A STUDY OF THE RELATIONSHIP OF SELECTED VARIABLES TO GRADE POINT AVERAGE IN GENERAL BIOLOGY AT THOMAS NELSON COMMUNITY COLLEGE

A Dissertation

Presented to the

Faculty of The School of Education

College of William and Mary in Virginia

In Partial Fulfillment

of the Requirements for the Degree

Doctor of Education

by

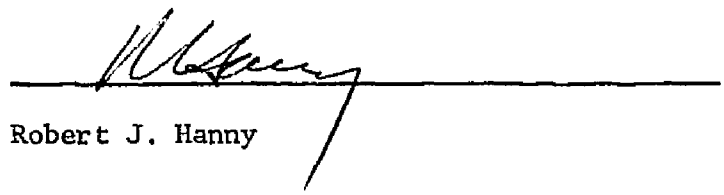
Turner McKinley Spencer

December, 1975

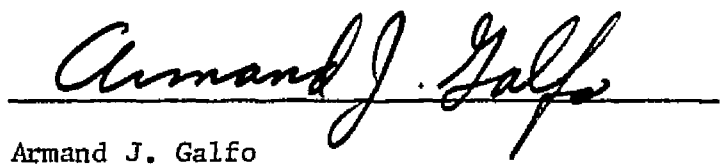
APPROVAL SHEET

We the undersigned do certify that we have read this dissertation and that in our individual opinions it is acceptable in both scope and quality as a dissertation for the degree of Doctor of Education.

Accepted December 1975 by



Robert J. Hanny



Armand J. Galfo

Daniel R. Gerber, Dissertation Director and
Chairman of Doctoral Committee

ACKNOWLEDGMENTS

I am indebted to the members of my doctoral committee for their perceptiveness, interest, and support during the conduct of this research. I am also indebted to the administration of Thomas Nelson Community College for the use of college facilities. To my wife, Lottie, I owe a great debt for her patience, understanding, and encouragement.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

A STUDY OF THE RELATIONSHIP OF SELECTED VARIABLES TO GRADE POINT AVERAGE IN GENERAL BIOLOGY AT THOMAS NELSON COMMUNITY COLLEGE

CHAPTER I

BACKGROUND AND INTRODUCTION

The open-door admissions policy adopted by the Virginia State Board for Community Colleges permits any person to enter a community college who holds a high school diploma, or the equivalent, or is eighteen years of age and can benefit from a program of instruction. This policy placed a tremendous responsibility upon college personnel since its implementation resulted in the acceptance of numerous students who were judged to be academically deficient. A special burden was placed upon the colleges' guidance and advisement services. Counselors and faculty advisors were forced to make judgements as to the proper courses or curriculum to which the student should be assigned. While standardized tests and records were available to assist counselors and advisors, locally developed standards and criteria would have been more helpful and more reliable. Wherein high school performance was useful in predicting college performance, studies had shown that test scores made a stronger contribution for older than younger students. In one study, it had been shown that the high school averages did not predict as consistently for blacks as it did for whites (Thomas & Stanley, 1969). This study was designed to assess the predictability of student success in college freshman biology.

Thomas Nelson Community College was created in 1966 by the legislature of Virginia as a part of the Virginia Community College System. The college opened its doors in 1968 with an enrollment of 1200 students.

By 1974 this enrollment had increased to over 3400 (Institutional Self-Study, 1974).

The college offered two-year programs in occupational-technical areas, university parallel areas, and vocational-diploma areas. In addition a broad developmental program was offered for those students who were not deemed ready to enter a regular program or curriculum (TNCC Bulletin, 1973-74).

The policy of the Virginia Community College system mandated that "open admission" be practiced within each college throughout the state. During the period 1968 to 1970, students entering Thomas Nelson Community College were required to take the American College Testing series. These scores, along with high school grades and high school SCAT and STEP scores, were used to place the student into the various programs During the period 1970 to 1973, the Comparative Guidance and Placement tests were administered to entering students (TNCC Annual Report, 1972-73).

The typical Thomas Nelson student fitted the pattern that had been described by researchers in that field (Cross, 1968). He tended to be slightly older, had been out of school for a few years and worked full-time or either part-time. The student body was 65% male and approximately 20% were of minority races (TNCC Annual Report, 1972-73).

The Thomas Nelson Community College biology program included the courses General Biology, Anatomy and Physiology, Microbiology, Introductory Genetics, and Conservation of Natural Resources. The general biology course was presented in three one-quarter periods of ten weeks each. The course required attendance at three hours of lecture and three hours of laboratory per week. A total of four quarter-hours of credit was given for the successful completion of each quarter. General Biology was

usually taken by all science majors and a large number of other majors in university-parallel programs.

Since the first entrance requirements were instituted for American higher education, a continuing debate has raged over what constitutes a sound curriculum for education. A second debate has centered around what constitutes sound admission standards. It is believed that the proper blend of admission standards with curriculum requirements would maximize achievement.

There are those who advocate a rigorous selection process for admission to college. On the other hand, there are those who advocate the implementation of a policy that anyone who can benefit from the college experience should be allowed to enter. In either case, an institution is obligated to aid the student in his selection of a curriculum and courses (Coley, 1973, p. 613). To perform such a task requires that methods of measuring individual potential for college work be made available to the student. This would suggest that information derived from prediction studies can enhance the purpose of instruction by reducing the element of chance of possible failure in guiding students toward academic success. The purpose of academic prediction, therefore, is to prevent gross errors and to curtail wasted efforts, so that real educational challenges can be offered and mastered (Bloom & Peters 1961, p.7).

The Purpose of the Study

Statement of the Purpose

The major purpose in this study was that of determining the relationship of selected variables to achievement, as measured by grade

point average, in general biology at Thomas Nelson Community College. A secondary purpose was that of determining the relative usefulness of high school grade point averages, selected scores from portions of the Comparative Guidance and Placement Test (CGP), and verbal and quantitative scores of the Cooperative School and College Ability Tests (SCAT) in predicting achievement in general biology.

The specific questions that were to be answered were:

1. To what extent did high school grade point averages; verbal ability, mathematical ability, motivation and biology interest scores, as measured by CGP; and SCAT verbal and quantitative scores correlate with the biology grade point average?
2. To what extent did each factor correlate with the others?
3. What linear combination of the independent factors would produce a useful prediction equation?

Assumption

The major assumption in this study was that a high correlation value (a large "r" value) would indicate that a factor would be useful in predicting the biology grade point average. Guilford (1965, p. 379) had shown that a range of "r" values from 0.3 to 0.8 produced efficiency indicies ranging from 5% to 40% in forecasting the correct prediction of the dependent variable. This meant that prediction errors would be 5% to 40% less (depending upon the "r" value) than they would have been without the knowledge of the predictor variable.

The Hypotheses

The hypotheses in the present study were supported by research of

previous investigators whose work also suggested the procedures and methods used in this study. After a thorough review of the literature, several theoretical relationships seemed apparent and suggested a basis for solving the problems stated above. Generally, each of the independent variables was assumed to have had a significant and positive impact on achievement in general biology.

As it will be shown in chapter two, studies of McKelpin (1965), Jenkins (1966), and others supported the contention of Bloom and Peters (1961) that a combination of high school grades and aptitude test scores would provide a better means of predicting college achievement than the use of these variables individually. Edwards (1972) had found that CGP test scores served as useful criteria for predicting success in remedial mathematics in the community college. SCAT variables were found to be predictive for college achievement in general by Scott (1966). The effects of motivation and aspiration had been studied, respectively, by Pemberton (1963) and Worell (1959), and according to Lavin (1965, p. 74), consideration of interest categories frequently produced positive correlations.

The major hypothesis for the present study was that high school grade point average; SCAT verbal and quantitative scores; CGP verbal, mathematical, biology interest, and motivation scores would correlate positively with grade point average in General Biology and therefore could be used to predict achievement in general biology. The sub-hypotheses were:

(1) Of the independent variables, high school grade point average would be the most important.

(2) CGP verbal scores and CGP mathematical scores would

correlate highly and respectively with SCAT verbal and SCAT quantitative scores.

(3) A linear combination of independent variables could be developed into a regression equation that would be useful in predicting student success in general biology.

Definition of Terms

The following terms have been given definitions according to their general usage in the literature (Good, 1973 and Hopke, 1968).

American College Test (ACT)

A test administered to students upon entry to college at many institutions. It yields five scores: English, science, social studies, mathematics, and total.

Comparative Guidance and Placement Test (CGP)

A combination aptitude and achievement test used as an aid in student placement in the community college. It yields seven measures: academic motivation, academic interest, vocabulary, reading, sentences, mathematics and special abilities. The vocabulary and reading scores are combined to form a verbal ability score.

Cooperative School and College Ability Tests (SCAT)

A test administered by some high schools to students in their junior year. This test produces three scores: verbal, mathematics, and total.

Methods and Procedures

During the period of September 1970 through June 1973, five

hundred and eighty two students had completed the three-quarter sequence in general biology. The majority of these students had taken the CGP test upon entering the college. In addition most had taken the SCAT tests during their junior year of high school.

A list of those students who had completed both the CGP test and the three-quarter sequence of general biology courses was provided by the Thomas Nelson Computer Center. A sample of 140 students was randomly selected from the list. The data for this study were obtained from the students' files in the office of admission and records. For each student in the sample the following data were collected: (1) CGP motivation score, (2) CGP biology interest score, (3) CGP verbal score, (4) CGP mathematics score, (5) high school grade point average, (6) SCAT verbal score, (7) SCAT quantitative score, and (8) the biology grade for each quarter. The overall biology CGP was computed by averaging all grades earned by the student during his completion of the three-quarter sequence. The following values were assigned to each grade: A-4.0, B-3.0, C-2.0, D-1.0, and F-0.0.

The first seven variables served as the independent variables and the eighth (the overall biology GPA) as the dependent variable. To determine the strength and the direction of the relationship between each of the independent variables and the dependent variable a correlation analysis was conducted. The Pearson product-moment procedure of the Statistical Package for Scoial Sciences was used for this purpose (Nie, Dale, & Hall, 1970). Correlation coefficients were computed for all pairs of independent and dependent variables. The coefficients indicated the strength and direction of the simple relationships between the measures of ability, motivation, and interest and the biology grade

point average. This procedure served as the test for three of the hypotheses.

To determine that linear combination of independent variables that would best predict the biology grade point average, a stepwise multiple regression analysis was performed. The purpose of this procedure, then, was to test the hypothesis that a linear combination of the seven independent variables would be a highly reliable predictor of the biology grade point average. It would also show the relationships between both sets of quantitative and verbal measures (the third hypothesis), and would show that using both sets would generate little additional impact on the criterion variable. The computer program used for this procedure was supplied by the Statistical Package for the Social Sciences. The computer facilities of the Virginia Community College System were utilized to obtain the results.

The output statistic of the regression procedure is the coefficient of multiple correlation (R), which is a measure of the relationship between a set of independent variables and a dependent variable while controlling for the interrelationships between the dependent variable. In addition, the stepwise procedure selects that independent variable with the strongest product-moment correlation (r) with the dependent variable and then, in subsequent steps, selects the independent variables that, when combined with the previously selected variables, will provide the best possible prediction of the dependent variable. The procedure continues until all the independent variables are added to the prediction equation or until no other variable will make a significant contribution to the equation. The square of the coefficient of multiple regression, known as the coefficient of multiple determination (R^2),

indicates the percentage of variation in the dependent variable that is explained by the combination of independent variables. The relative contribution of each of the independent variables to the dependent variable is measured by the standard partial regression coefficients (beta weights) of each of the indpendent variables.

Summary

The purpose of this study was to determine the relationship of selected variables to achievement in general biology. It was hypothesized that high school grade point averages and selected test scores would correlate significantly with biology grade point averages and therefore could be used to predict the biology grade point average. To test this hypothesis, data collected from student files were statistically analyzed by utilizing the techniques of correlation and multiple regression. The hypothesis was theoretically supported by evidence found in the review of related literature (Chapter II). The results and conclusions of this investigation will be presented in Chapters III and IV.

CHAPTER II

REVIEW OF RELATED LITERATURE

More than twenty-one items of pertinent research are reviewed in this chapter. The first part of this chapter includes studies that illustrate the theories and methodologies used in prediction studies. The second part includes research that examine those factors that affect achievement in general biology, in other science subjects, and in community college subjects. This review provided the basis for the formulation of the hypotheses that were presented in Chapter I.

In general, prediction studies are based upon two sets of criteria: (1) global ability measures and (2) specific ability measures. These criteria are used to make either of two kinds of predictions: (1) prediction of overall grade point averages or (2) prediction of grade averages in specific subjects or areas. The ability measures most often used are grade point averages, aptitude test scores, and achievement test scores. Other measures include personality factors and sociological factors. This review provided the basis for selecting the measures and methods used to test the hypotheses.

The Theory and Methodologies of Prediction

Concern with the prediction of academic performance has increased during recent years. One reason for this increase has been the growth in student population and the increased competition for admission to college. Another reason has been the growth of programs designed to

identify and support the training of students with outstanding talents. A third reason has been the development, within the social sciences of a serious concentrated study of the process of education (Lavin, 1965, p. 11).

In spite of the many studies which have been conducted in the attempt to identify accurate predictors of college success, little progress toward improved prediction has been noted. Even with more effective centralized testing services and even with improvements in the interpretation of grades, it is still unusual to find a correlation between college grades and other measures above the level of .60. Most correlations fall in the range of .45 and .55 (Bloom & Peters, 1961, p. 8).

Problems Related to Prediction

Several problems exist with respect to the conduct of prediction studies. One such problem concerns the standardization of the prediction measures. If reliable knowledge is to be accumulated, the findings of the researcher must be substantiated by repeated observations and consistent findings. When one researcher attempts to replicate another's work, he must be sure that the study is comparable to the earlier investigation. If the procedures are not comparable, the interpretation of differences between studies becomes ambiguous, and hinders the accumulation of knowledge (Lavin, 1965, p. 35).

Another problem is that of interpreting the degree of independence of the predictor measures. One index of the usefulness of a variable is that it makes an independent contribution to the prediction of performance, otherwise it should be classified with other predictor variables.

Other problems center around interpreting the relationship between predictors and academic performance. In most studies, the

correlation methods assume linear relationships - that is, they assume that unit increases in the predictor variable would be followed by unit increases in the criterion. However, when one considers the different segments of the criterion range, he may find that the measures are predictions for certain segments and not for others. In other studies, the question of causal relationships is the major concern. The observation of an association between two variables does not in itself, establish the presence of a causal relationship. In field investigations, such as research on academic achievement, it is difficult to establish causal interpretation because it is not possible frequently to control extraneous factors (Lavin, 1965, p. 40).

Many researchers however, are not concerned with the question of causality. They seek, primarily, to discover correlations of academic performance and to use these for prediction purposes. There is ample evidence that discovery of predictive factors may be useful on practical grounds, even if these factors have no causal significance (Lavin, p. 42).

Kinds of Prediction Studies

Early research on academic performance focused primarily on intellective and ability factors as predictors. Recently, there has been increased concern for "non-intellective" or personality characteristics. In most studies of academic performance the traditional criterion for performance was the student's grades (Lavin, 1965, p. 14).

Studies that utilize ability measures to predict academic performance exhibit considerable variation. The chart below depicts the general variations in the types of studies that have been conducted.

Figure 1.1. Types of Studies Relating Ability and Academic Performance (Lavin, 1965, p. 47).

Predictor	Criterion	
	Global	Multidimensional
Global	Global Ability measures used to predict grades point average. A	Global Ability measures used to predict grades in specific courses. B
Multi-dimensional	Several specific ability dimensions used to predict grade point average C	Several specific ability dimensions used to predict grades in specific courses. D

Cell A portrays the type of study werhe a single index of ability is used to predict a single overall index of academic performance. In cell B, a global measure of ability is used to predict performance in separate courses or course areas. This type or study does not occur very frequently.

Cell C depicts studies that employ a number of dimensions of ability to predict a global measure of performance. Cell D represents the situation where different ability dimensions are used for the prediction of performance in specific courses or course area.

Two kinds of studies can be classified within cell D. First, a uniform battery of predictor variables may be used for predicting grades in different courses. Second, the composition of the predictor battery may be changed according to the particular course for which grades are being predicted. In the latter case, the combination of intellective variables used is the one that yields the highest correlation with a

given course grade. When the content of the predictor battery varies according to the particular course it is referred to as the differential prediction technique. The differential prediction technique has the advantage over global prediction of being able to isolate those abilities in which the students scored high and those subjects in which the students did well. For the differential prediction of grades in mathematics, science, and social studies, the most effective predictive variables are the parallel content areas of the predictive tests (Lavin, p. 53).

When correlations based upon differential aptitude measures were compared with those based upon global measures, there was no conclusive evidence that one was superior to the other. However, in both types of studies the single best predictor of performance on the college level was the high school academic record. This was due in part to the fact that high school grades were determined by many factors in addition to measured intellectual ability (McKelpin, 1965, p. 161).

High School Grades as Predictors

The high correlation between high school grades and college grades can be accounted for by the fact that high school and college students are subjected to the same treatments (assignments, lecture, extra-class activity) persumably designed to develop the behaviors (the expected outcomes) that are later assessed in terms of grade point averages. "Since the ability to perform both intellectually and non-intellectually results from the nature of the interactions between individual organisms and their respective environments, and assuming that these particular students represent a distribution of genetic potential characteristic of students in general, then the assessed ability of the students (SAT) probably reflects some of the enduring effects induced by interactions

with common and unique elements of their high schools and the college" (McKelpin, 1965, p. 161).

The fact that grades have been shown to be the best single evidence from which to predict college achievement does not alter the fact that the level and precision of prediction from grades has remained relatively low and stable (Bloom and Peters, 1961, p. 9). Raw high school grades do not provide better predictions because of three sources of variation. One source of variation is the error in judgement of teachers about the quality of a student's academic achievement. Another is the difference among students in achievement and motivation. A third source of variation is the difference in standards from teacher to teacher and from school to school.

Attempts to improve the predictive validity of grades involve the use of rank-in-class and experience records. Another approach to the problem of improving the impact of grades on prediction involves the use of test data as the basis for adjustment (Bloom & Peters, p.12).

The contribution of scholastic aptitude test scores in improving prediction was demonstrated by McKelpin (1965). In his multiple regression equation, the chief function of SAT scores was to provide information in addition to high school grades in a way that would account for ability differences within the schools. SAT scores were used to account for the social milieu operating for the Negro freshman. Given students of equal aptitudes, some high schools would produce a more academically able graduate. Schools for Negroes tended to make adjustments in expectations and placed less emphasis on intellectual factors. Colleges, unlike high schools, while adjusting programs to students in terms of their needs, placed greater emphasis on the intellectual

factors (McKelpin, 1965, p. 166).

Aptitude Test Scores as Predictors

Intelligence and ability tests attempt to measure dimensions of problem-solving capacity. There are three positions as to the source of this capacity. The first is the position that the intelligence test score is an index of inherited ability. The second is the environmentalist view that intelligence is largely a product of cultural and environmental factors. A third position is that intelligence is the product of the interaction of heredity and environment (Lavin, 1965, p. 47).

Aptitude tests have been widely used to predict college achievement. Alfred Binet's development of the intelligence test opened new vistas for the testing movement. But, because individual intelligence tests were time-consuming and costly, they were not widely used for screening college applicants. The development of group testing techniques during the following World War I led to widespread use of intelligence or academic aptitude test scores for the purpose of college admission (Bloom & Peters, 1961, p. 19).

The correlations that resulted from studies utilizing the Army Alpha test, the Stanford-Binet test, and the Otis test demonstrated the potential of aptitude or intelligence tests as college selection and placement devices. In the 1920's four college aptitude tests were developed: the CAVD[1] by Thorndike, the American Council on Education Psychological Examination by Thurston, the College Entrance Examination Board Scholastic Aptitude Test by Bingham, and the Ohio State Psych-

[1]The acronym stands for sentence completion, arithmetical reasoning, vocabulary, and ability to follow directions (Sills, 1968, p. 11).

ological Examination by Toops. All four of these tests (in revised form) are still in use, although the ACE Psychological Examination has been superseded by the School and College Ability Test (Bloom & Peters, 1961, p. 20).

The typical correlation between school and college averages and tests of general intelligence falls between .40 and .50. While aptitude tests of various kinds have proved to have some merit for the problem of predicting college scores, almost forty years of efforts to refine and improve academic aptitude measures have not markedly enhanced their effectiveness (Bloom & Peters, 1961, pp. 19 & 22).

Achievement Test Scores as Predictors

Though less widely used than school grades as aptitude tests, achievement tests have been extensively tried in predictions of college success. The achievement test differs from the aptitude test in that it is specifically designed to test mastery of special subject matter.

The Iowa Placement Examination and the Iowa High School Content Examination, the Sequential Tests of Educational Progress, and the College Examination Entrance Board Achievement Test are commonly used achievement tests. These tests have proved to be equal or superior to aptitude tests for prediction of college success. However, there is still much to be desired in terms of the precision of prediction (Bloom & Peters p. 24).

The Use of Predictors in Combinations

The most common approach in prediction is the use of a combination of school grades and aptitude tests. The problem in such an approach is to find predictors that are relatively independent of one another.

One index of the usefulness of a variable is that it makes an independent contribution to the prediction of performance (Lavin, p. 37).

If grades and test scores were perfectly correlated, the use of both would not provide any better prediction than using either one separately. Since school grades and test scores are not perfectly correlated, they could be used together and the combination would ordinarily provide somewhat improved estimates of probable college success.

While school grades, aptitude test scores, or achievement test scores would ordinarily each correlate within a range of .40 to .60, multiple correlation using two or more of these in combination would usually be within the range of .55 to .65 (Bloom & Peters, p. 25).

Personality Factors as Predictors

There is much evidence to show that college success is in part a function of qualities or attributes not directly related to intellectual ability. Such qualities as motivation, interest, study habits, personality, and social adjustment are just a few of the factors that have been shown to affect academic success (Bloom, 1961, p. 26).

Although ability measures are generally the best singular types of predictors, they account for less than half of the variation in academic performance. This fact led many investigators to focus on personality characteristics as a partial explanation of this variation.

Some of the personality characteristics centered around the motivational state of the student. These included levels of anxiety, achievement motivation, and level of interest in content areas. Some characteristics involved personality style; these included such factors as the degree of independence, impulse control, and introversion. A

third kind of personality characteristic centered around self-concept, a fourth around study habits, and finally some studies focused on manifestations of pathology to account for achievement (Lavin, p. 64).

Two basic methods of analysis were used in the studies of personality variables. First, the correlational method was used to assess the degree of relationship between the personality factor and the academic performance. In studies using this method, ability was controlled either by means of partial correlation analysis or by multiple correlation in which the contribution of a personality variable to a battery of intellective factors was assessed. The second technique for studying performance related to personality involved the formation of groups of high and low achievers, or over and under achievers, and then the possible personality differences between such groups were assessed (Pemberton, 1963, p. 64).

Measures of Study Habits and Attitudes Toward Study. Measures of study habits and attitudes are commonly used in prediction studies. Some measures simply assess the actual mechanics of studying; while others assess the students' attitudes toward studying or school work in general.

Measures of Interest. Interest measures generally have been put to three uses for the prediction of academic performance. In the first place, scores on particular interest categories have been related to performance in corresponding courses. It would be predicted, for example, that students with high scores on interest in science would have higher grades in science classes than students whose expressed interests in this area were low. Secondly, interest scores have been used in attempts to assess whether interests of any type were predictive of academic

performance. A third area of concern has been with general dimensions of interests which cut across content, such as clarity of interests, definition of vocational goals, the intensity of goals, and the like (Lavin, 1965, p. 74).

Measures of Achievement Motivation. The concept of achievement motivation refers to the need of an individual to perform according to a high standard of excellence. It is usually measured in two general ways: by projective techniques or by pencil-and-paper questionnaires. In the projective technique the subject is presented a series of pictures and is asked to compose a story of response to each of them. The stories are scored in terms of the frequency with which the achievement theme appears. This technique is exemplified by the Thematic Appreciation Test (TAT). However, it appears that studies utilizing questionnaire measures of achievement motivation present clearer pictures overall, than those utilizing projective measures. The results of studies using projective measures are quite inconsistent. One factor contributing to this inconsistency is the low reliability of projective measures, particularly the TAT. Questionnaire measures of academic motivation appear to provide consistent and positive relationships with academic performance even though in most instances the relationships are not very strong (Lavin, p. 77).

Level of Aspiration. Measures of the level of aspiration showed high correlations to total grade average and class rank in a study by Worell in 1959.

The level of aspiration refers to the subsequent level of performance which an individual "hopes for", "expects", and "is minimally

satisfied with" following his performance on a task. The difference between the actual performance and the expected performance generates discrepancy scores. The individual with the higher discrepancy scores is expected to perform more poorly since an achievement situation for him evokes more unrealistic behaviors. One with lower discrepancy scores would evoke more realistic behaviors. The student who behaved unrealistically has an aspiration level markedly beyond his potential capacity and tends to attain a lower scholastic standing. On the other hand, the student who holds moderate aspirations, perceives his efforts as being commensurate with potential capacity performance, tends to obtain grade success (Worell, 1959, p. 47).

In the study by Worell (1959), aspiration indicies alone produced a multiple R of .69. When combined with ability and high school achievement indicies, a multiple R of .72 was obtained for the total grade point average of freshmen students.

Measures of Independence. Measures of independence show some promise of being useful predictors of academic performance. Conceptually, this variable has been used in different senses. It is used sometimes to indicate the need to make decisions and to select alternative courses of action on one's own initiative without seeking the advice or support of others. It is sometimes used in the sense of conformity to or deviation from some group norm. Independence appears to be positively related to academic performance.

Measures of Impulsivity. In an achievement oriented society, adequate adult role performance often requires delay in immediate gratification in the interest of long-term goals (Lavin p. 81). The

ability to delay immediate gratification and to persist at tasks when the rewards lie in the future is a requirement of a student's educational role. Thus variations in this personality characteristic are often related to academic performance.

Measures of Anxiety. On the college level, general measures of anxiety are not directly useful for prediction of academic performance. However, some evidence did suggest that general anxiety might be useful in multiple correlation analysis, since it might boost the level of correlation between ability and grades (Lavin, p. 87).

Measures of Introversion. The term "introversion" refers to shyness and a tendency to withdraw from social contact. Its opposite, extroversion refers to a tendency toward sociobility and the seeking of social contacts. Introversion on the college level appears to be positively related to academic performance (Lavin, p. 90).

Measures of Self-Image. Even though spotty, the studies suggest that a positive self-image is associated with higher performance. However, the studies do not establish whether the self-image is determined by prior performance or whether performance is determined by the self-image (Lavin, p. 93).

Measures of Adjustment. A number of investigations had used the Minnesota Multiphasic Personality Inventory (MMPI) to study the relationship between adjustment and academic performance. The MMPI is a clinically oriented instrument that defines a number of personality dimensions having pathological significance. Some studies revealed a level of significance and others did not.

Many other personality variables have been studied singly and in multiples for their significance in academic performance. At best the results are tenuous, indicating that further study is needed.

Sociological Determinants as Predictors

While no sociological variable was considered in this study, these variables do play a role in academic prediction. Many studies were reviewed to ascertain the effect of sociological variables.

Sociological studies take two forms, basically. One type examines the effects of role relationships on academic achievement. An example of this would be a study of the student-teacher relationship in which the degree of congruence between the student's and the teacher's definition of the student's role is measured. A second type of sociological study examines the effect of various ecological and demographic characteristics upon academic performance. These investigations examine such variables as socioeconomic status, sex of the student, race of the student, religion, rural-urban background, high school characteristics, age, and the like (Lavin, p. 122).

Sociological variables are related to performance because they symbolize certain uniformities of personality. That is, position in the social structure such as socio-economic status and sex tends to produce certain similiarities in personality among occupants of these positions. Some of these personality characteristics are, in turn, related to academic achievement (Lavin, p. 123).

Similar Studies in Prediction

In reviewing the literature for other studies similar to this one, very few were found that were limited solely to the prediction of

general biology grade point averages for community college students. Therefore, the review was broaden to include prediction studies that were related to freshman biology in general, to other science subjects, and to other community college subjects. Also reviewed were studies that used CGP test scores for prediction; interest, motivation and aspiration measures, such as SAT and SCAT; and the high school grade point average.

Studies Involving the Prediction of Biology Grade Point Averages

Williams studied the effects of selected environmental factors on achievement in general college biology in the San Antonio Union Junior College District. To do this he established such dichotomous groups as science versus non-science majors, freshmen versus non-freshmen, and full-time versus part-time students. Other dichotomies were (1) students who had a content-oriented background versus those who had a process-oriented background, (2) those who viewed biology as process-oriented versus those who viewed it as content oriented, and (3) those whose ACT Natural Science scores were above-the-mean versus those whose scores were below-the-mean. He used the point bi-serial method to calculate coefficients of correlation. When using the first semester's grade point average as the criterion of achievement, Williams obtained correlation coefficients that were significant at the .01 level. When the scores on the Advanced Placement Biology Examination were used as the criterion variable, instead of the GPA, only the ACT above or below the mean dichotomy produced a significant correlation (Williams, 1972).

In a study entitled "The Relationship of Certain Measurable Factors to Academic Success in Freshman Biology at Alabama Agricultural

and Mechanical College", Jenkins developed the following prediction equation:

$$X_1 = 8.4 + 0.1877\ X_2 + 0.0071\ X_3 + 0.0651\ X_4 + 0.1608\ X_5.$$

She considered the factors of sex (X_1), high school rank (X_2), intelligence as measured by the California Short Test of Mental Maturity (X_3), reading ability as measured by the Iowa Silent Reading Tests (X_4), critical-thinking ability as measured by the Watson-Glaser Critical Thinking Appraisal (X_5), and general achievement in science as determined by STEP (X_6). Correlation coefficients were calculated for the first semester biology grade point average and each of the independent variables. No significant relationship was found between sex and the criterion variable. A correlation coefficient of .07 was obtained for these two factors. Correlation coefficients for the criterion variable (the first semester grade point average) and the other factors were as follows: high school rank, .80; mental ability, .24; reading ability, .33; critical thinking, .29; achievement in general science, .19. She concluded that high school rank was the best predictor; followed by reading ability, critical thinking ability, and mental ability (Jenkins, 1966).

Craft, in an unpublished dissertation at the University of Kentucky, used (1) high school grade point average, (2) high school science grade point average, (3) ACT standard score, (4) ACT English score, (5) ACT Natural Science score and (6) the first semester grade point average to predict achievement in biology. All variables showed some relationship to achievement in biology, however, the strongest relationships were shown by high school GPS and high school science GPA. His sample was divided into five groups according to the grades A, B, C, D, and E. He used analysis of variance, the Duncan Multiple Range, and

discriminant functional analysis to determine the relationships (Craft, 1972).

In a study conducted at the University of Nebraska, Johnsten found a positive relationship between high school background in science and mathematics and achievement in general college biology. The gain in scores on pre-tests and post-tests using the Advanced Placement Biology Examination served as the dependent criterion. He divided his sample into five major test cases:

(1) Those who had taken high school chemistry, versus those who had not.

(2) Those who had taken high school physics versus those who had not.

(3) Those who had less than two years of mathematics, versus two to three years of mathematics, versus more than 3½ years of mathematics.

(4) Those who had participated in extra-curricular science activities versus those who had not.

(5) Those who had high school teachers whose credit hours in biology ranged from 0 to 17 hours, 18 to 35 hours, and 36 hours or more.

He used analysis of variance and the "t" test to determine significant differences. Significant relationships at the .01 level was found for cases 1, 2, and 3 and at the .05 level for cases 4. No significance was found in case 5 (Johnsten, 1967).

Bennett (1970), in a dissertation at Iowa State University, found significant differences among high school biology groups, high school chemistry groups, and three college groups in achievement in Biology 101

as measured by an achievement test and final grades. He also studied the predictive effect of high school rank, the Minnesota Scholastic Aptitude tests, the English and mathematics placement scores. Of these variables, he found that the previous high school biology and chemistry programs were more significantly related to success in Biology 101 and could, therefore, serve as predictors.

The effects of selected cultural-environmental factors and student attitudes on achievement in freshman biology were studied by McCall (1972) at Middle Tennessee State University. He used various statistical measures to determine the effect of each variable. Significant effects were found for the number of science courses the students had completed in high school, and the type of biology course completed in high school. Significant relationships were also found with respect to student employment; those who were moderately employed scored highest. With respect to the self-report of high school grades, those who reported grades of B+ to A, scored significantly higher on the biology achievement examination and the biology numerical average. Students who had a desire to take the course scored significantly higher than those who took it only because it was required.

The relationships of sex, ability level and biology preparation to achievement in freshman biology at Metropolitan State College were investigated by Spurlin (1968). He organized his data into various factoral designs with sex, high school biology background, ACT total score, ACT science score, and high school rank as factors. The criteria for success were scores on three tests: the Nelson Biology Test, the Krabill Test of Biological Principles, and locally prepared final examinations. He used analysis of variance and covariance procedures

to determine any significance.

The factors of sex, ACT total score, Science ACT Score, and high school rank varied significantly with student achievement. Also, the type of high school biology which a student had completed was found to have made a difference upon his performance in the college course. He developed three prediction equations according to whether the student had previously taken BSCS biology, conventional biology, or no biology in high school. In each case the ACT total score was the most significant variable. Spurlin concluded that college biology achievement was affected by prior biological education as well as by the student's intelligence and reading ability.

Is there any significant difference in achievement in general biology within a community college and a university if the students backgrounds are similar? This question provided the focus of a study by Kocherberger at the State University of New York at Buffalo. He took samples from the university and from Jamestown Community College. Four hypotheses were tested. The first was that the two-year college produces better results on a common achievement measure than does the university, especially for those in the lower 50th percentile of the class as determined by the high school average and the Nelson Biology Test. Even though the university sample scored higher on a common criterion examination than the community college sample, there was no significant difference found between the scores in the lower 50th percentile groups. The two-year college did not provide instruction that was significantly different from that of the university.

The second hypothesis tested was that achievement in high school and achievement on the Nelson Biology test is positively correlated with

success in general biology. The results indicated that correlations between high school averages and the criterion and also between the test and the criterion variable were significant.

Thirdly, it was shown, as hypothesized, that the lack of success as measured by "D" and "F" grades was greater in the university than in the two-year college although criterion scores were somewhat higher. Fourthly, the two-year college student perceived a closer relationship between himself and his faculty than did the university student. Overall, Kockerburger concluded that the community college appears to provide satisfactory academic instruction in an atmosphere that is more conducive to the academic survival of the less well prepared students (Kochersberger, 1966).

In another study, the relationship of mathematical aptitude and achievement to success in high school biology was examined. The investigator used partial correlation techniques to measure the effects of mathematical achievement and aptitude on both conventional and BSCS biology while controlling for verbal reasoning. He found significant results in both instances (Cain, 1964).

Studies Involving the Prediction of Achievement in Other Community College Science Subjects

The prediction of success in general chemistry in a community college was investigated by Coley at Chabot College in Haywood, California. All science majors at this institution were required to take General Chemistry. Upon entry into the program many students had not taken high school chemistry and both years of high school algebra. All were required to take the Toledo Chemistry Placement Examination where an arbitrary score of 50 was set as the minimum score for admission to general chemistry.

Students who scored below 50 were assigned to pre-college Chemistry 31, who then, upon successful completion, took the General College Chemistry ACT series.

To determine the best predictor or the best combination of variables that would predict success in General Chemistry 1A, ten independent variables were correlated with two dependent variables. The independent variables were Chemistry 31, the Toledo Chemistry Placement Exam, ACT scores (Composite, Mathematics, Natural Science, English, Social Science), and high school chemistry and algebra courses. The two dependent variables were General Chemistry 1A grades and the American Chemical Society (ACS) General Chemistry Examination scores. The ACS scores and the Chemistry 1A grades correlated from .72 to .81. Multiple correlation techniques were used to determine the degree of relationship between the variables. Stepwise regression was employed to develop the differential weightings of the predictor variables.

For those students who had taken the pre-college Chemistry 31, the only predictor of any significance was the grade in Chemistry 31. With only three variables in the equation, a multiple R of .43 was obtained, along with an R square of .18 and a standard error of .94. This indicated that the Chemistry 31 grade alone accounted for 18% of the variance. When the Toledo Chemistry Placement Exam scores were entered as the second best variable it only increased the total variance accounted for to 19%, thus was not needed in the regression equation. The first equation of $Y = 0.42 + 0.63$ (Chemistry 31 grade) was useful for predictions.

For those students who had not taken the pre-college Chemistry 31 as prerequisite, the Toledo Chemistry Placement Exam was the best

predictor. It yielded a multiple R of 0.39, an R square of 0.15 and a standard error of 1.17. It accounted for 15% of the total variance. The prediction equation on this basis was Y = 1.47 + 0.06 (Toledo Chemistry Placement Exam). The other variables did not contribute to the prediction.

In attempting to explain the lack of significance when other predictor variables were used, the study was in agreement with the literature which suggests that course areas and grade point average are better predictors than test scores. ACT scores tend to correlate better with overall freshmen grade point averages than with the specific course grades.

The study suggests that it is important that each institution develop its own unique prediction equation and methods. However, a look at the total amount of variance explained by the independent variables leads to the conclusion that there were other factors that contributed to success in chemistry. They may or may not have been academic in nature, but whatever they were, they were significant (Coley, 1973).

In another similar study dealing with prediction of success in community college, the area of concern was remedial mathematics and among the criteria were CGP test variables. This was one of the few studies found that utilized GCP test scores. CGP differs from ACT in that it was originally developed primarily for use in the community college.

The study was done in seven community colleges in the states of Connecticut and Massachusetts. Data on 181 remedial mathematics students were used to develop a regression equation for predicting success in remedial mathematics courses. In the regression analysis the following

independent variables were identified: selected scores from the CGP test (reading, sentences, mathematics, and mathematics interest), high school average, number of class hours for which registered, number of credit hours given in remedial mathematics, an attitude toward mathematics score from the Dutton test, work status while attending college, and sex. The criterion variable was a dichotomous variable based on grades in remedial mathematics courses - A, B, C, or satisfactory for success and D, F, W, or unsatisfactory for failure.

Intercorrelations of the independent variables with the criterion variable were significant only for the following: high school average, $r = 0.29$; CGP reading score, $r = 0.13$; CGP sentence test score, $r = 0.18$ and CGP mathematics score, $r = 0.19$. In order to determine the best predictors, the investigator used stepwise regression analysis. From this analysis the best combination consisted of five variables: high school average (X_1), CGP mathematics test score (X_2), Dutton attitude toward mathematics score (X_3), CGP sentence test score (X_4), CGP mathematics interest score (X_6). The multiple R for these five variables was 0.33 which was significant at the 0.15 level. The multiple R for all ten variables was 0.35. The regression equation based on the first five variables was:

$$Y = 0.1809X_1 + 0.0132X_2 + 0.0129X_3$$
$$+ 0.006X_4 - 0.0006X_5 - 0.6526$$

Edwards, 1972).

Act scores and high school grade point averages were used in a study to predict grades in occupational and academic curricula of two-year colleges. The test scores and the high school GPA were correlated with the end-of-the second-year-college grades in twelve curricular areas.

It was found that by optimally weighting various combinations of these variables, grades in the occupational curricula could be predicted with the same accuracy as they could be predicted in the academic curricula. However, they were less reliable for women than for men. The best single predictor, in any case, was the high school grade point average (Baird, 1969).

Worsley (1969) in a doctoral dissertation at Arizona State University supported in his research the observation that high school achievement was more meaningful for predicting first semester grade point averages for junior college students than aptitude test scores. He used the ACT scores and six multiple regression analysis models and found that by combining the variables he could produce the best prediction.

In a doctoral study by Jenkins (1969) six scores from the College Qualification Test (CQT) and fifteen personality variables from the Edward Personal Preference Schedule (EPPS) were used to analyze the academic achievement of junior college freshmen in terminal and transfer curricula. Few differences existed between the two curricular groups in EPPS manifest need. However, the transfer group scored significantly higher than the terminal group on all but the numerical section of the CQT.

In a study of the success of the C-average high school graduate in a junior college, no real significant differences were noted. Scores from SCAT and the Cooperative Reading Test were correlated with the first quarter grade point average. All correlations were low. Subsequently, the interview technique was employed to develop an understanding of the relationship between high school achievement and junior college achievement. This led the author to conclude that the interview approach was

more helpful than tests (Williams, R.A., 1963).

Studies Related to the Prediction of Success in other Scientific Areas

Arm attempted the prediction of academic success in ten selected sciences at the University of Washington in 1953. He used grades from six high school areas, three reading test scores, and two aptitude scores from the A.C.E. Psychological Exam as the predictor variables. Correlation co-efficients were calculated for the areas of biology, botony, chemistry, engineering, forestry, geology, home economics, and zoology. The coefficients ranged from .60 to .80 (Arn, 1953).

In an effort to determine the relationship between achievement in high school and success in college, Ralph Scott (1966) correlated high school science and mathematics courses with college science and mathematics courses. The number of units in mathematics or science had very little predictive value. Grades in high school mathematics however, were good predictors of success in college mathematics and science areas with the exception of geology and physical science. Grades in high school science subjects were found to be good predictors of success in college with the exception that high school biology could not predict college chemistry.

Perlberg, working at the Israel Institute of Technology, found variables similar to those found in the United States to be reliable in predicting the academic achievement of engineering and science college students (Perlberg, 1967). High school grades were found to be somewhat superior to test scores as predictors of college achievement for freshmen, but they were inferior to a combination of high school grades and test scores.

Cropley and Field (1969) found that scientific achievement is related to cognitive variables other than simply the level of intellect. Such variables as abstract thinking, originality, and flexibility related significantly to achievement when IQ was statistically controlled. The most successful science students in their study were characterized by being highly abstract and original in their thinking and by being able to relate inconsistant data.

It was not clearly determined whether the existence of a cognitive organization appropriate to high science achievement led certain individuals to enter science in the first place, or whether effective science teaching resulted in the increased scores on the variables. In any case, Cropley and Field felt that intellective variables other than IQ were significantly related to scientific success and would be relevant in attempts to recognize students with scientific talent.

In 1973, Goldman and Hudson conducted a multivariate analysis of academic abilities and strategies for success in different major fields. They showed that when strategy measures are partialed out, the ability differences between major fields are no longer significant. This suggests that strategy differences between major fields exist independently of ability differences. In science, formal reasoning seems to be the strategy that is more important. In other studies reported by Goldman and Hudson, it was shown that science students were more intrinsically motivated and more dogmatic but less tolerant than liberal arts students. Their findings lend support to the idea that strategies may be the more fundamental determinants of academic success than abilities. However, it must be noted that because of the selection process they were dealing with a narrower range of college abilities than that found in

community colleges.

Studies Involving the Use of Similar Predictor Variables

McKelpin studied the predictive validity of scholastic aptitude scores (SAT) - verbal and mathematical - and high school averages for freshman grade point average at North Carolina College at Durham, a liberal arts college for Negroes. He found that SAT scores account for sixty percent of the variation in the grades explainable by the data from the preadmission variables. He concluded that since Negro high schools and Negro colleges were somewhat alike, even low scores on the SAT had a high correlation with the relative success in each.

However, in a study by Thomas and Stanley (1969), high school grades did not consistently make the greatest contribution in predicting college grades of black students, especially the males. They did, however, for whites. Stanley and Porter (1967) earlier had shown that by combining SAT verbal and SAT mathematical scores with high school grade point averages, predictions were improved.

ACT scores were used by Richard and Lutz (1968) in an effort to predict student non-academic accomplishments in college. They found that for non-academic accomplishments the ACT had no validity. Non-academic accomplishments were independent of academic potential.

SCAT verbal and SCAT mathematical scores, along with high school percentile rank, proved to be useful predictors of the grade point average of regularly admitted freshmen and dis-advantaged freshmen admitted as part of a special educational opportunity program at the University of Illinois (Bowers, 1974). Multiple regression equations utilizing all three variable showed significant differences between the

two groups.

Interest in the predictive value of "non-intellectual" factors in academic achievement has increased as a consequence of the limited predictive value of conventional academic aptitude measures. Only a small portion of the variance in academic success can be attributed to the variance in measures of ability and previous academic achievement. Leonard Worell (1959) showed in a study at the University of Iowa that the level of aspiration correlated significantly with academic success. When correlated with total grade average, his two achievement measures yielded a multiple R of 0.47; wherein his four aspiration indicies produced a multiple R of 0.69. This illustrated the value of non-intellectual indicies in predicting academic success. When the six variables were combined a multiple R of 0.72 was obtained.

The student who held moderate aspirations or ones close to previous performance, who perceived his effort as being commensurate with his potential performance capacity, who did not see his performance as markedly improving by making a "total push," and whose standards of acceptable satisfaction were below his previous achievement tended to be successful in grade achievement. On the other hand the student who behaved unrealistically or who perceived his reasonable level of performance satisfaction as lying above previous achievement, who had aspirations markedly beyond his past performance, who estimated his potential capacity as lying far above the effort he expended, and who believed he can achieve far beyond what he already had done by pressing himself to the limit of his ability, tended to attain a lower scholastic standing (Worell, 1959).

Again, as in the previous study, the nature and unique setting

of this study limits the applicability of the results. One might not expect that such non-intellectual variables would play as meaningful a role among less homogeneous and less academically oriented students (Worell, 1959, p. 54).

The impact of another important non-intellectual factor was investigated by Pemberton in a study at the University of Delaware (Pemberton, 1963). According to him the variable motivation plays a more important role in determining achievement in higher education than ability. He identified four categories of graduating seniors, which he labeled as high-achieving, over-achieving, under-achieving and low-achieving. Over-achievers were characterized by low ability and an orientation toward social service rather than intellectual achievement. Under-achievement was associated with high ability but a low inclination to accept institutional standards. The high achieving groups were characterized by high ability and a preference for intellectually challenging tasks; wherein, the low-achievers were found to have low ability and a motivation toward "easy" rather than challenging programs. In the latter group, feelings of personal inadequacy were seen to be compensated by group identify as a substitute for self-direction. Pemberton concluded that tests and grades fall short of being ideal criteria for college achievement.

In another study, Packwood (1973) administered a motivation check-list to junior college students in an effort to determine the effect of motivation on academic achievement. He correlated the responses on the checklist with first quarter grade point averages and compared the predictability of the motivation variables with the predictability of high school rank and ACT scores. He divided his sample into two groups.

For his male group, the correlation between the check-list and the actual first quarter GPA was 0.347. The correlation between the GPA predicted by high school rank and ACT scores and the actual GPA was 0.343. The two correlations were almost equal; however, they were shown to have been measuring different variances since the check-list and the predicted GPA only correlated at 0.011. When combined, all variables (the check-list, high school rank, and ACT scores) produced a multiple R of 0.48. For his female group similar results were obtained. Packwood concluded that while high school rank and ACT scores accounted for approximately 12 percent of the variance in the first quarter GPA, adding the responses from the motivation check-list explained an additional 12 percent.

Even though this factor was not considered in this study, age differences may play a greater role in achievement in the community college than in the university. This particular aspect of achievement in the community college was studied by Glenn Groenke, in an Ed.D dissertation at Arizona State University in 1969. He compared placement test scores and with performance in two groups - those who entered as adults (21 or older) versus those who entered immediately after high school (18 or less). He computed Pearson product-moment correlation coefficients between average composite scores of the ACT and average first semester grade point averages for each group. He found that ACT test scores were more useful for prediction in the young group than in the older group (Groenke, 1969).

The prediction of the overall grade point average of junior college freshman has been the subject of many studies and dissertations. Most of these studies have employed correlation and multiple regression techniques. For example, Worsley used six multiple regression analysis

models to determine the usefulness of ACT scores and high school grade point averages as predictors of the first semester grade point average for students at three Maricopa County Junior Colleges in Arizona. Even though the high school grade point average had the greatest impact, the best overall predictor consisted of the combined variables (Worsley, 1969).

Summary

The research studies reviewed in this chapter have shown that the use of a combination of measurements produces higher correlations than the use of single measures. This review has also shown that psychological and sociological determinants, as well as intellectual determinants, affect achievement in college courses. What remains is the need for investigations that will blend these determinants into equations that will effectively predict achievement for various subject areas and for various educational conditions.

While many studies have focused on the problem of achievement in general biology, a need for further study is suggested by the review of the literature. As suggested, predictions of success in community college science subjects can be made from records of high school achievement and from admission test scores. However, perfect correlations of 1.0 are rarely obtained. Yet, efforts to improve correlations would be worthwhile even if the reduction in the prediction error is small. If the variables that affect achievement in general biology are known in advance, then appropriate teaching strategies and learning techniques may be devised.

The hypothesis of this study is that high school grade point averages; SCAT verbal and quantitative scores; CGP verbal, mathematical, biology interest, and motivation scores would correlate positively with

grade point average in general biology and therefore could be used to predict achievement in general biology. To test this hypothesis, the Pearson product-moment correlation and a stepwise multiple regression analysis were conducted. The results of these statistical procedures are shown in chapter III.

CHAPTER III

RESULTS AND ANALYSIS

The purpose of this study was to determine the relationship of selected variables (CGP scores, SCAT scores, and high school GPA) to achievement in general biology. In addition, this study was an attempt to determine the extent to which achievement in general biology, when measured by grade point average, could be predicted by the selected variables. The statistical procedures employed were Pearson product-moment correlation and stepwise multiple regression. The computations were performed by computer utilizing two programs from the Statistical Package for the Social Sciences (SPSS). The results of these procedures are presented in this chapter.

The data presented include the means and standard deviations of each variable, the correlation (r) between each independent variable and the dependent variable, the inter-correlations of the independent variables, the multiple correlation (R) for each combination of variables, and the regression coefficient (B) for each independent variable in the prediction equation. The findings are presented as they relate to the hypotheses stated in Chapter I.

Means and Standard Deviations of the Variables

The mean and standard deviation of each variable are shown in Table 1. Both the high school grade point average and the biology grade point average have similar standard deviations (0.79 in the case of the

TABLE 1

MEANS AND STANDARD DEVIATIONS OF THE VARIABLES

Variable	Mean	Standard Deviation
Biology Grade Point Average	2.62	0.79
CGP Verbal Score	53.96	8.38
CGP Mathematics Score	54.46	8.54
CGP Motivation Score	48.25	9.55
CGP Biology Interest Score	16.97	9.34
SCAT Verbal Score	285.02	11.67
SCAT Quantitative	294.78	12.64
High School Grade Point Average	2.06	0.65

biology grade point average and 0.65 for the high school grade point average). These small standard deviations indicate that there was less variance in these two variables than in the others. It is also noted that the standard deviations of the CGP verbal scores and the CGP mathematical scores are similar; likewise the CGP motivation scores and the biology interest scores show standard deviations that are similar--9.55 and 9.34, respectively.

Simple Correlations and The Contributions of Each Variable

The relationships between the independent variables and the dependent variable were established through correlation procedures. The contribution of each variable to the prediction of the dependent variable was analyzed according to the weight of the correlation value.

The Pearson Product-moment Correlations

The results of the Pearson product-moment correlation procedures are shown in tables 2 and 3. The correlation value (r) of each independent variable to the biology grade point average is shown in table 2, and intercorrelation values of the independent variables are shown in table 3. Each independent variable showed a positive relationship to the dependent variable, however, only five variables were significant. They were high school grade point average, CGP biology interest score, CGP motivation score, CGP mathematics score, and SCAT verbal score. High intercorrelation values resulted between SCAT verbal and CGP verbal scores and between SCAT quantitative and CGP mathematics scores. CGP motivation was negatively correlated with both the verbal and quantitative scores of CGP and SCAT, wherein the biology interest score was negatively correlated with only the quantitative scores.

TABLE 2

CORRELATION COEFFICIENTS
FOR THE DEPENDENT VARIABLE:
BIOLOGY GRADE POINT AVERAGE

INDEPENDENT VARIABLES	BIOLOGY GRADE POINT AVERAGE (Y_1)
High School Grade Point Average (X_1)	.3958 **
CGP Biology Interest Score (X_2)	.2619 **
CGP Mathematics Score (X_3)	.2906 **
CGP Verbal Score (X_4)	.2421 **
SCAT Quantitative Score (X_5)	.1544
CGP Motivation Score (X_6)	.1059
SCAT Verbal Score (X_7)	.2160 *

** Significant at the .01 level

* Significant at the .05 level

TABLE 3

INTERCORRELATION COEFFICIENTS
FOR THE INDEPENDENT VARIABLES

INDEPENDENT VARIABLES	BIO INT	CGP MATH	CGP VERB	SCAT QUANT	CGP MOT	SCAT VERB
HSGPA	.1346	.2616	.1368	.3178	.4065	.2005
BIO INT		- .0311	.1337	- .0316	.1606	.1331
CGP MATH			.2758	.5977	- .0021	.3147
CGP VERB				.3710	- .1726	.6952
SCAT QUANT					- .0131	.4086
CGP MOT						- .1328

Contributions of each Variable

High School Grade Point Average. Of the seven independent variables used in this study, high school grade point average correlated highest with the criterion variable. The mean of this variable was 2.06 and the standard deviation was 0.65. The simple correlation value was 0.3958 which was significant at the 0.01 level of significance. As hypothesized, this variable appeared to contribute most to the prediction of grade point average in general biology.

CGP Mathematics Score. The second highest correlate between the independent variables and the criterion variable was the CGP mathematics score. This variable had a simple r value of 0.2906, and was significant at the 0.01 level. It intercorrelated with high school grade point also; an r of 0.2616 is shown in Table 3.

CGP Biology Interest Score. The CGP biology interest score showed a correlation coefficient of 0.2619, the third highest value of all the independent variables. This score was obtained from that portion of the CGP test which asked the student to indicate whether he would like, dislike, or be indifferent to engaging in each of 176 specific activities. His interest score was based upon his replies to those activities that were related to biology (A Counselor's Guide to CGP, 1972, p. 14). The biology interest score appeared to have been the most important non-academic correlate examined by this study. It made an important contribution to the prediction of achievement in general biology.

CGP Verbal Score. The CGP verbal score, as expected, correlated significantly with the dependent variable. Most studies, reported in the literature survey, showed high correlation between verbal ability

measures and achievement measures.

SCAT Verbal Score. Even though the CGP verbal score and the SCAT verbal score showed a high intercorrelation value (0.6952), the SCAT verbal score produced a correlation coefficient of only 0.2160 with the biology grade point average. This correlation coefficient was significant but appeared to be of less importance. It might be remembered that this score had been obtained from high school records of the students' junior year. This fact might explain why the SCAT verbal score exhibited less impact on the criterion variable.

SCAT Quantitative Score. Quantitative ability as measured by SCAT correlated very highly with mathematical ability as measured by the Comparative Guidance and Placement Test. (A value of 0.5977 is shown in Table 3.) When correlated with the biology grade point average, the SCAT quantitative was not significant, and therefore was not a predictor of the biology grade point average as hypothesized. As was noted in discussing the SCAT verbal score, the SCAT scores were established by testing that occurred during a student's junior year of high school A growth period of two or more years had occurred prior to his completion of the biology course.

CGP Motivation Score. Of the seven independent variables, the CGP motivation score showed the lowest correlation (.1059) with the biology grade point average. This fact negated the hypothesis that CGP motivation score could be used to predict biology point average. However, the CGP motivation score correlated relatively high with the high school grade point average (a value of 0.4063 is shown in Table 3). This may be accounted for by the fact that the motivation score was derived from

questions asked during a biographical inventory. When asked about his attitudes toward his studies, his study habits, his academic achievements, and his willingness to work hard for grades, a student had four responses to choose from, ranging from low to high. His score was based on the aggregate of his answers (A Counselor's Guide to CGP, 1972, p. 11). Most students in the sample had just recently completed high school when the CGP tests were taken. As seen in Table 1, the mean high school average of the sample was 2.06. It would appear then that the motivational level of the student would be somewhat reflective of his high school academic achievement.

In summary, it can be said that five of the seven independent variables correlated significantly with the dependent variable and therefore might be useful in predicting the general biology grade point average. The CGP motivation score and the SCAT quantitative were not significantly correlated with the biology grade point average.

Multiple Regression and the Contribution of Combined Variables

The results of the stepwise multiple regression analysis of the seven independent variables with the biology grade point average are shown in tables 4 through 7. It was hypothesized that a linear combination of independent variables could be developed into an equation that would predict the biology grade point average. The stepwise regression analysis produced a series of equations derived selectively from those independent variables that made the greatest contribution to the dependent variable. A discussion of these steps is presented in the following sections of this chapter.

Stepwise Regression Analysis

In the stepwise program of SPSS the variable that contributes most to the prediction is selected first. The second independent variable to be added to the regression equation is that which provides the best prediction in conjunction with the first variable. The program continues in this manner until no other variable makes a significant contribution to the prediction equation. At each step the optimum or nearly optimum variable is selected, given the other variables in the equation.

As expected from the results of the Pearson product-moment correlation analysis, the high school grade point average was the first independent variable entered into the stepwise regression analysis. The second variable to be entered into the regression analysis was the CGP biology interest score.

Stepwise regression involves the solving of a system of linear equations. The computational procedure provides two pieces of information which are used to select the next variable. The first piece of information is the normalized regression-coefficient value that the prospective variable would have if it were brought into the equation on the next step.

The second piece of information used in the selection process is a value known as tolerance. If the tolerance is small, then that variable is nearly a linear combination of variables already in the equation. A large tolerance indicates that a new "dimension" is being added to the prediction equation (Nie, et.al., 1970, p. 180).

Figure 2 is an example of a printed output of the regression program which shows how the variables not included in the previous prediction equation are considered according to beta input, partial

correlation and tolerance. Such print-outs are produced for each step.

Figure 2. Statistics for Variables Not In The Equation At Step One.

VARIABLE	BETA INPUT	PARTIAL CORRELATION	TOLERANCE
CGP Verbal Score	0.19147	0.20652	0.98126
CGP Mathematics Score	0.20074	0.21097	0.93154
CGP Motivation Score	- 0.0659	- 0.6557	0.83471
Biology Interest Score	0.21251	0.22929	0.98188
SCAT Verbal Score	0.14234	0.15184	0.95967
SCAT Quantitative Score	0.03155	0.03257	0.89878

The first column in Figure 2 shows the beta coefficient (the normalized or standardized regression coefficient B) which each variable would have if it alone were brought into the regression equation on the next step. The second column shows the partial correlation between the prospective independent variable and the dependent variable when the independent variables in the regression equation are controlled for. The third column shows the tolerance. The product of the tolerance and the beta squared gives an indication of the amount of variance that will be explained by adding the new variable. The variable then that yields the largest product is the one added at the next step.

At step one only the high school grade point average had been entered into the regression analysis. The statistics produced from this step are shown in Figure 3.

Figure 3. Statistics For Variable Entered at Step One of the Stepwise Regression Analysis
Variable Entered: HSGPA

PROCEDURE	STATISTIC	VALUE
MULTIPLE CORRELATION	Multiple R	0.39574
	R Square	0.15661
	Standard Error	0.73202
MULTIPLE REGRESSION	Regression Coefficient (B)	0.48132
	Standardized Coefficient (BETA)	0.39574
	Standard Error of B	0.09508
	Constant	1.63090
	F Value	25.625

In the above figure the multiple R is the same as the simple r shown in Table 2. It can also be seen that the value of the multiple R is the same value of BETA. BETA is a standardized measure which tells how much each variable is contributing to the dependent variable (Hayes, 1973, p. 702).

In figure 3, R square can be interpreted as that proportion of the variance in the dependent variable accounted for by the regression equation. In other words, it can be said that 15 percent of the variation in biology grade point average can be accounted for solely by the high school grade point average. If R square is small, much of the variation of the dependent variable is unexplained. It may be due to random variation, or it may be due to other independent variables not yet considered in the regression analysis (Snedecor, 1956, p. 438).

The standard error in figure 3 is the standard deviation of the residual--the difference between the predicted biology grade point average and actual biology grade point average. The standard error then is the typical error of the prediction.

Standard error is the measure of error due to chance. It is the standard deviation of the sampling distribution of the correlation coefficients. The standard error is a useful statistical tool. Dividing a statistic by the standard error gives an indication of how significant that statistic is in comparison with other statistics (Kerlinger, 1964, p. 178). If the standard error is much smaller than the statistic then the coefficient can be interpreted with confidence.

The B and BETA values in Figure 3 are the regular and normalized regression coefficients, respectively. The prediction equation at step one would be: $Y_1 = 1.63090 \times 0.48132\ (X_1)$. The standard error of this prediction would be 0.73202. The standard error of B gives a measure of the reliability of the regression coefficient B. Thus, the range of the regular regression coefficient at step one is 0.48132 + or - 0.09508. The F value is determined by dividing the regression coefficient by the standard error. This F value of 25.625 is significant at the .01 level (Rohlf and Sokal, 1969, p. 169).

A re-examination of Figure 2 (p. 52) reveals that the variable biology interest score has the highest "beta input" and "tolerance". Therefore it would contribute most to the reduction of the unexplained variance in the prediction equation developed at step one. The R square increase caused by adding the variable biology interest is 0.0444. The biology interest score therefore, explains approximately 4% of the variance in the biology grade point average.

Multiple Correlations for Each Combination of Variables

Table 4 shows the complete stepwise multiple regression analysis. The final multiple R was 0.5234. The R square was 0.2740 which suggests that approximately 27% of the variance in the biology grade point average can be explained by the linear combination of the seven selected independent variables.

From step 4 to step 5 in Table 4, it was noted that the R square change was 0.0144 and the multiple R was increased from 0.5078 to 0.5218 with a corresponding increase in the R square. At step 6, the additional increase in the multiple R was considerably less. The addition of the CGP motivation scores made no significant contribution to the variance. It can be further noted that the standard error increased as a result of adding this variable. At step 7, the addition of the seventh variable, SCAT verbal scores, offered no improvement in the overall correlation.

The Prediction Equations

Tables 5, 6 and 7 show several possible prediction equations that were developed at various steps in the regression analysis. At step 4, a multiple R of 0.5078 was obtained (Table 4), along with an R square of 0.2579; which meant that approximately 26% of the variance was explained by the first four variables. The prediction equation at this step was:

$$Y_1 = 0.0067 + 0.3679(X_1) + 0.0179(X_2) + 0.0171(X_3) + 0.0115(X_4)$$

At step 5, the variable SCAT quantitative was entered into the prediction equation. As hypothesized this variable correlated (Table 2) highly with the CGP mathematics score and added very little to the prediction equation. The F value of 2.659 was not significant at the 0.05 level. The multiple R was increased to 0.5218 and the R square was

TABLE 4

STEPWISE MULTIPLE REGRESSION: BIOLOGY GRADE POINT AVERAGE WITH THE INDEPENDENT VARIABLES

Variable Entered at Step *	Multiple R	R Square	R Square Change	Standard Error
1. High School Grade Point Average	0.3957	0.1566	-	0.7320
2. CGP Biology Interest Score	0.4483	0.2010	0.0444	0.7151
3. CGP Mathematics Score	0.4945	0.2446	0.0436	0.6978
4. CGP Verbal Score	0.5078	0.2579	0.0133	0.6942
5. SCAT Quantitative Score	0.5218	0.2723	0.0144	0.6900
6. CGP Motivation Score	0.5234	0.2739	0.0016	0.6919
7. SCAT Verbal Score	0.5234	0.2740	0.0001	0.6944

* Each step includes all preceeding variables.

TABLE 5

REGRESSION EQUATION AT STEP 4: FOUR VARIABLES ENTERED

VARIABLE	B	BETA	STD ERROR B	F
HSGPA (X_1)	0.3679	0.3025	0.0946	15.130 **
BIO INT (X_2)	0.0179	0.2107	0.0064	7.736 **
CGPM (X_3)	0.0171	0.1844	0.0074	5.342 *
CGPV (X_4)	0.0115	0.1216	0.0074	2.425
(Constant)	(.0067)			

** Significant at .01 level

* Significant at .05 level

TABLE 6

REGRESSION EQUATION AT STEP 5:
Five Variables Entered

VARIABLE	B	BETA	STD ERROR B	F
HSGPA (X_1)	0.4006	0.3293	0.0961	17.369 **
BIO INT (X_2)	0.0170	0.1997	0.0064	6.983 **
CGPM (X_3)	0.0244	0.2625	0.0086	8.029 **
CGPV (X_4)	0.0149	0.1569	0.0076	3.793 *
SCAT Q (X_5)	- 0.0100	- 0.1593	0.0061	2.659
(Constant)	(2.3179)			

** Significant at .01 level

* Significant at .05 level

TABLE 7

COMPLETE REGRESSION
With all variables entered

Step 7

VARIABLE	B	BETA	STD ERROR B	F
HSGPA (X_1)	0.4263	0.3505	0.1076	15.697 **
BIO INT (X_2)	0.0175	0.2063	0.0066	7.157 **
CGPM (X_3)	0.0244	0.2622	0.0087	7.882 **
GCP V (X_4)	0.0146	0.1538	0.0100	2.133
SCAT Q (X_5)	- 0.0100	- 0.1603	0.0062	2.601
GCP MOT (X_6)	- 0.0038	- 0.0463	0.0071	0.294
SCAT V (X_7)	- 0.0008	0.0199	0.0072	0.012
(CONSTANT)	2.71			

** Significant at .01 level

increased to 0.2723. However, this one percent increase in variance was not significant.

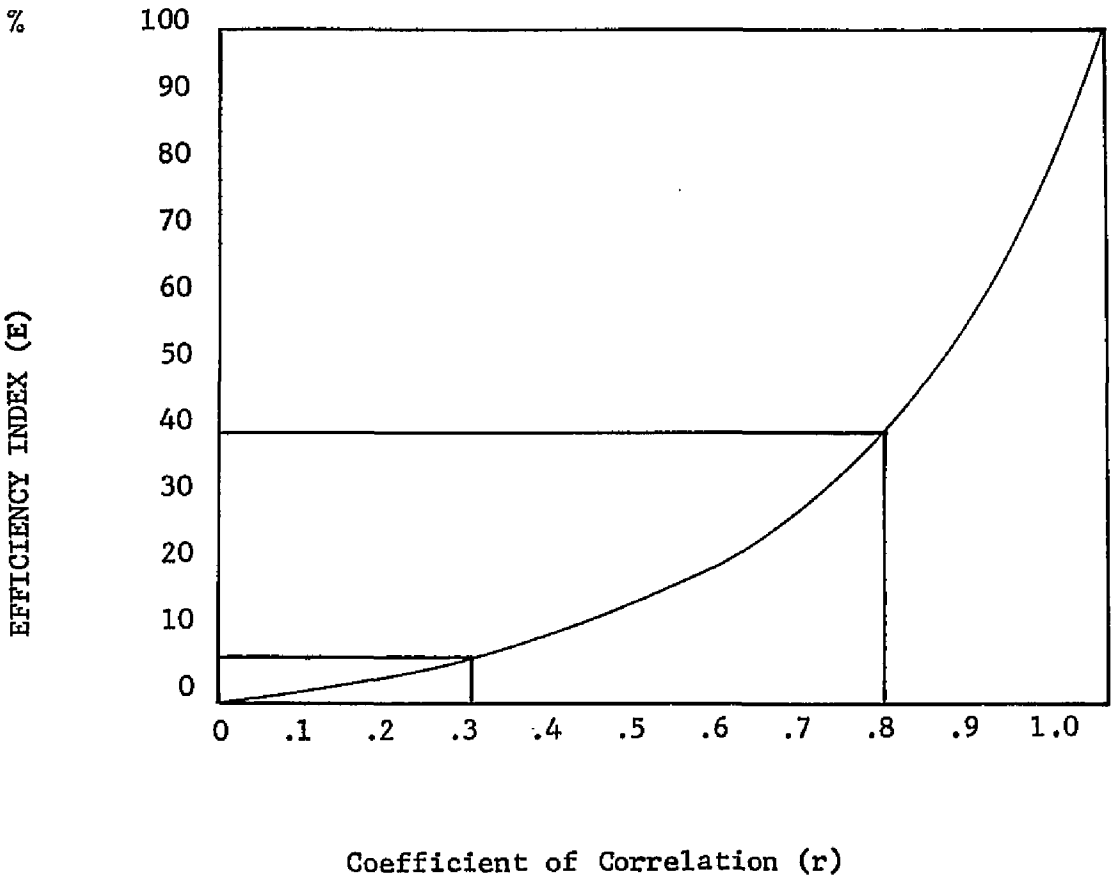
The introduction of the variables CGP motivation and SCAT verbal at the next two steps (Table 6) caused little further impact on the prediction equation. Since the last three variables changed the direction of B from positive to negative, their partial correlations with respect to the biology grade point average were also negative. For all three variables the standard errors were nearly as large as the regression coefficients (Table 7). Therefore the coefficients must be used with care since there is a significant chance that the sign of the true regression coefficient is opposite that of the calculated one due to the random errors in the data (Nie, et. al., 1970, p. 196). For these reasons it appears that the equation produced at step 4 (Table 5) would be the most reliable for predicting the grade point average in general biology. The best prediction equation then is:

$$Y_1 = .0067 + .3679(X_1) + .0179(X_2) + .0171(X_3) + .0115(X_4)$$

The usefulness of this equation was determined by calculating its forecasting efficiency in accordance with indices developed by Guilford (1965). The relationship between the correlation coefficients (r) and Guilford's index of forecasting efficiency (E) is shown in Figure 4. The range of r's from 0.3 to 0.8 is marked off as representing the level of validity coefficients usually found useful for predictive instruments in psychological and educational practices. Tests rarely show correlations greater than 0.8 with practical criteria, and those correlating less than 0.3 are usually of very limited value when used alone (Guilford, 1965, p. 279).

To compute the index of forecasting efficiency the formula

Figure 4. The Index of Forecasting Efficiency (from Guilford, 1965, p. 379)



$E = 100\ (1- \sqrt{1-R^2})$ was used. At step 3, the multiple R was 0.4945 and the R square was 0.2466. By using the formula, an E of 13% was obtained. At step 4, a multiple R of 0.5078 and a R square of 0.2579 produced an index of forecasting efficiency (E) of 13.8%. This meant that the prediction error was 13.8% less than it would have been without the knowledge of the high school grade point average, the CGP biology interest score, the CGP mathematical score, and the CGP verbal score. This meant also that the prediction of the biology grade point average by means of the equation

$$Y_1 = 0.0067 + 0.3679(X_1) + 0.0179(X_2) + 0.0171(X_3) + 0.0115(X_4)$$

would be 13.8% better than that made merely from a knowledge of the means of the biology grade point average.

Summary

Correlation analysis indicated that significant relationships existed between the dependent variable--biology grade point average--and five of the independent variables. The five were high school grade point average (X_1), CGP biology interest score (X_2), CGP mathematics score (X_3), CGP verbal score (X_4), and SCAT verbal score (X_7). Stepwise regression analysis produced a prediction equation that included four of the independent variables. The equation was:

$$Y_1 = .0067 + .3679(X_1) + .0179(X_2) + .0171(X_3) + .0115(X_4)$$

The conclusions of this study and recommendations for further study are presented in the next chapter.

CHAPTER IV

SUMMARY AND CONCLUSIONS

The aim of this study was to advance the systematic understanding of the manner in which differences in ability, motivation, interest, and high school achievement leads to differences in achievement in general biology in the community college. More specifically, the aim was to determine the impact of seven particular variables on the prediction of grade point average in general biology at Thomas Nelson Community College. The results from this study would aid in the guidance process and in the selection of courses in which the potentialities of the individual would be best utilized.

Summary

A random sample of 140 students was drawn from a list of 582 students who had taken biology during the academic years 1970 through 1973. The findings in this study were based on that random sample.

From the student's records the following items of information were obtained: the biology grade point average (Y_1), the high school grade point average (X_1), the CGP biology interest score (X_2), the CGP mathematics score (X_3), the CGP verbal score (X_4), the SCAT quantitative score (X_5), the CGP motivation score (X_6), and the SCAT verbal score (X_7). The biology grade point average was designated as the dependent variable and the others as independent variables. It was then hypothesized that the independent variables would correlate with the dependent variable and that they could be used to predict the dependent variable. Secondly,

it was hypothesized that the high school grade average would be the most important variable in the prediction. Thirdly, it was hypothesized that CGP verbal and mathematical scores would correlate highly with the SCAT verbal and quantitative scores.

The three hypotheses were tested by means of a Pearson product-moment correlation analysis. From this analysis the following correlation (r) values resulted for the independent variables: high school grade point average, 0.3958; CGP biology interest score, 0.2619; CGP mathematics score, 0.2906; CGP verbal score, 0.2421; SCAT quantitative score, 0.1544; CGP motivation score, 0.1059; SCAT verbal score, 0.2160. All variables correlated significantly with the dependent variable except SCAT quantitative score and CGP motivation score. With the exceptions of these two variables, the first hypothesis was partially verified. The final verification was determined by stepwise regression analysis.

High school grade point average yielded the highest correlation value and became the most important variable in the prediction equation. The SCAT verbal score and the CGP verbal score showed an intercorrelation value of 0.6952; the SCAT quantitative score and the CGP mathematics score showed an intercorrelation value of 0.5977. As was shown in the stepwise regression analysis, the two variables in each set measured similar qualities, and therefore both variables were not needed in the prediction equation. The CGP scores became the most useful.

A fourth hypothesis in this study was tested by stepwise regression analysis of the independent variables with the dependent variable. This hypothesis was that a linear combination of independent variables could be developed into an equation that would be useful in predicting success in general biology. The stepwise regression analysis

produced the following equation: $Y_1 = 0.0067 + 0.3679(X_1) + 0.0179(X_2) + 0.0171(X_3) + 0.0115(X_4)$. This equation showed a correlation value of 0.5078 with the biology grade point average, and therefore accounted for 26 percent of the variance in the biology grade point average.

By using the formula $E = 100\,(1-\sqrt{1-R^2})$, it was determined that the index of forecasting efficiency (E) for this equation was approximately 14 percent. This meant that a prediction of biology grade point average produced by the equation would be 14% more accurate than a prediction made without the use of the equation.

Conclusions

To determine those factors that affect achievement in any area requires first discovering, through systematic observations and measurements, the basic regularities that function in that area. Still further, the discovery of the effects of the individual's own abilities, personality, and interests upon his achievement is required.

The results of this research into the relationship of selected variables to grade point average in general biology led to the following conclusions:

1. The single best predictor of success in general biology was the high school grade point average.
2. Other variables that correlated significantly with the biology grade average and, therefore, were useful in predicting success in general biology were the CGP biology interest score, the CGP mathematics score, and the CGP verbal score.
3. The biology grade point average would be predicted by using weighted values of the high school grade point average, the CGP biology interest score, the CGP mathematics score, and the CGP verbal score.

4. The independent variables--CGP motivation score, SCAT quantitative score, and SCAT verbal score were not useful in predicting the biology grade point average.

Tests of abilities alone were not the best instruments for the prediction of academic success in general biology. The acquisition of mental skill is cumulative and by the time the students were old enough to enter college, previous attainments, special abilities, and interests were beginning to assume a more important role than pure abilities in affecting achievement.

Recommendations For Further Research

The independent variables used in this study accounted for only twenty seven percent of the total variance in the biology grade point average. Therefore, much of the variance remained unexplained. There were probably other independent variables contributing to this variance. It is therefore recommended that further research be conducted to consider other academic and non-academic variables that affect the prediction of grade point average in general biology.

Even though this study of the impact of selected variables on the biology grade point average has answered many questions, others still remain to be answered. Furthermore, this study has stimulated new research questions. Some questions remaining to be answered are:

1. What was the relationship between the student's high school science background and his success in general biology?
2. What was the relationship between the student's socio-economic background and his success in biology?

New questions that have been stimulated by this study are:

1. Were there other intellectual dimensions that affected achievement in

general biology at Thomas Nelson Community College?

2. Was there a relationship between teaching strategies and success in general biology?

3. Did the college's academic environment effect success in general biology?

4. Did achievement in general biology produce effective changes in students in terms of intellectual growth?

5. How accurately did the grade point average measure knowledge of general biology?

It is recommended that further research be conducted to answer these specific questions.

With improvement in the prediction of grade point average in general biology, studies should be directed toward the development of expectancy tables (See Appendix) for use in counseling and advising. Teaching techniques for biology in the community college remains in need of investigation. In addition, further research is needed in other programs offered at the community college, if the community college is to define its niche in the world of higher education.

Raising the level of achievement of students requires more than increasing expenditures and time spent in the classroom. Gains need to be made in understanding the whole process of attaining skills and creativity.

How to predict academic achievement has not been fully resolved in higher education. Continued research is needed in the development of instruments and tests that will accurately assess a student's ability and potential. With improvements in testing, prediction, and teaching strategies will come improvements in the total educational process.

There are generally two approaches to analyzing achievement. One approach has to do with teaching methods that can be applied to everyone and consequently raise everyone's standards of performance. The other has to do with the reaction of individuals, according to their different capacities and interests, to the learning practices presented. Regardless, of whether advances in learning methods lead to teaching machines or other devices, an interaction will always remain between the teaching methods and the personality and motivation of the individual. These interactions must be continuously investigated.

BIBLIOGRAPHY

Arn, E. H. The prediction of academic success in ten selected science areas at the University of Washington (Doctoral dissertation, University of Washington, 1953). Dissertation Abstracts, 1953, 13, 495. (University Microfilms No. 5290)

Astin, A. W. Undergraduate achievement and institutional excellence. Science, 1968, 161, 661-668.

Astin, A. W. Predicting academic performance in college. New York: The Free Press, 1971.

Astin, A. W. & Panos, R. J. The educational and vocational development of college students. Washington: The American Council on Education, 1969.

Baird, L. L. The prediction of grades in occupational and academic curricula in two-year colleges. Journal of Educational Measurement, 1969, 6, 247-253.

Bennett, R. M. Student achievement in Biology 101 at Iowa State University (Doctoral dissertation, Iowa State University, 1970). Dissertation Abstracts International, 1971, 31, 4445A. (University Microfilms No. 71-7245)

Bennett, R. M. Effects of previous high school programs on achievement in college biology. Journal of College Science Teaching, 1975, 4, 242-244

Bloom, B. S. & Peters, F. R. Academic prediction scales. New York: The Free Press of Glencoe, Inc., 1961.

Bowers, J. The comparison of GPA regression equations for regularly admitted and disadvantaged freshmen at University of Illinois. Journal of Educational Measurement, 1970, 7, 219-225.

Buros, O. K. (Ed.). The seventh mental measurements yearbook (2 vols.). Highland Park: The Gryphon Press, 1972.

Cain, R. W. An analysis of the achievement of students in selected high school biology programs in relation to their mathematical aptitude and achievement (Doctoral dissertation, University of Texas, 1964). Dissertation Abstracts, 1965, 25, 5149-5150. (University Microfilm No. 65-4297)

Cattrell, R. B. & Butcher, H. J. The prediction of achievement and creativity. Indianapolis: The Bobbs-Merrill Company, Inc., 1968.

Coley, N. R. Prediction of success in general chemistry in a community college. Journal of Chemical Education, 1973, 50, 613-615.

Counselor's guide to CGP, A. Princeton: College Entrance Examination Board, 1972-73.

Craft, L. N. Predictive factors associated with final grades in a general biology course (Doctoral dissertation, University of Kentucky, 1972). Dissertation Abstracts International, 1972, 33, 2068A-2069A. (University Microfilms No. 72-39, 267)

Cropley, A. J. & Field, J. W. Achievement in science and intellectual style. Journal of Applied Psychology, 1969, 53, 132-135.

Cross, K. P. The junior college student. Princeton: Educational Testing Service, 1968.

Edwards, R. R. The prediction of success in remedial mathematics courses in the public community junior college. Journal of Educational Research, 1972, 66, 157-160.

Feldman, K. A. & Newcomb, T. M. Impact of college on students. San Francisco: Jossey-Bass Co., 1969.

Goldman, R. D. & Hudson, D. J. A multivariate analysis of academic

abilities and strategies for successful and unsuccessful college students in different major fields. Journal of Educational Psychology. 1973, 65, 364-370.

Good, C. V. (Ed.). Dictionary of education. New York: McGraw-Hill Book Company, 1973.

Groenke, G. R. The relationship of the entrance examination score to GPA of junior college freshmen when classified by age, sex, and curriculum (Doctoral dissertation, Arizona State University, 1969). Dissertation Abstracts International, 1970, 30, 3709A. (University Microfilm No. 70-4858)

Guilford, J. P. Fundamental statistics in psychology and education. New York: McGraw-Hill Book Company, 1965.

Guilford, J. P. and Franklin, B. Fundamental statistics in psychology and education. New York: McGraw-Hill Book Company, 1973.

Hayes, W. L. Statistics for the social sciences (2nd ed.). New York: Holt, Rinehart, Winston Inc., 1973.

Hopke, W. E. (Ed.). Dictionary of personnel and guidance terms. Chicago: J. G. Ferguson Publishing Co., 1968.

Institutional self-study. Hampton: Thomas Nelson Community College, 1974.

Jenkins, A. C. The relationship of certain measurable factors to academic success in freshman biology (Doctoral dissertation, New York University, 1966). Dissertation Abstracts, 1967, 27, 2279A-2280A.

Jenkins, N. L. An analysis of the relationship between academic achievement and selected criteria for junior college freshmen in terminal and transfer curricula (Doctoral dissertation, Purdue University, 1969). Dissertation Abstracts International, 1970, 30, 3728A-3729A. (University

Microfilms No. 70-3912).

Johnsten, T. D. Achievement in general college biology as related to high school background in science and mathematics. Journal of Research in Science Teaching, 1967, 5, 243-244.

Johnsten, T. D. A study of achievement in general college biology at the University of Nebraska as related to high school background in science and mathematics (Doctoral dissertation, University of Nebraska's Teachers College, 1967). Dissertation Abstracts, 1967, 28, 1989A.

Kerlinger, F. N. Foundations of behavioral research. New York: Holt, Rindhart, and Winston, Inc., 1964.

Kocherberger, R. C. A comparison of achievement in general biology in a community college with similar students in a university as related to their backgrounds (Doctoral dissertation, State University of New York, 1965). Dissertation Abstracts, 1966, 27, 417A-418A. (University Microfilms No. 65-8896).

Lavin, D. E. The prediction of academic performance. New York: Russell Sage Foundation, 1965.

McCall, W. P. Achievement in freshman biology at Middle Tennessee State University as related to selected cultural-environmental factors and students attitude (Doctoral dissertation, University of Iowa, 1972). Dissertation Abstracts International, 1972, 33, 1540A. (University Microfilm No. 72-26,715).

McKelpin, J. P. Some implications of the intellectual characteristics of freshmen entering a liberal arts college. Journal of Educational Measurement, 1965, 2, 161-166.

Nie, N., Bent, D. H., & Hull, H. C. Statistical package for the social

sciences. New York: McGraw-Hill, 1970.

Nicken, J. M. A comparison of accuracy of selected models for predicting academic performance of junior college transfer students. Journal of Educational Research, 1972, 66, 111-113.

Packwood, W. T. Motivation and junior college achievement. Journal of Educational Research, 1973, 66, 299.

Pemberton, W. A. Ability, values, and college achievement. Newark, Delaware: University of Delaware, 1963.

Perlberg, A. Predicting academic achievement of engineering and science college students. Journal of Educational Measurement, 1967, 4, 241-246.

Richards, J. M., Jr. & Lutz, S. W. Predicting student accomplishment in college from ACT assessment. Journal of Educational Measurement, 1968, 5, 17-19.

Rohlf, F. J. & Sokal, R. R. Statistical tables. San Francisco: W. H. Freeman and Co., 1969.

Roueche, J. E. A modest proposal: students can learn. San Francisco: Jossey-Bass Company, 1972.

Scott, R. L. The relationship between achievement in high school and success in college with reference to science and mathematics (Doctoral dissertation, University of Arkansas, 1966). Dissertation Abstracts, 1966, 27, 639A. (University Microfilms No. 66-7052)

Sills, D. L. (Ed.). International encyclopedia of the social sciences (Vol. 16). New York: The Macmillan Company and The Free Press, 1968.

Snedecor, G. W. Statistical methods. Ames: The Iowa State University Press, 1956.

Spurlin, M. D. A study of the relationship of sex, ability level, and biology preparation to achievement in freshman biology at Metropolitan

State College (Doctoral dissertation, University of Colorado, 1968). Dissertation Abstracts, 1968, 29, 1173A. (University Microfilm No. 68-14,237)

Stanley, J. C. & Porter, A. C. Correlation of scholastic aptitude test score with college grades for Negroes versus whites. Journal of Educational Measurements, 1967, 4, 199-215.

TNCC Annual Report, 1972-73. Hampton: Thomas Nelson Community College, 1973.

TNCC Bulletin, 1973-74. Hampton: Thomas Nelson Community College, 1974.

Thomas, C. L. & Stanley, J. C. Effectiveness of high school grades for predicting college grades of black students. Journal of Educational Measurements, 1969, 6, 203-215.

Williams, R. H. An assessment of the success of C-average high school graduates on Grand Rapids Junior College (Doctoral dissertation, Michigan State University, 1963). Dissertation Abstracts, 1964, 25, 317. (University Microfilm No. 64-7556).

Williams, T. R. A study of factors related to achievement in general college biology in the junior college (Doctoral dissertation, University of Iowa, 1972). Dissertation Abstracts International, 1972, 33, 205A.

Worell, L. Level of aspiration and academic success. Journal of Educational Psychology, 1959, 50, 47-54.

Worsley, R. L. An analysis of selected variables and the prediction of the educational achievement of junior college freshman (Doctoral dissertation, Arizona State University, 1969). Dissertation Abstracts International, 1970, 30, 3705A. (University Microfilms No. 70-4885)

Worthington, L. H. & Grant, C. W. Factors of academic success: A multivariate analysis. Journal of Educational Research, 1971, 65, 7.

APPENDIX

Expectancy Tables

TABLE 1

High School Grade Point Average and
General Biology Grade Point Average

High School GPA	Biology GPA A	B	C	D	Row Total
A	4 80*	1 20			5
B	9 30	15 50	4 14	1 5	29
C	11 13	34 41	29 35	8 11	82
D	2 8	2 8	17 71	3 13	24
Sample Total					140

* percent

TABLE 2

CGP Biology Interest Score and
General Biology Grade Point Average

Biology Interest Score	Biology GPA A	B	C	D	Row Total
0 - 11	2 5*	16 38	21 50	3 7	42
12 - 21	6 12	16 32	23 46	5 10	50
22 - 33	15 32	21 43	9 19	3 6	48
Sample Total					140

* percent

TABLE 3

CGP Verbal Score and General Biology
Grade Point Average

CGP Verbal Score	Biology GPA A	B	C	D	Row Total
57 or above (73%ile or above)	12 24*	23 46	12 24	3 6	50
47 - 56 (35%ile-71%ile)	9 15	16 27	30 50	5 8	60
46 or below (34% or below)	2 7	13 43	12 40	3 10	30
Sample Total					140

* percent

TABLE 4

CGP Mathematics Score and General Biology
Grade Point Average

CGP Math Score	Biology GPA A	B	C	D	Row Total
57 or above (71%ile or above)	15 26*	23 39	18 30	3 5	59
47 - 56 (40%ile-70%ile)	6 11	23 41	23 41	4 7	56
46 or below (39%ile or below)	2 8	6 24	13 52	4 16	25
Sample Total					140

* percent

ABSTRACT

A STUDY OF THE RELATIONSHIP OF SELECTED VARIABLES TO GRADE POINT AVERAGE IN GENERAL BIOLOGY AT THOMAS NELSON COMMUNITY COLLEGE

The purpose of this study was to determine the relationship of certain selected variables to grade point average in general biology at Thomas Nelson Community College. The independent variables tested were: high school grade point average, SCAT verbal and quantitative scores, and CGP mathematics, verbal, motivation and biology interest scores. The biology grade point average served as the dependent variable. Four hypotheses were tested. They were (1) that the independent variables would correlate positively with the dependent variable and, therefore, could be used to predict the dependent variable, (2) that the high school grade point average would be the most important variable, (3) that CGP verbal and mathematical scores would correlate highly and respectively with SCAT verbal and quantitative scores, (4) that a linear combination of independent variables could be developed into an equation that would be useful in predicting student success in general biology.

A random sample of 140 students was drawn from a list of 582 students who had taken biology during the academic years 1970 through 1973. The SPSS programs were used to conduct a Pearson product-moment correlation and a stepwise multiple regression analysis on the sample.

For the independent variables, the following correlation (r) values resulted: high school grade point average (X_1), 0.3958; CGP biology interest score (X_2), 0.2619; CGP mathematics score (X_3), 0.2906; CGP verbal score (X_4), 0.2421; SCAT quantitative score (X_5), 0.1544; CGP motivation score (X_6), 0.1059; and SCAT verbal score (X_7), 0.2160. All variables correlated significantly with the dependent variable except SCAT quantitative score and CGP motivation score. The SCAT verbal score and the CGP verbal score showed an intercorrelation value of 0.6952; the SCAT quantitative score and the CGP mathematical score showed an intercorrelation value of 0.5977. Stepwise multiple regression produced the following prediction equation: $Y_1 = .0067 + 0.3679(X_1) + 0.0179(X_2) + 0.0171(X_3) + 0.0115(X_4)$. This equation showed a multiple R value of 0.5078.

It was concluded that: (1) the best single predictor of success in general biology was the high school grade point average; (2) of the other variables that correlated with the biology grade point average, the CGP biology interest score, the CGP mathematics score, and the CGP verbal score were most useful in predicting success in general biology; (3) the biology grade point average would be predicted by using weighted values of the high school grade point average, the CGP biology interest score, the CGP mathematics score, and the CGP verbal score; and (4) the CGP motivation score, SCAT quantitative score, and SCAT verbal score were not useful in predicting biology grade point average. In general, tests of ability were not the best instruments for predicting success if used alone. Previous achievement and interest were also important.

VITA

Turner McKinley Spencer

Born April 19, 1935 Emporia, Virginia

B.S., Biology, Virginia State College, 1953-57

M.S., General Science, Virginia State College, 1961-65

M.A., Secondary Education, Hampton Institute, 1960-67

Virginia Institute of Marine Science (University of Virginia), 1969-70

Advanced Certificate, Higher Education Administration, College of William and Mary, 1971-72