the mean increases dramatically with a score equal to or greater than 90 for the G factor and 100 for the F and V factors.

TABLE IV

EXPECTANCY INDICIES OF SCORING ABOVE THE MEAN ON CRITERIA RANKINGS FOR AUTO MECHANICS

RANKED CRITERIA	APTITUDE FACTORS	GATB SCORE RANGES 60-79	80-89	90-99	100-↑
		(percent)	(percent)	(percent)	(percent)
ACADEMIC RANK	G	22.73	29.33	58.11	60.56
	F	35.80	46.84	53.70	61.67
	V	17.50	47.56	54.95	68.89
SKILL RANK	S	42.11	34.38	43.48	60.65
	F	37.04	46.84	53.70	62.50
	V	35.00	52.44	54.62	68.89
SUCCESS RANK	S	39.47	37.50	39.67	62.04
	G	34.09	36.00	51.35	61.27

In order to maximize his chances of exceeding the mean for the success ranking, a student needs to score in excess of 100 for both the S factor and G factor.

If a student associates the levels of the four factors listed for Auto Mechanics that maximize his expectancy to score above the mean on all three factors, he can determine that he needs a score equal to or greater than 100 for the GATB factors of G, S, F, and V.

Table V contains the expectancy indicies for Carpentry, based upon criteria rankings with a mean of 49.64, a range of 10 to 87, a standard deviation of 18.27, and an N of 149. The significant variables include General Intelligence for all three rankings (G), Form Perception (P) for the academic ranking and Motor Coordination (K) for all three rankings.

Examination of the table reveals that in order to maximize his expectancy of ranking above the mean for academic rankings, the student needs to score equal to or greater than 100 for G and 90 for P and K. For skill rank the factor scores need to be equal to or greater than 100 for G and 90 for K. The success rank achievement expectancies are maximized at levels equal to or greater than 100 for G and K. The student then could summarize that he needs scores at 100 for G and K and 90 for P to maximize his expectancy of success on all three criteria.

Table VI contains the expectancy indicies for Child Care, based on criteria rankings with a mean of 51.7, a range of 17 to 85, a standard deviation of 16.5, and an N of 27. For the Child Care program area, there is a relatively small N of 27 when compared to many of the others program areas. As a result of the low number of observations, slight changes in the numbers of students failing to achieve a score in

TABLE V

EXPECTANCY INDICIES OF SCORING ABOVE THE MEAN ON CRITERIA RANKINGS FOR CARPENTRY

RANKED CRITERIA	APTITUDE FACTORS	GATB SCORE RANGES 60-79	80-89	90-99	100-↑
ACADEMIC RANK	G	21.05	50.00	51.23	72.88
	P	20.00	38.10	59.62	62.57
	K	35.71	59.46	71.43	73.69
SKILL RANK	G	26.32	50.00	53.33	61.02
	K	33.33	59.46	71.43	73.69
SUCCESS RANK	G	31.58	53.85	53.89	64.41
	K	38.10	56.76	66.67	75.42

TABLE VI

EXPECTANCY INDICIES OF SCORING ABOVE THE MEAN ON CRITERIA RANKINGS FOR CHILD CARE

RANKED CRITERIA	APTITUDE FACTORS	GATB SCORE RANGES 60-79	80-99	100-↑
		(percent)	(percent)	(percent)
ACADEMIC RANK	G	40.00	50.00	85.71
	S	50.00	55.56	58.33
SKILL RANK	S	50.00	66.33	68.45
	V	---	55.56	66.33
SUCCESS RANK	S	50.00	58.33	59.26
	V	---	50.00	66.33
	P	---	22.22	61.11

excess of the mean for a criteria ranking for a given range of GATB factor scores can cause a dramatic change in the student probability scores in the expectancy indicies. The percentages listed, however, are still good indicators of the factor score ranges necessary to achieve varying expectancies of criteria achievement.

Students contemplating enrollment in Child Care can determine that for academic rank, they need scores of 100 or greater for the General Intelligence factor (G) and 80 or greater for the Spatial Perception factor (S). A student's expectancy to achieve above the mean for skill is maximized with factor scores of 80 or greater for Spatial Aptitude and 100 or greater for Verbal Aptitude (V). The perceived success criteria mean rank achievement is maximum for scores of 80 or greater on S, 100 or greater on V, and 100 or greater on Form Perception (P).

A student's optimum factor profile should include scores equal to or greater than 100 for G, 80 for S, 100 for V, and 100 for P. It should be noted that a student has a 50 percent chance of achieving above the mean with low G, V, and S scores, but that low P scores could considerably affect achievement.

Table VII contains the data for Distributive Education II (DE II) which is the first-year DE course offered in the Area Vocational and Technical Schools. De III is the second-year course in the overall DE curriculum and a student contemplating completing the entire DE program should refer to the information on both DE II and DE III. The expectancy indicies in Table VII are based upon criterion rankings with a mean of 49, a range of 6 to 94, a standard deviation of 18.28, and an N of 95.

TABLE VII

EXPECTANCY INDICIES OF SCORING ABOVE THE MEAN ON CRITERIA RANKINGS FOR DISTRIBUTIVE EDUCATION II

RANKED CRITERIA	APTITUDE FACTORS	GATB SCORE RANGES			
		60-79	80-89	90-99	100-↑
		(percent)	(percent)	(percent)	(percent)
ACADEMIC RANK	Q	---	26.67	28.57	63.49
	G	26.67	47.62	53.57	58.06
	M	33.33	35.14	54.55	58.18
SKILL RANK	M	33.33	39.29	56.27	63.64
	G	53.33	47.62	53.57	61.29
SUCCESS RANK	G	26.67	52.38	60.71	61.29
	F	33.33	50.00	75.00	78.57

The GATB factors of Clerical Perception (Q), General Intelligence (G), and Manual Dexterity (M) are the most significant for the student's academic rank. Examination of the expectancy tables reveal that a student needs scores equal to or greater than 100 for Q, and 90 for G and M to optimize his chances of ranking above the mean in the academic portion of the program. The factors of Manual Dexterity (M) and G are the most significant for skill achievement with scores in excess of 100 for both factors needed to optimize his expectancy of success. For the success criteria, G and Finger Dexterity (F) are the most significant with scores in excess of 90 necessary for each factor.

A student needs scores of 90 or greater on factors G, M, and F, and 100 or greater on Q to have a reasonable assurance of achieving above the mean on the ranked criteria.

Distributive Education III criteria rankings ranged from 13 to 87 on a converted basis with a mean of 50, a standard deviation of 18.80, and an N of 20. Due to the low number of observations, expectancy indicies could not be developed. The relevant aptitude scores for the program criteria, however, provide some general guidelines. For academic ranking, the aptitudes of Clerical Perception and Form Perception were relevant; for skill rankings, the aptitudes of Verbal and Spatial Perception were significant; and, for success rankings, Verbal and Numerical aptitudes were significant.

Table VIII contains the expectancy tables for the three ranked criteria for the Drafting program, which are based on converted data with a mean of 49.98, a range of 11 to 89, a standard deviation of 18.33 and an N of 184.

TABLE VIII

EXPECTANCY INDICIES OF SCORING ABOVE THE MEAN ON CRITERIA RANKINGS FOR DRAFTING

RANKED CRITERIA	APTITUDE FACTORS	GATB SCORE RANGES 60-89	90-99	100-↑
		(percent)	(percent)	(percent)
ACADEMIC RANK	G	29.03	47.73	62.62
	N	32.43	45.61	68.49
	S	25.00	37.50	64.89
SKILL RANK	G	22.58	43.18	65.42
	S	15.00	31.25	64.12
SUCCESS RANK	G	29.03	45.45	62.62
	S	25.00	18.75	66.41

It was mentioned in the discussion of the correlation analysis that Drafting was the most academically oriented curriculum of all the programs being studied and the expectancy tables again bear that fact out. All of the expectancy tables for the ranked criteria show that a student's expectancy of ranking above the mean is greatly increased with scores equal to or greater than 100 for all of the factors identified, which include General Intelligence (G), Numerical Aptitude (N), and Spatial Aptitude (S).

Table IX contains the expectancy indicies for the Electricity program rankings, which are based upon converted criteria rankings with a mean of 48.31, a range of 10 to 90, a standard deviation of 18.52, and an N of 95. The GATB factors of Numerical Aptitude (N), General Intelligence (G), Form Perception (P), and Finger Dexterity (F) were the factors determined to be the most significant contributors to success on the ranked criteria.

The factors of N, F, and P at levels equal to or greater than 100 are necessary for reasonable levels of success of the academic criteria, the factors of G and P needed to equal or exceed 100 and F needed to be 90 or greater for skill success; N needed to equal or exceed 90 for success rank. The student's overall GATB profile should contain scores equal to or greater than 100 for G, N, and P and 90 for F to insure reasonable levels of success in the Electricity programs.

Table X is a compilation of the expectancy indicies for Food Services, which are based upon criteria rankings with a mean of 53.3, a range of 8 to 92, a standard deviation of 18, and an N of 82. The variety of GATB factors listed in the expectancy tables is indicative of the varied curriculum involved in the Food Service curriculum which

TABLE IX

EXPECTANCY INDICIES OF SCORING ABOVE THE MEAN ON CRITERIA RANKINGS FOR ELECTRICITY

RANKED CRITERIA	APTITUDE FACTORS	GATB SCORE RANGES			
		60-79	80-89	90-99	100-↑
		(percent)	(percent)	(percent)	(percent)
ACADEMIC RANK	N	18.18	47.62	53.57	62.86
	F	28.57	42.86	43.10	75.00
	P	---	30.77	40.67	53.52
SKILL RANK	G	25.00	38.89	55.17	60.53
	F	28.57	42.86	63.16	64.12
	P	---	15.38	61.67	57.75
SUCCESS RANK	N	18.18	52.38	57.14	68.57
	P	23.87	62.86	63.16	65.00

TABLE X

EXPECTANCY INDICIES OF SCORING ABOVE THE MEAN ON CRITERIA RANKINGS FOR FOOD SERVICE

RANKED CRITERIA	APTITUDE FACTORS	GATB SCORE RANGES 60-79	80-89	90-99	100-↑
		(percent)	(percent)	(percent)	(percent)
ACADEMIC RANK	N	32.14	42.86	52.63	70.00
	V	17.65	38.46	72.43	73.68
	G	36.67	47.06	76.47	82.35
SKILL RANK	Q	28.57	33.33	41.18	54.90
	V	41.18	30.77	61.90	73.68
	N	35.71	42.86	52.63	75.00
SUCCESS RANK	V	41.18	30.77	61.90	68.42
	K	25.00	35.71	42.86	65.91

ranges from business management to public relations training. The academic rank expectancy table lists the GATB factors of Numerical Aptitude (N), Verbal Aptitude (V), and General Intelligence (G). The factor N shows a large increase in criteria achievement for scores equal to or greater than 100 while the factor of V and G show appreciable increases for scores above 100.

The skill rank has the factors of Clerical Perception, V, and N listed as being the most relevant factors with scores of 100 or greater increasing the student's expectancy of success appreciably. The success rank expectancy tables show that the factors of V and Motor Coordination (K) are the most significant contributors to achieving above the mean ranking with scores of 90 or greater for V, and 100 or greater for K needed for reasonable assurance of success. The student's GATB profile then should contain scores of 100 or greater for the GATB factors of G, V, N, Q, and K.

Table XI contains the data for Machine Tool which includes a listing of the expectancy indicies for each of the ranked criteria, which are based upon converted rankings with a mean of 50.6, a range of 14 to 89, a standard deviation of 19.35 and an N of 110. The Machine Tool expectancy indicies are unusual in that in all three indicies, there are only three GATB factors listed. The GATB factors included in the indicies include General Intelligence (G), Numerical Aptitude (N), and Finger Dexterity (F). The indicies percentage levels show large increases for all three of the listed variables for scores equal to or greater than 100. The summary GATB profile then should have scores in excess of 100 for G, V, and F.

TABLE XI

EXPECTANCY INDICIES OF SCORING ABOVE THE MEAN ON CRITERIA RANKINGS FOR MACHINE TOOL

RANKED CRITERIA	APTITUDE FACTORS	GATB SCORE RANGES			
		60-79	80-89	90-99	100-↑
		(percent)	(percent)	(percent)	(percent)
ACADEMIC RANK	G	---	29.41	33.33	66.67
	N	---	26.67	50.00	70.73
SKILL RANK	G	---	23.53	36.67	60.32
SUCCESS RANK	G	---	41.18	60.00	69.84
	F	42.86	45.16	7.89	63.83

Table XII contains the expectancy indicies for Welding, which are based upon converted rankings with a mean of 54.07, a range of 12 to 91, a standard deviation of 19, and an N of 161. Welding is similar to Machine Tool in that it has only three GATB factors that contributed significantly to scoring above the mean on the criteria rankings. The significant factors included General Intelligence (G), Motor Coordination (K), and Clerical Perception (Q). The factors of Q and K contribute to increased expectancies up to scores of 90 with only slight increases for scores in excess of 100. The C score for academic rank shows a large percentage increase for scores of 100 or larger, but the G scores for skill rank and success rank increase percentages only slightly for scores of 90 or larger. The student who has a GATB profile which includes GATB scores for G, Q, and K in excess of 90 can be reasonably sure of scoring above the mean rank for the three criteria.

To summarize the findings interpreted from the expectancy indicies, it should be stated that the GATB factors indicate only the potential to achieve and are not absolute quantities of success. A student can use expectancy tables in making vocational career decisions, but he should use it in association with other factors such as his desire to succeed and his overall attitude about the type of work he is training for.

The indicies in general indicate that students with GATB factor scores in excess of 100 have a 60 to 70 percent chance of succeeding on the three ranked criteria. For those students whose GATB scores all exceed 100, the tables will not contribute a great deal to their decision making process, but those students who score less than 100 can derive a

TABLE XII

EXPECTANCY INDICIES OF SCORING ABOVE THE MEAN ON CRITERIA RANKINGS FOR WELDING

RANKED CRITERIA	APTITUDE FACTORS	GATB SCORE RANGES 60-79 (percent)	80-89 (percent)	90-99 (percent)	100-↑ (percent)
ACADEMIC RANK	G	21.62	42.42	58.14	72.73
	K	38.24	51.11	60.00	61.09
SKILL RANK	G	35.14	39.39	59.09	62.79
	Q	40.00	48.65	58.70	59.76
SUCCESS RANK	G	32.43	42.42	60.47	63.64
	Q	40.00	43.24	56.52	58.65

great deal of information from the expectancy indicies as to how their lower scores will affect their chances of satisfactorily completing a vocational course of instruction.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

In Chapter V a brief overview of the problem addressed by the study, the objectives of the study, the design and conduct of the study, and the major findings of the study will be presented. Also presented will be the conclusions and recommendations which are based upon the analysis and summarization of the research results.

Summary of the Study

Purpose of the Study

The primary purpose of this study was to develop expectancy indicies which will indicate a student's chances of achieving predetermined levels of selected criteria achievement based upon a student's individual GATB factor scores. A concurrent purpose was to determine that there was a strong correlation between how a student achieves in the vocational classroom when compared to how he achieves in the shop or laboratory and also how his instructor feels he will achieve in the job for which he is being trained.

Specific Objectives of the Study

The specific objectives of the research which were developed to achieve the purpose of the study were:

1. To determine the correlation between student rankings for (1) academic achievement, (2) skill achievement, and (3) the teacher's overall perception for success in order to establish the importance of each criteria in a student successfully completing a vocational program.

2. To determine the aptitudes that most significantly contribute to how a student ranks on the three criteria of success.

3. For the academic areas where there is a high correlation between the rankings for academic success, skill success, and the teacher's overall rating of success, develop an expectancy index for the criteria that students and counselors can use to determine the probability of student success in the vocational program with the students given aptitude ratings or identity aptitudes that they need to improve in order to increase their probability of success.

Rationale for the Study

A survey of administrators of Area Vocational and Technical Schools found that all but four of the twenty-two area school sites provided General Aptitude Test Battery administration to all sophomore students in their area school district who thought they might attend the area school during their junior and senior years. As a result of the survey, it was discovered that although the GATB scores were available there were no standards available to compare the scores to in order to provide students guidance information concerning a student's probable success in the training programs. As a result of the absence of training standard references, the Occupational Aptitude norms were

being used which are job proficiency standardized and may not reflect a student's potential for training success. The discrepancy between the availability of GATB scores and the lack of training success standards for vocational programs based on the GATB scores resulted in recognition of the problem addressed by this study.

Design and Conduct of the Study

After the identification of the problem a review of the literature related to similar problems was conducted in order to glean information helpful in the design and conduct of the study. Upon completion of the review of literature, the major tasks of (1) selecting the population, (2) developing the data-gathering instruments, (3) collecting the data, and (4) analyzing the findings were completed.

The population for this study consisted of all first-year students who were enrolled in the programs of Auto Body, Auto Mechanics, Carpentry, Child Care, DE II, DE III, Drafting, Electricity, Food Service, Machine Tool, and Welding in the Area Vocational and Technical Schools. The programs selected for inclusion in the study were limited to include only those programs who had a standardized state curriculum available to them in order to insure a more uniform treatment of the subjects. From the total population of these students, the ones who did not have GATB scores available were not included in the Multiple Regression Analysis or in the expectancy table indicies development.

The information obtained in this study included two major sets of data. The first data set was the student's individual GATB profile which was collected largely from on-site visits to the schools. In a few instances, the data was sent by the school counselor when it wasn't

available during the school visit. The second major data set was the instructor ranking of the students which was gathered by mailing a standard reporting form to the instructors along with an instruction sheet for completing the form.

Findings of the Study

This study was concerned with first establishing that there is a strong positive relationship between how a student performed in the classroom as compared to how he performs in the shop or lab and that both class and shop performance affect how he will succeed in the occupation for which he is being trained. Secondly, the study was concerned with which GATB factor scores related significantly to how a student ranks in class on the shop, skill and success related criterion. Then most important of all, the study was concerned with the development of expectancy indicies based upon how students with varying GATB scores ranked on the three study criteria.

Shop, Skill and Success Correlation. The first specific objective of the study was to establish how the area school students in the eleven program areas included in the study correlated on their rankings of academic achievement, skill achievement, and the teachers' perception of how the student will succeed in the occupation for which he is being trained. The findings of the Spearman Rank Order Correlation analysis were that all of the programs were highly positively correlated at significance levels greater than the .01 level needed to reject the null hypothesis that there is no positive correlation between the three

ranked criteria. The correlation coefficients and significance levels are listed in Table I in Chapter IV.

Multiple Regression Analysis. The second objective of the study was to determine which specific student aptitudes measured by the General Aptitude Test Battery related to how a student ranked on the research criteria. The objective was accomplished using multiple linear regression analysis to determine the best one-, two-, and three-variable regression model with the GATB factor scores used as the independent variables and the student rankings for the academic, skill, and success criteria as the dependent variables. The results of the regression analysis are listed in Table II of Chapter IV. In general it was established that there were at least two GATB variables that contributed significantly to the prediction of student rankings. Twelve of the possible thirty-three three-variable models did not come into solution due to the lack of a third GATB factor that was significant to the prediction model at the .01 level on an F test. The results of the regression analysis consistently indicated that the relationships between the GATB factors and the ranked criteria were significant and positive but low in magnitude as determined by the regression coefficients. The low degree of the independent-dependent variable relationships was the main reason the regression models were not used to predict student ranking. The literature provides several studies indicative of the low magnitude of the GATB factors to student achievement criteria, therefore the results of the regression analysis in this study are not uncommon.

Expectancy Indicies. The final objective of this study was to develop expectancy indicies against which students could compare their GATB profiles or scores, determine the significant GATB factor scores, and then determine their probability of ranking above the mean on the three student success criteria based on varying GATB factor score ranges. The real advantage of using expectancy indicies instead of prediction models is that a student is given more information when he is able to determine how his probability of obtaining a criterion rank equal to or greater than some predetermined level varies in relationship to how his individual independent variable score varies.

The expectancy indicies for the eleven vocational programs included in this study are represented in Tables III - XII in Chapter IV of this study. In general, they indicate that there are different aptitudes contributing to success on each of the three student ranked criteria and that GATB scores in excess of 100 for the aptitude factors are necessary in order to reach the 60 percent or greater level of probability of ranking above the mean for the criteria.

Conclusions

Based upon the interpretations of the findings relative to the stated objectives of the study, the following conclusions have been formulated:

1. The vocational programs in the area schools which include Auto Body, Auto Mechanics, Carpentry, Child Care, DE II, DE III, Drafting, Electricity, Food Service, Machine Tool, and Welding all have high positive correlations for the way instructors rank their students on how they achieve academically, how they achieve in the shop

or lab, and how the instructors perceive the students will achieve in the occupations based on the students' attitudes and course performance.

2. There are specific GATB variables that relate to how students achieve on the three ranked criteria for each of the vocational programs included in the study, as indicated in Table II of Chapter III.

3. Table XIII provides a summary of the GATB variables used in the development of the expectancy indicies. The GATB variables are listed for each of the three criterion rankings by program area and numbered according to the order in which they were used in the expectancy indicies development. For the criteria rankings the cognitive aptitudes such as G, V, N, S, P, and Q are the most predominant variables contributing to achievement, which further supports Ghiselli's findings that cognitive aptitudes contribute more to training success than do the psychomotor variables K, F, and M.

4. The General Intelligence aptitude factor was the most frequently reoccurring factor for all of the program areas, as can be seen in Table XIII.

5. GATB factors have a low magnitude of correlation to the three ranked criteria; however, the relationships between the factors and criteria are statistically significant.

6. As a student's GATB scores increase, his probability of achieving a rank above the mean for criteria rankings increases.

7. It is possible to develop indicies of a student's expected probability of ranking above the mean on the program criteria for varying ranges of GATB factor scores.

TABLE XIII

THE GATB VARIABLES NUMBERED ACCORDING TO THE ORDER IN WHICH THEY WERE INCLUDED IN THE EXPECTANCY INDICIES FOR THE CRITERIA RANKINGS BY PROGRAM AREA

PROGRAM AREAS	ACADEMIC RANK GATB VARIABLES*									SKILL RANK GATB VARIABLES*									SUCCESS RANK GATB VARIABLES*								
	G	V	N	S	P	Q	K	F	M	G	V	N	S	P	Q	K	F	M	G	V	N	S	P	Q	K	F	M
AUTO BODY	1			3					2	1						3		2	1						3		2
AUTO MECH	1	3						2			3		1				2		2			1					
CARPENTRY	1				2		3			1						2			1						2		
CHILD CARE	1			2							2		1							2		1	3				
DE II	2					1				1								2	1	2							
DE III					2	1			3		1		2							1	2						
DRAFTING	1	3	2	2						1			2						1			2					
ELECTRICITY			1		3			2		1					3					2	1						
FOOD SERVICE	3	2	1								3	2				1				1					2		
MACHINE TOOL	1		2							1									1								2
WELDING	1						2			1						2			1					2	2		

*The GATB variables listed in Table XIII have been abbreviated as follows:

General Intelligence	G	Spatial Aptitude	S	Motor Coordination	K
Verbal Aptitude	V	Form Perception	P	Finger Dexterity	F
Numerical Aptitude	N	Clerical Perception	Q	Manual Dexterity	M

Implications and Recommendations

Based upon the data collected, study findings, and the observations made as a result of the research done for this study, the following general recommendations were formulated:

1. It is recommended that the procedure of determining the relationships between GATB factors and student achievement be more refined through additional research which implements procedures to control more of the error variability.

2. It is recommended that extensive efforts be incorporated in vocational research to determine which GATB variables have significant relationships to student success in programs not included in this study.

3. It is further recommended that vocational teachers and counselors be made aware of the potential use of student GATB scores in the vocational counseling of students in vocational course selection and the formulation of general academic courses that will be useful in promoting success in vocational program training.

4. It is also recommended that students be made aware of the usefulness of the General Aptitude Testing Battery in providing them information for vocational career planning.

5. It is recommended that high schools offering vocational training offer GATB testing for their students.

6. It is recommended that after further research has refined the expectancy indicies developed for this study that the indicies be made available to school counselors in order to help them better prepare students for vocational training.

The implications of this study include the following:

1. The relationships between General Aptitude Testing Batteries and vocational training do exist and does provide valuable information for student career decision making.

2. If the GATB test is administered to a student early enough that he can identify his low aptitude areas prior to entering a vocational training program, he can select regular high school courses that will enhance his probability of success in the vocation program he chooses.

3. The expectancy indicies are not meant to be used as student selection criteria, but as student guidance instruments. When students are prohibited from entering a course due to their failure to meet some predetermined criteria without someone taking the responsibility for helping him overcome some educational deficiency, he is being deprived of a chance to receive training that could aide him in becoming a productive individual.

4. The types of learning experiences necessary to become a good vocational student are not too dissimilar to those that are traditionally considered college preparatory even though they may be at differing levels of difficulty, which is indicative of the prevalence of the aptitudes of General Intelligence and Numerical and Verbal Aptitudes in the expectancy indicies.

5. The use of the GATB as a vocational guidance tool can be developed beyond the point at which it is currently being used with further effort by vocational researchers.

6. The need for a student to have a good background in basic educational skills such as Math and English is indicated by (1) the

strong relationship between the academic criterion and the shop and success criterion, and (2) the contributions made by the cognitive GATB factors in explaining the variation in student ranking on the three ranked criteria.

7. Vocational students perceived by their instructors as having the greatest potential for success on the job are those students who do well both in the classroom and in the shop or lab.

8. Though further research should be undertaken before the expectancy tables developed by this study are used as standards, the importance of the concepts developed by this study indicate the potential for the use of each instrument in vocational student guidance activities.

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APPENDIX

MEMORANDUM

TO: GATB Project Participants

FROM: John Starr, Project Coordinator

SUBJECT: Student Information & Student Rating Form

Attached to this memorandum is a student rating form that pertains to additional input into the GATB Study by providing information concerning a student's skills and attitude. In the first column, list the students you are reporting for the GATB project in alphabetical order. In the second column, rank your students according to their academic standing in your class by placing a one by the top student, a two by the second, continuing until you have ranked all of your students.

In the second column we are looking at strictly a student's shop or lab skills--again rank your students according to the quality of work they perform in the shop or laboratory portion of the course.

The last column is meant to allow the instructor to take into account attitude, skills, and intelligence in determining how he perceives his students should be ranked according to their potential to succeed in their occupational area.

The student rating form is a result of concern on the part of teachers that the study was leaving out a student's skills and attitudes in determining his program success. I feel that this information will strengthen the study and provide more useful information for student guidance.

Please fill out this form and return it, and any student information forms that you have completed, as soon as possible.

The school year will end in a few weeks and before that time I need to have all information reported.

Rank your participating students according to the following abilities:

List Alphabetically Student's Name	Academic Grade	Shop or Lab Skills	The Student's Potential To Succeed In The Occupation For Which He Was Trained

GATB Profile Aptitude Score Sheet

School_____

Student Name	G Intell.	V Verb. Apt.	N Num. Apt.	S Spat. Apt.	P Form Perc.	Q Cler. Perc.	K Motor Coord.	F Fing. Dex.	M Manual Dex.

VITA

John Lloyd Starr, Jr.

Candidate for the Degree of

Doctor of Education

Thesis: THE DEVELOPMENT OF INDICIES FOR THE USE OF GATB SCORES IN PREDICTING STUDENT SUCCESS IN ELEVEN OKLAHOMA AREA VOCATIONAL-TECHNICAL SCHOOL PROGRAMS

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