# PREDICTING CHEMISTRY GRADES OF NON-FRESHMEN WITH THE ACT AT KANSAS STATE UNIVERSITY

by


LARRY MICHAEL COSTIGAN

B. S., Mankato State College, 1964


---

A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

College of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1966

Approved by:

Richard E. Owens

Major Professor

## ACKNOWLEDGMENTS

The writer is particularly grateful to his Major Professor Dr. Richard E. Owens, Assistant Professor of Education, Kansas State University, for his guidance and inspiration throughout the course of this study.

The writer is indebted to Mr. James M. Foster for his help, ideas, and encouragement. He particularly wishes to thank Dr. Jack L. Lambert and Dr. Adrian H. Daane for their support during the course of his studies in graduate school.

The author wishes to thank his wife, Lois, for typing the preliminary, the revised, and the final copies of this thesis and to express his gratitude for her patience, understanding and support during the course of his studies.

## TABLE OF CONTENTS

LIST OF TABLES

# CHAPTER I

## INTRODUCTION

<u>General</u> <u>Background</u>. Using the American College Testing Program (ACT) test scores as predictors of success is nothing new at Kansas State University. The Student Counseling Center has been guiding the freshmen students by giving them a probability statement as to their chances of earning a passing mark in a given course. These probability statements were derived from the student's ACT test scores and may influence a student enough that he may decide to wait a year before enrolling in a class where his chance of success is rather poor. By waiting a year or two before enrolling, the student may become adjusted to college life and he may settle down with good study habits, therefore, increasing his chance of success in a class where he was predicted to have a poor chance of success. Due to these facts and others, many non-freshmen are enrolled in freshmen classes each year. One of these classes is the first semester chemistry course, Chemistry I.

There has never been a study conducted at Kansas State University in which ACT test scores have been used to predict the success of non-freshmen in freshmen courses. It could be possible that the student who waits a year or two before enrolling in Chemistry I may not have the same chance of success that he had as a freshmen enrolling in Chemistry I.

Statement of the Problem. The Department of Chemistry and the Student Counseling Center at Kansas State University have indicated an interest in the prediction of a course grade for non-freshmen enrolled in Chemistry I. Chemistry I is a freshmen general chemistry course that is frequently by-passed by the student in order that another class may be taken; or because of its difficulty, it is put off until later in his academic life. About 15 percent of the over 800 students who take Chemistry I each fall are non-freshmen. The failure and drop out percentage for all the students enrolled in Chemistry I is about 20 percent each fall semester.

It was felt that an investigation of the ACT test scores for the non-freshmen could be of great service to the Student Counseling Center, the Department of Chemistry, and to the students at Kansas State University. Perhaps the overall guidance of students could be improved and the percentage of students failing or withdrawing from Chemistry I could be decreased. Also as an introductory investigation of non-freshmen ACT test scores, this study may indicate the need for additional predictive studies of non-freshmen students in freshmen courses at Kansas State University.

This study was made to investigate the ability of ACT test scores to predict the success of non-freshmen enrolled in Chemistry I at Kansas State University. As a major goal, it was the writer's intent to increase the effectiveness of the ACT as a predictor of success at Kansas State University for non-freshmen enrolled in Chemistry I and this would improve the guidance and counseling of the entering students.

Importance of the Study. It has already been established that the ACT test scores are good predictors of success for freshmen at Kansas State University[1] and through this study of the predictive ability of the four ACT test scores for the non-freshmen enrolled in Chemistry I, it was hoped that the effectiveness of the ACT as a counseling tool might be improved. The more effective the prediction of student success can be made, the better will be the college success of many students who depend on the counseling and guidance that they receive as they enter college.

The overall importance of this study lies in the guidance and counseling received by the entering student. In order to give increasingly better service to these students, better methods, tests, and predictors must be found and developed.

Hypotheses. These four hypotheses were tested:

1. There will be no significant difference in the academic success of the freshmen and non-freshmen in Chemistry I.

---

[1] James M. Foster and David G. Danskin, "American College Test (ACT) Tested Three Ways," Personnel and Guidance Journal, 43:904-9, May, 1965.

2. There will be no significant difference in the means of the four ACT test scores of the freshmen and non-freshmen in Chemistry I.

3. The ACT test predictors will be the same for the non-freshmen as they were for the freshmen enrolled in Chemistry I.

4. The ACT test predictors for non-freshmen success in Chemistry I will be no better (that is, will carry no more weight) than those predictors used to predict the success of freshmen in Chemistry I.

Definition of Terms Used. The following list of terms was defined for clarification of the problem.

1. Chemistry I - This is a freshmen chemistry course, described in the University catalog as the "Beginning of the study of general chemistry. Three hours of rec. and six hours of lab. a week."[1] It is the first of two courses taken by those students whose curriculum calls for a full year of general chemistry.

2. Non-freshmen - This term, as used in this study, refers to the student who is not a freshman. He may be classified as a sophomore, a junior, or a senior.

---

[1]Kansas State University, Kansas State University Bulletin: General Catalog 1964-1966 (Manhattan, Kansas: Kansas State University of Agriculture and Applied Science, 1964), p. 127.

3. Variable - "A quantity which can take on any of the numbers of some set."[1]

4. Correlation Coefficient (r) - "A measure of the degree of relationship, or 'going-togetherness', between two sets of measures for the same group of individuals."[2] A correlation coefficient can have a value ranging from +1 for perfect positive correlation or relationship to a -1 for perfect negative correlation or relationship, with a value of 0 for a complete lack of relationship.

5. t-test - "A test of the hypothesis that the true means are equal."[3]

6. Standard Deviation - "The square root of the mean of the squares of the deviations of scores from the mean of the scores."[4] "A measure of the variability of dispersion of a set of scores. The more the scores cluster around the mean, the smaller the standard deviation."[5]

---

[1]Glenn James and Robert C. James, Mathematics Dictionary (New York: D. Van Nostrand Company, Inc., 1962), p. 412.

[2]Roger T. Lennon, "A Glossary of 100 Measurement Terms," Test Service Notebook, No. 13, p. 2.

[3]E. F. Lindquist, Statistical Analysis in Educational Research (Boston: Houghton Mifflin Company, 1940), p. 56.

[4]Arthur S. Otis, Statistical Method in Educational Measurement (New York: World Book Company, 1925), p. 92.

[5]Lennon, op. cit., p. 5.

7. Standard Error of Estimate -

"An estimate of the magnitude of the 'error of measurement' in a score, that is, the amount by which an obtained score differs from a hypothetical true score. The standard error is an amount such that in about two-thirds of the cases the obtained score would not differ by more than one standard error from the true score. The larger standard error of a score, the less reliable the measure."[1]

8. Variance - This term "pertains to the amount of spread or dispersion of measurements around the mean, but it is measured by the square of the standard deviation."[2]

9. Regression Equation - Also called a prediction equation is used "to predict the most likely measurement in one variable from the known measurement in another."[3]

10. Multiple Regression Equation - A multiple prediction equation that is used to predict the most likely measurement in one variable from the known measurements of several variables.

11. Multiple Correlation Coefficient (R) -

"The amount of correlation between a dependent variable and two or more others simultaneously. The multiple coefficient of correlation indicates the strength of relationship between one variable and two or more others taken simultaneously."[4]

12. Beta Coefficients - These coefficients are used to calculate the b coefficients (score weights) used in the multiple

---

[1] Ibid.

[2] J. P. Guilford, Fundamental Statistics in Psychology and Education (New York: McGraw-Hill Book Company, Inc., 1942), p. 146.

[3] Ibid., p. 211.

[4] Ibid., p. 256.

regression equation. The beta coefficients (beta weights) are calculated by using the simple correlation coefficients between the variables that will be used in the multiple regression equation. "The beta weights give the contribution of the various independent variables in the regression equation to the dependent variable (the criterion)."[1]

13. b Coefficients - "The partial regression coefficients (b's) in terms of the scores of the test."[2] The b coefficients are also called score weights in the ordinary regression equation.

14. a Coefficient - This is also called the y-intercept. It is a constant that is calculated from the data and used in all regression equations. It is calculated from the means of the variables and the b coefficients of these variables.

15. F-test - "The ratio of 'between' variance to 'within' variance."[3] The principle of the "F-test is to use the ratio of the between variance to the within variance as a basis of deciding whether the sets could have arisen by random sampling from the same population."[4]

---

[1]Henry E. Garrett, Statistics In Psychology and Education (New York: Longmans, Green and Co., 1939), p. 454.

[2]*Ibid*.

[3]Guilford, *op. cit.*, p. 147.

[4]*Ibid*.

16. ACT Standard Scores -

"On each of the four tests in the ACT battery, the total number of correct responses yield a raw score. The Program uses a scale from 1 (low) to 36 (high) to convert raw scores into standard scores. This scale is the same for the four tests."[1] These standard scores can be converted into percentile ranks.

The ACT Program. The American College Testing Program (ACT), Inc., is a federation of state programs founded in 1959 and chartered under the laws of the state of Iowa as an independent, non-profit corporation. Since its beginning, the growth rate of this Program has been very rapid. The ACT battery of tests consists of four subtests - one each in English, Mathematics, Social Studies, and Natural Sciences. "These tests were developed to measure as directly as possible the abilities the student will have to apply in his college course work."[2]

The four-part test is taken by many college-bound students as part of the entrance requirements to colleges and universities. Kansas State University requires that all entering freshmen take the ACT battery of tests. The ACT tests were made available to non-Iowa schools so recently that there has not been time for research to appear, and consequently very little data are to be found in professional journals on the ACT Program.

---

[1]American College Testing Program, Inc., Using ACT on the Campus (Iowa City, Iowa: American College Testing Program, Inc., 1965-66), p. 8.

[2]Ibid., p. 5.

The ACT battery of tests is given every November and at three other times during the year, mainly to seniors who are planning to go on to college. To account for this difference in the time at which the ACT battery of tests can be taken by the student, a growth curve was developed by the American College Testing Program.[1] The growth curve was designed to make all of the test scores show the score that a student would have received if he had taken the tests at a different date. If no adjustments were made, it would mean that students tested at a later date would have a slight advantage over the students tested earlier.

---

[1]American College Testing Program, Inc., ACT, Technical Report (1965 edition; Iowa City, Iowa: American College Testing Program, Inc., 1965), p. 10.

## CHAPTER II

## REVIEW OF LITERATURE

Guidance and the Prognosis of Success. The solution to the problem of the prediction of achievement is still in a preliminary stage. It was not until after the beginning of the twentieth century that much statistical work was done in the field of prognostic testing for achievement in college. Many items are generally conceded to be important in determining success in any field of endeavor. Some of these factors are intelligence, attitudes, personality traits, and interests. Numerous studies have been conducted using the above factors as the criteria for prediction of college success.

University counseling centers or clinics have, at times, justified their existence with claims that counseling can aid the academic process by freeing students from their problems. Several studies have shown that counseled students tend to earn better marks than noncounseled students.[1] Others have found better per-

---

[1]E. B. Blackwell, "An Evaluation of the Immediate Effectiveness of the Testing and Guidance Bureau of the University of Texas," Journal of Educational Research, 40:302-8, 1946; B. A. Kirchheimer, D. W. Axelrod, G. X. Hickerson, Jr., "An Objective Evaluation of Counseling," Journal of Applied Psychology, 33:249-57, 1949; J. W. Rothney and B. A. Roens, Guidance of American Youth (Cambridge, Massachusetts: Harvard University Press, 1950); J. R. Ward and L. E. Tyler, "A Preliminary Report of an Evaluation of the Veterans Administration Counseling Service in the University of Oregon," American Psychology, 2:416, 1947; and E. G. Williamson and E. S. Bordin, "Evaluating Counseling by Means of a Control Group Experiment," School and Society, 52:434-40, 1940.

formance among counseled students as measured by the criterion of graduation from college.[1]

Despite generally encouraging findings in counseling evaluation from the above studies, the values of counseling are not fully verified. Wrenn in a review of counseling outcome studies commented that "The critical observer is led to the conclusion that there is no 'proof' that counseling actually makes any difference."[2] Griffiths and Bigge,[3] in 1963, concluded that counselors can help teachers better determine the needs, abilities, and interests of students and that they should carry on research to adequately determine student aptitudes.

The findings of A. E. Ivery[4] of Bucknell University in 1962 suggest that counseling as conducted in a university counseling center can be beneficial on the academic scene. Long-term counseling of students was more likely to improve their marks than short-term counseling.

---

[1] M. Faries, "Short-term Counseling at the College Level," Journal of Counseling Psychology, 2:182-4, 1955; J. R. Toven, "Appraising a Counseling Program at the College Level," Occupations, 23:459-66, 1945; G. H. Watson, "An Evaluation of Counseling with College Students," Journal of Counseling Psychology, 8:99-104, 1940.

[2] C. G. Wrenn, "Counseling Theory," Encyclopedia of Educational Research (New York: The Macmillan Company, 1960), p. 350.

[3] I. A. Griffiths and M. L. Bigge, "Educational Guidance and Quality Education," Education, 83:556-9, May, 1963.

[4] Allen E. Ivery, "The Academic Performance of Students Counseled at a University Counseling Service," Journal of Counseling Psychology, 9:347-52, 1962.

C. H. Miller[1] stressed that testing is one of the most important tools of the counseling process. He considered tests as one of a number of tools useful in assessing a pupil's interests and abilities. "Well-considered testing programs, including competent interpretation of test results, can contribute to identification of the able."[2]

High school grades are frequently used as predictive indices, and generally they have been found to provide as accurate a base for predicting college scholarships as any other single criterion. Several different studies have substantiated this fact over the past fifty years.[3] These studies have found the best single predictor of college success was the average high school mark or the rank in the high school class. Byrns and Henmon[4] concluded that the lack of ability to do successful college work could be determined at an even earlier phase of the

---

[1]C. H. Miller, "Guidance and Programs of Testing," School Life, 42:18-20, September, 1959.

[2]Ibid., p. 20.

[3]C. T. Leaf, "Prediction of College Marks," Journal of Experimental Education, 8:303-7, March, 1940; J. R. Hills and others, "Admissions and Guidance Research in the University System of Georgia," Personnel and Guidance Journal, 39:452-7, February, 1961; and N. S. Endler and D. Steinberg, "Prediction of Academic Achievement at the University Level," Personnel and Guidance Journal, 41:694-9, April, 1963.

[4]R. Byrns and V. A. C. Henmon, "Long-range Prediction of College Achievement," School and Society, 41:877-80, June, 1935.

student's education; that is, the tenth grade. J. W. Lewis[1] in 1964 at the State University of Iowa found that high school rank was also a significant predictor of sophomore grade point averages and was not significant at predicting the grade point average for juniors.

Many different methods and procedures have been used to predict college achievement. They are far too numerous to mention all of them. In three separate studies by Hackett,[2] Hake,[3] and Doleys,[4] three different criteria were considered for predictive value. They were the Minnesota Multiphasic Personality Inventory (M.M.P.I.), Kuder Preference Record, and student self-estimates of college grades, respectively. In each case it was concluded that future academic achievement could be predicted.

Multiple differential and multiple absolute prediction have been repeatedly demonstrated as some of the most accurate methods of prediction. In these methods a combination of several indices is used to predict success rather than any single index

---

[1] J. W. Lewis, "Pre-college Variables as Predictors of Freshman, Sophomore, and Junior Achievement," Educational and Psychological Measurement, 24:353-6, Summer, 1964.

[2] Herbert R. Hackett, "Use of M.M.P.I. Items to Predict College Achievement," Personnel and Guidance Journal, 39:215-7, November, 1960.

[3] Dorothy Terry Hake and C. H. Ruedisili, "Predicting Subject Grades of Liberal Arts Freshmen with the Kuder Preference Record," Journal of Applied Psychology, 33:553-8, December, 1949.

[4] E. J. Doleys and G. A. Renzaglia, "Accuracy of Student Prediction of College Grades," Personnel and Guidance Journal, 41:528-30, February, 1963.

alone. In a summary by Durflinger,[1] the average multiple correlation coefficient was found to be about 0.65 which was higher than most zero order coefficients for a single index.

In a prediction study by Angell at the University of Washington he concluded that multiple differential prediction "may very well be one of the really major advances of truly practical value in the areas of academic prognosis and academic counseling."[2]

In two separate studies using the College Qualification Tests Total score (CQT), it was agreed that the multiple regression technique will predict more effectively and efficiently than the more simple methods of prediction. They all concluded that even though the multiple regression technique is burdensome and time-consuming, it appears to be the most promising for purposes of differential guidance.[3]

In an early review of prediction, the Review of Educational Research sums up the importance of prediction studies by saying,

---

[1] G. W. Durflinger, "The Prediction of College Success," Education Digest, 9:30-1, December, 1943.

[2] M. A. Angell, "Multiple Differential Prediction: significance for college academic counseling," Personnel and Guidance Journal, 37:423, February, 1959.

[3] A. G. Wesman and G. K. Bennett, "Multiple Regression vs. Simple Addition of Scores in Prediction of College Grades," Educational and Psychological Measurement, 19:243-6, Summer, 1959; B. A. Kirk, R. W. Cummings, and L. D. Goodstein, "The College Qualification Tests and Differential Guidance of University Freshmen," Personnel and Guidance Journal, 42:47-51, September, 1963.

> "The most important studies bearing upon educational counseling dealt with the prediction of success in college. While there was general agreement among the investigators that college grades could be predicted with sufficient reliability to make the predictions of practical value, there was marked disagreement as to the single measures that gave the best prediction."[1]

Chemistry and the Prognosis of Success. While searching the literature of the last half century dealing with the prediction of success in college chemistry, one cannot but become aware of the diverse opinions on the question of the value of high school chemistry and many other criterion to the student taking college chemistry. Many studies have attempted to determine what single criterion or what combination of criteria were the best predictors of future success in college chemistry.

The effect of high school chemistry on college chemistry success has been studied by many investigators. In 1930, Scofield[2] concluded that good high school mathematics grades, when combined with good high school chemistry grades, are better than good placement examination grades for picking good students.

---

[1] A. J. Brumbraugh, Review of Educational Research, 6:202, April, 1936.

[2] M. B. Scofield, "Further Studies on Sectioning in General Chemistry," Journal of Chemical Education, 7:117-26, January, 1930.

Others[1] have shown that, in general, high school chemistry is advantageous to students who enroll in beginning college chemistry. While West[2] concluded that factors such as intelligence are more important than specific high school training.

Several studies have used established tests, or developed their own tests, for the prediction of college success in chemistry. In separate studies, Clark[3] and Cornog and Stoddard[4] found that the Iowa Chemistry Training Examination and the Iowa Chemistry Aptitude Examination are capable of predicting, with reason-

---

[1]Merle E. Betts, "High School Chemistry for College Preparation," The Agriculture Education Magazine, 25:233, April, 1953; P. E. Clark, "The Effect of High School Chemistry on Achievement in Beginning College Chemistry," Journal of Chemical Education, 15:285-9, June, 1938; E. H. Hadley, R. A. Scott, and K. A. Van Lente, "The Relation of High School Preparation to College Chemistry Grades," Journal of Chemical Education, 30:311-3, June, 1953; Ira D. Garard and Thalia B. Gates, "High School Chemistry and Student's Record in College Chemistry," Journal of Chemical Education, 6:514-7, March, 1929; G. A. Herrmann, "An Analysis of Freshmen College Chemistry Grades with Reference to Previous Study of Chemistry," Journal of Chemical Education, 8:1376-85, July, 1931; Herbert A. Meyer, "What Value High School Chemistry to the Freshman College Chemistry Student?" School Science and Mathematics, 62:410-4, June, 1962; and L. E. Steiner, "Contribution of High School Chemistry Toward Success in the College Chemistry Course," Journal of Chemical Education, 9:530-7, March, 1932.

[2]G. A. West, "Influence of High School Science on Grades in College Chemistry," School Science and Mathematics, 32:911-3, November, 1932.

[3]Clark, loc. cit.

[4]Jacob Cornog and George D. Stoddard, "Predicting Performance in Chemistry," Journal of Chemical Education, 2:701-8, August, 1925.

able accuracy, the performance in college freshmen chemistry. The correlation coefficients in these studies ranged from 0.44 to 0.79, which indicates capable prediction. The two examinations were studied together and individually with the combined test scores being the best predictor of college chemistry success.

In a study conducted in 1934, using the same two Iowa examinations, Reusser, Brinegar, and Frank concluded that "Neither the Chemistry Aptitude test nor the Chemistry Training test yields a sufficiently high correlation with chemistry marks to make a very valuable basis for prediction of success in first-year chemistry."[1]

In two other studies, using the Iowa Chemistry Examinations in different ways, Hovey and Krohn[2] developed the Toledo Chemistry Placement Examination (T.C.P.E.). They used this test to predict with satisfactory accuracy which students should be denied admission to a college level general chemistry course. MacPhail and Foster[3] used the Iowa test in combination with four other indices to arrive at a multiple correlation coefficient of 0.638

---

[1]W. C. Reusser, V. Brinegar, and G. Frank, "Predicting Success in First-Year College Chemistry," School and Society, 40:200, August, 1934.

[2]Nelson W. Hoveg and Albertine Krohn, "An Evaluation of the Toledo Chemistry Placement Examination," Journal of Chemical Education, 40:370-2, July, 1963.

[3]A. H. MacPhail and L. S. Foster, "Placement in Beginning Chemistry Courses at Brown University," Journal of Chemical Education, 16:270-3, June, 1939.

in the placement of students in one of three freshmen chemistry courses at Brown University.

Another study found that an intelligence test score and the rank in high-school class were equally good criteria for predicting achievement in college freshmen chemistry.[1] Jackson[2] at Michigan State College found a correlation coefficient of 0.546 between the student's grade in chemistry and two tests given to the students.

ACT and the Prognosis of Success. Very little data on the ACT Program has been published because of the Program's brief existence on the market as a nationwide test battery. The American College Testing Program, Inc. has been conducting extensive research on its battery of four tests and the Program publishes a technical[3] report on its findings each year. The ACT Program has developed national norms for each of the four tests, and the reliability and the content and predictive validity have been thoroughly tested for each one of the four tests in the ACT battery.

---

[1]W. J. Oakley, "A Study of the Relationship Between Certain Factors and Achievement in College Freshmen Chemistry," Louisiana State University Bulletin, 32:45-6, 1939.

[2]Robert Jackson, "The Selection of Students for Freshmen Chemistry by Means of Discriminant Functions," Journal of Experimental Education, 18:209-14, March, 1950.

[3]American College Testing Program, Inc., ACT, Technical Report, 1965 (Iowa City, Iowa: Research and Development Division, American College Testing Program, Inc., 1965).

The writer believes that a great amount of unpublished work has been done at the local level and that in the very near future much more research on the ACT Program will be published in professional journals. The following is a brief summary of the research that has been published which was related in some way to the problem at hand.

Foster and Danskin, of the Kansas State University Student Counseling Center, have conducted several studies of the ACT scores using Kansas State University freshmen. In 1962, they studied the ACT scores as predictors of grades in several courses typically taken by freshmen and found that by using a combination of predictors, the ACT was a good predictor of academic performance.[1]

Again, in 1965, they published a paper in which they investigated relationships between the following:

1. First semester grade-point averages and ACT scores alone and in combination with high school rank.

2. Estimated grade-point averages and obtained grade point averages.

3. ACT scores and grades in nine freshmen courses. They found that the ACT scores can be used to predict (with reasonable

---

[1]James M. Foster, "Predicting Course Grades with the ACT" (Manhattan, Kansas: Student Counseling Center, Kansas State University, 1962). (Mimeographed.)

error) first semester grade-point averages and grades for freshman courses.[1]

Foster[2] used the ACT scores to obtain prediction equations for estimating grade-point averages of students enrolled in several different colleges at Kansas State University. Again, he reported that the ACT was an effective predictor of academic success at Kansas State University.

Funches,[3] in a study at about the same time at Jackson State College, investigated the relationship between ACT scores and the year-end grade-point average. His results agreed with those at Kansas State University, as he reported that the ACT is "a reliable factor if used to predict first-year success."[4]

Peters and Plog,[5] in a study at Ohio State University, in which the ACT tests were compared with their own University tests

---

[1]James M. Foster and David G. Danskin, "American College Test (ACT) Tested Three Ways," Personnel and Guidance Journal, 43:904-9, May, 1965.

[2]James M. Foster, "Further Investigation of the ACT as a Predictor of Academic Success at K. S. U.," (Manhattan, Kansas: Student Counseling Center, Kansas State University, 1962). (Mimeographed.)

[3]De Lars Funches, "A Correlation Between the ACT Scores and the Grade Point Averages of Freshmen at Jackson State College," College and University, 40:321-6, Spring, 1965.

[4]*Ibid*., p. 326.

[5]F. R. Peters and E. L. Plog, "Effectiveness of the ACT for Selection and Placement at the Ohio State University," Educational Research Bulletin, 40:232-41+252, December, 1961.

in selection and placement, reported the ACT English test to be inferior to their own Ohio State University English test. The reason for this inferiority, according to the writers, was that their test was constructed by the English faculty at Ohio State University who were intimately acquainted with the students, staff, and courses at the University. They also found that the other ACT tests were not inferior to their own homemade tests and could be used with no less error in selection or placement of its students.

In an examination of ACT predictive abilities, Tiedeman[1] reported that in 136 colleges the median of the multiple correlation coefficients of the ACT tests with the overall college freshman grade-point averages proved to be 0.53. This indicates that the ACT test scores are good estimators of academic performance at many different colleges besides Kansas State University.

During a three-year study at Iowa State University, it was found that the ACT tests were good measures of general scholastic aptitude. Brown and Wolins,[2] the investigators, found that the ACT was not as accurate as high school grades in measuring general scholastic aptitude, but very few tests are. It was

---

[1]D. V. Tiedeman, "American College Testing Program Examination," Personnel and Guidance Journal, 41:814-9, May, 1963.

[2]F. G. Brown and L. Wolins, "Empirical Evaluation of the American College Testing Program," Personnel and Guidance Journal, 43:451-6, January, 1965.

also reported that the ACT had no incremental validity for predicting grade-point averages after the first quarter in the University.

Runde,[1] while at the Chicago City Junior College, used the Standard ACT scores or a simple addition of two of the Standard ACT test scores to place entering students. In order to be placed in an English Honors class the entering student had to have a score between 44 and 60 on the ACT English and ACT Social Studies tests when the two test scores were added together. He indicated that this method worked very well after the third revision.

Staton[2] in a study designed to discover the relationships that exist between information available on prospective students and their academic success during their first semester at the University of Oklahoma found "that the ACT scores were not adequate predictors of academic success for purposes of prediction of the different degrees of success."[3]

---

[1]Robert M. Runde, "Freshman Placement Uses of a Nationwide Test," College and University, 41:190-8, Winter, 1966.

[2]Jon Tom Staton, "The Relationship of Selected Factors to Academic Success for Beginning Freshmen," Dissertation Abstracts, 23:1564, 1962.

[3]Ibid.

In two other separate studies, Burns[1] and Lester[2] reported that the ACT tests appeared to predict academic achievement and that other variables, predictors or combinations of predictors will also predict academic success.

The preceding review of the literature should help put the present study in its proper perspective. The above studies have generally shown that there is a definite positive correlation between the ACT tests and the success of college freshmen. The present study should help to determine whether or not the prediction of academic success of non-freshmen is feasible.

---

[1]Robert Leo Burns, "An Investigation of the Value of the American College Testing Program, the Scholastic Aptitude Test and the Purdue Placement Tests as Predictors of Academic Success of Purdue University Freshmen," Dissertation Abstracts, 24:1477, 1963.

[2]Robert A. Lester, "The Relationship of SVIB and ACT Scores to Differential Academic Achievement," Dissertation Abstracts, 24:1076, 1963.

## CHAPTER III

## METHODS AND PROCEDURES

Selection of Subjects. The freshmen subjects used in this study were the 1964 Chemistry I class and the non-freshmen subjects were extracted from the Chemistry I class of 1965. The data for this study came from the university records of each student and from the records kept by the Student Counseling Center at Kansas State University.

The freshmen subjects consisted of 633 students enrolled in Chemistry I for the fall semester of 1964. Most of these freshmen had taken the ACT battery of tests while in high school. Those that had not taken the ACT battery in high school took it either during pre-enrollment or when they enrolled in the fall. Those students who took the ACT battery at the later dates had their scores adjusted by a growth curve.[1] This growth curve, developed by the American College Testing Program, Inc., tends to lessen the difference due to the increase in academic potential.

The non-freshmen subjects consisted of 89 students from the 1965 Chemistry I class. The writer would have preferred a sample from the 1964 class, but so few of the non-freshmen in

---

[1]American College Testing Program, Inc., ACT, Technical Report (1965 edition; Iowa City, Iowa: American College Testing Program, Inc., 1965), p. 10.

the 1964 class had taken the ACT battery of tests, that a predictive study such as this would have been impractical. By using the 1965 class, most of these students in this study were 1964 high school graduates. Only a small percentage of the non-freshmen were upperclassmen. This sample of 89 non-freshmen does not include all of the non-freshmen enrolled in the 1965 Chemistry I class, but these were the only students for whom ACT test scores were available. Their ACT test scores had also been adjusted by the growth curve.

These two groups of subjects were not divided by curriculum or sex. They were simply those students whose ACT test scores were available. Most of the students enrolled in Chemistry I are male (about 85 percent).

<u>Procedures</u>. The procedures used in this investigation were to:

1. Compare the Chemistry I grades of freshmen and non-freshmen, to see if there was a significant difference in the success of each group.
2. Compare the ACT test scores of the freshmen and non-freshmen to see if there was a significant difference between the ACT tests of each group in Chemistry I.
3. Establish which ACT tests are the best predictors of success for non-freshmen taking Chemistry I.
4. Investigate the success of these ACT tests in

predicting non-freshmen grades in Chemistry I.

5. Compare the ACT test predictors established in this study as predicting Chemistry I for both the freshmen and non-freshmen.

Methods. Four different hypotheses were set forth in this study. In attempting to prove or disprove these hypotheses, the writer used the following methods:

1. t-tests
2. F-tests
3. Simple correlation coefficients
4. Multiple correlation coefficients
5. Multiple regression equations
6. Standard deviation
7. Standard error of estimate

The first two hypotheses, 1 and 2, were studied by using the t-test. This test determines whether or not there is a significant difference between the means of the different variables; in this case, the four ACT test scores and the Chemistry I grades for the two sample groups. Therefore, the t was calculated for each of the four variables in the study and the Chemistry I grades. The t's in this study were computed by using the following formula:[1]

---

[1]Paul Blommers and E. F. Lindquist, Elementary Statistical Methods in Psychology and Education (Boston: Houghton Mifflin Company, 1960), p. 348.

$$t = \frac{\overline{X_1} - \overline{X_2}}{\sqrt{\frac{n_1 s_1^2 + n_2 s_2^2}{n_1 + n_2 - 2} \left( \frac{1}{n_1} + \frac{1}{n_2} \right)}}$$

where $\overline{X}$ is the mean of the variables, n is the size of the population sample, and $s^2$ is the variance or the square of the standard deviation.

The standard deviations for the considered variables were calculated by the following formula:[1]

$$s = \sqrt{\frac{\Sigma x_i^2}{N}} \quad (x_i = Xi - \overline{X})$$

where $x_i^2$ is the square of the difference between the sum of the squares of the scores and the square of the sum of the scores and N is the population.

The variance or the square of the standard deviation used in calculating the t was computed by the following equation:[2]

$$s^2 = \frac{\Sigma x_i^2}{N}$$

where $s^2$ is simply the square of the standard deviation.

---

[1] Ibid., p. 140.

[2] Ibid., p. 141.

In order that hypotheses 3 and 4 could be fully studied, many different methods and computations were used. The most common method of showing a relationship between two or more variables is the coefficient of correlation. The Pearson product-moment correlation coefficients in this study were computed by using the following equation:[1]

$$r_{xy} = \frac{N\Sigma XY - (\Sigma X)\ (\Sigma Y)}{\sqrt{\left[N\Sigma X^2 - (\Sigma X)^2\right]\left[N\Sigma Y^2 - (\Sigma Y)^2\right]}}$$

where N is the population size and X and Y are the considered variables.

The multiple regression technique was used to develop the prediction equation for the non-freshmen enrolled in Chemistry I. The predictor data on the students, both freshmen and non-freshmen, were the four ACT test scores [English ($X_1$), Mathematics ($X_2$), Social Studies ($X_3$), and Natural Sciences ($X_4$)]. The data were processed by the IBM 1620 computor on a program developed by Efroymsen[2] and adapted to the IBM 1620 by the Department of Statistics at Kansas State University.

The data received from the above program was:

1. The mean and its standard deviations for all five

---

[1] Guilford, op. cit., p. 204.

[2] M. A. Efroymsen, Mathematical Methods For Digital Computors (Edited by A. Ralston and H. Wilf; New York: John Wiley and Sons, Inc., 1950), Chapter 17.

variables.

2. Multiple correlation coefficient (R) for the best combination of variables along with an R for the combination of all four variables to the criterion (Chemistry I grades).
3. Standard error of estimate of the predicted Chemistry I grades.
4. Beta coefficients for the multiple regression equations.
5. b coefficients for the multiple regression equations.
6. y-intercepts or a constant for the multiple regression equations.
7. F ratios for all four of the ACT variables.

From the above data received from the computor the writer formulated multiple regression equations. From these multiple regression equations, predicted Chemistry I grades can be calculated. The following equation is an example of one of the formulated multiple regression equations used in this study:

$$X_6 = b_2 X_2 + b_4 X_4 + b_3 X_3 + \text{y-intercept}$$

where $X_6$ is the predicted grade, $X_2$, $X_4$ and $X_3$ are the standard ACT scores for the different ACT tests, the b's are coefficients calculated from the beta coefficients and the y-intercept is a constant.

# CHAPTER IV

## RESULTS

The four ACT test scores [English ($X_1$), Mathematics ($X_2$), Social Studies ($X_3$), and Natural Sciences ($X_4$)] were the variables used in this study to establish a prediction equation that could be used to predict non-freshmen grades in Chemistry I. The t-statistics used in this study to test whether hypotheses (1) and (2) were to be rejected or accepted and the F ratios used to indicate which variables contributed significantly to the prediction of Chemistry I grades in hypotheses (3) and (4) were designated to be significant only if at the 0.01 level of confidence. This level of confidence was arbitrarily decided upon as being essential in this study.

The first null hypothesis (1), that there will be no significant difference in academic success between freshmen and non-freshmen in Chemistry I, was tested by running a t-test on the means of the two groups. It was found that this hypothesis must be accepted.

Table I indicates the means, standard deviation of the means, and the calculated t for Chemistry I grades and the ACT variables. The Chemistry I grades are based on a four-point system, where A=4, B=3, C=2, D=1, F=0. In looking at the means of the two groups, freshmen and non-freshmen, the freshmen do have a higher grade point average than do the non-freshmen.

TABLE I

COMPARISON OF THE ACT PREDICTOR VARIABLES AND CHEMISTRY I GRADES

| ACT Predictor Variables | Freshmen N = 633 | | Non-freshmen N = 89 | | t |
|---|---|---|---|---|---|
| | Mean | Standard Deviation | Mean | Standard Deviation | |
| English ($X_1$) | 20.295 | 4.186 | 18.550 | 4.124 | 3.683* |
| Mathematics ($X_2$) | 25.720 | 4.794 | 22.607 | 5.698 | 5.588* |
| Social Studies ($X_3$) | 23.393 | 5.094 | 21.169 | 5.334 | 3.829* |
| Natural Sciences ($X_4$) | 25.150 | 4.355 | 22.146 | 4.882 | 6.299* |
| Chemistry I Grades | 2.269** | 1.258 | 2.045** | 1.289 | 1.561 |

*Significant at the 0.01 level of confidence

**F=0, D=1, C=2, B=3, A=4

The value of the t-statistic depends on the number in each group (n) and the degrees of freedom (d.f.). The degrees of freedom for any value of t is one less than the number in each group. Therefore, the degrees of freedom in this study are equal to $n_f + n_s - 2$, where $n_f$ is the number of freshmen and $n_s$ is the number of non-freshmen. The number of degrees of freedom, using the above formula, is 720. When considering the degrees of freedom for the t-test, 720 is large enough to be considered infinite. In order for the t to be significant at the 0.01 level of confidence, with 720 degrees of freedom, the t must be at least equal to 2.5758.[1]

Therefore, the t of 1.561, calculated from the difference in the means of the freshmen and non-freshmen Chemistry I grades, was not significant at the 0.01 level of confidence. The first null hypothesis (1) can be accepted. Even though there was a difference of 0.224 between the means of the two groups, this difference was not large enough to be significant. Hence, we can be reasonably confident that the observed difference between the means was due entirely to chance.

The second null hypothesis (2), that there will be no significant difference in the means of the four ACT scores between the freshmen and non-freshmen in Chemistry I, was tested in a

---

[1] E. F. Lindquist, Statistical Analysis in Educational Research (Boston: Houghton Mifflin Company, 1940), p. 53.

similar manner. A t-test was run using the difference in the means of each of the four ACT tests for the two groups of students. The degrees of freedom remained constant, because the same two groups of students were used. It was found that all four calculated t's were significant at the 0.01 level. The second null hypothesis (2) was therefore rejected because there was a significant difference between the means of the four ACT scores of the freshmen and non-freshmen.

Table I indicates the means, their standard deviations, and the calculated t for each of the four ACT tests. The ACT test scores were reported as standard scores. In each of the four cases, the mean of the ACT test for the freshmen was significantly higher than the mean of the ACT test for the non-freshmen. Therefore, each of the four calculated t's was larger than 2.5758. The t-values are listed in Table I.

The second null hypothesis (2), that the difference in the means of the four ACT scores for the freshmen and non-freshmen is not significant was rejected. The difference between the means was large enough to be significant as shown by the t calculated for each ACT test. Hence, we can be confident that the observed differences in the means of the four ACT test scores were not due entirely to chance.

The following variables were investigated for predictive value for success in Chemistry I for both the freshmen and the non-freshmen:

$X_1$ ACT English Test

$X_2$ ACT Mathematics Test

$X_3$ ACT Social Studies Test

$X_4$ ACT Natural Sciences Test

The above four symbols, ($X_1$, $X_2$, $X_3$ and $X_4$), when used in a multiple regression equation, represent the standard ACT test scores that the student earned on a certain test.

Other symbols used in this study are:

$X_5$ Predicted Chemistry I grade for the freshmen, before the removal of insignificant contributors or variables from the multiple regression equation.

$X_6$ Predicted Chemistry I grade for the freshmen, after the removal of insignificant variables from the multiple regression equation.

$X_7$ Predicted Chemistry I grade for the non-freshmen before the removal of insignificant variables from the multiple regression equation.

$X_8$ Predicted Chemistry I grade for the non-freshmen after the removal of insignificant variables from the multiple regression equation.

Tables II and III show the simple intercorrelation coefficients (r) of each predictor (ACT test) to each other predictor and to the criterion (Chemistry I grade). From the data shown in these two tables, the multiple regression equations for the prediction of the freshmen and non-freshmen Chemistry I grades were

TABLE II

INTERCORRELATION MATRIX OF THE FOUR ACT VARIABLES AND CHEMISTRY I GRADES FOR THE FRESHMEN OF 1964

N = 633

| ACT Variables | Mathematics ($X_2$) | Social Studies ($X_3$) | Natural Sciences ($X_4$) | Chemistry I Grades |
|---|---|---|---|---|
| English ($X_1$) | .48 | .61 | .58 | .38 |
| Mathematics ($X_2$) | | .43 | .50 | .53 |
| Social Studies ($X_3$) | | | .63 | .40 |
| Natural Sciences ($X_4$) | | | | .45 |

TABLE III

INTERCORRELATION MATRIX OF THE FOUR ACT VARIABLES AND CHEMISTRY I GRADES FOR THE NON-FRESHMEN OF 1965

N = 89

| ACT Variables | Mathematics ($X_2$) | Social Studies ($X_3$) | Natural Sciences ($X_4$) | Chemistry I Grades |
|---|---|---|---|---|
| English ($X_1$) | .55 | .56 | .56 | .37 |
| Mathematics ($X_2$) | | .60 | .61 | .50 |
| Social Studies ($X_3$) | | | .65 | .32 |
| Natural Sciences ($X_4$) | | | | .48 |

developed. All of these predictors were used in combination to obtain a multiple correlation coefficient (R) and F-ratios were calculated for each predictor to test the significance of the contribution of each predictor to this R. The predictors which did not contribute significantly to R were eliminated and a final R' was obtained which included only those ACT predictors which made a significant contribution to the multiple correlation coefficient (R') as determined by the F-ratios.

The third hypothesis (3), that the ACT predictors will be the same for the non-freshmen as they were for the freshmen enrolled in Chemistry I, was rejected after it was established that there was a difference in the ACT predictors. Three of the ACT variables, Mathematics ($X_2$), Natural Sciences ($X_4$), and Social Studies ($X_3$), proved to contribute significantly in the prediction of Chemistry I grades for the freshmen. Only two ACT variables, Mathematics ($X_2$) and Natural Sciences ($X_4$), contributed significantly in the prediction of Chemistry I grades for the non-freshmen.

The procedure used in determining which of the four ACT tests were predictors of success in Chemistry I was the technique of multiple regression. In using this multiple regression technique, developed by Efroymsen[1] for computors, all four of the suspected ACT predictors were used in combination to obtain the

---

[1]Efroymsen, _loc. cit._

multiple correlation coefficient (R) for both the freshmen and non-freshmen. To test the significance of the contribution of each of the four ACT variables to the R, an F-test was run. The F-ratio for a predictor was tested for significance at the 0.01 level of confidence before being considered as a significant contributor to the multiple correlation coefficient (R). Those predictors which did not significantly contribute to the R were eliminated and a final R' was obtained which included only those ACT predictor variables which made a significant contribution to the prediction of Chemistry I grades for the freshmen and the non-freshmen.

Beta coefficients (beta weights) were calculated for each predictor variable. These beta coefficients were used to calculate the b coefficients (score weights) used in the multiple regression equation and became the actual predictor weights of each of the ACT variables. Therefore, the larger the beta coefficient the more weight that predictor carries in the multiple regression equation. In the four multiple regression equations developed in this study, the largest contributor to each equation and therefore the largest beta coefficient in each equation was that of the ACT Mathematics test ($X_2$). This indicates that the $X_2$ score is the best single predictor of success in Chemistry I for these two groups of students. In referring to Tables II and III, the simple correlation coefficients also confirm that the $X_2$ test score is the best single predictor of Chemistry I grades for these two groups.

Table IV gives data calculated and used to find which of the ACT variables predict, significantly, Chemistry I grades for the freshmen. The F values of $X_2$, $X_4$ and $X_3$ were significant at the 0.01 level of confidence. The F value must be at least equal to 6.64 in order to be significant at this level.[1] Therefore, only three variables were used in the final multiple regression equation for the freshmen Chemistry I grades. The standard error of estimate changed as each new ACT variable was taken into consideration. The standard error becomes smaller with the addition of each new ACT variable until the variable $X_1$ was added. This indicated that $X_1$ was not a significant predictor variable and should be eliminated before calculating the final multiple correlation coefficient (R') for the freshmen.

From Table V, which gives the coefficients used in the multiple regression equation before the insignificant predictor variable had been eliminated, the multiple regression equation for the prediction of freshmen grades in Chemistry I can be formulated. This multiple regression formula resulted in the following equation:

$$X_5 = b_2X_2 + b_4X_4 + b_3X_3 + b_1X_1 + a$$

$$X_5 = 0.10063X_2 + 0.04910X_4 + 0.02706X_3 + 0.01104X_1 - 2.41233$$

where $X_5$ was the predicted grade in Chemistry I for the freshmen

---

[1]Lindquist, <u>op</u>. <u>cit</u>., p. 65.

TABLE IV

F VALUES AND STANDARD ERROR OF ESTIMATE BEFORE INSIGNIFICANT VARIABLES WERE ELIMINATED FOR THE FRESHMEN IN CHEMISTRY I

N = 633

| ACT Variables | F Values | Standard Error of Estimate |
|---|---|---|
| Mathematics ($X_2$) | 252.14* | 1.0653 |
| Natural Sciences ($X_4$) | 43.234* | 1.0313 |
| Social Studies ($X_3$) | 8.3348* | 1.0254 |
| English ($X_1$) | .68783 | 1.0256 |

*Significant at the 0.01 level of confidence

TABLE V

b COEFFICIENTS, STANDARD ERROR OF b COEFFICIENTS, AND THE BETA COEFFICIENTS BEFORE THE INSIGNIFICANT VARIABLES WERE ELIMINATED FOR THE FRESHMEN IN CHEMISTRY I

N = 633

| ACT Variables | b Coefficients | Standard Error b Coefficients | Beta Coefficients |
|---|---|---|---|
| English ($X_1$) | 0.01104 | 0.01332 | 0.03675 |
| Mathematics ($X_2$) | 0.10063 | 0.01024 | 0.38339 |
| Social Studies ($X_3$) | 0.02706 | 0.01127 | 0.10954 |
| Natural Sciences ($X_4$) | 0.04910 | 0.03220 | 0.16994 |

$R = 0.58384$; $R^2 = 0.34086$; y-intercept = -2.41233 using all four ACT variables as predictors. The constant, a, at the end of the equation is the y-intercept value in the regression equation and will be different for each new multiple regression equation developed in this study.

The multiple correlation coefficient (R) between the predicted Chemistry I grade and the grade earned in Chemistry I by freshmen was 0.58384 and $R^2$, which is the percent of variance or contribution to the R by the four variables, was 0.34086. The beta coefficients in Table V were used to calculate the b coefficients used in the above multiple regression equation.

After the elimination of the one ACT variable, $X_1$, which was not a significant contributor to R as determined by the F values, a final multiple regression equation was formulated. Table VI contains the coefficients used in this final regression equation. The beta coefficients were recalculated after the elimination of $X_1$ and new b coefficients were then calculated for each of the three ACT predictor variables ($X_2$, $X_4$ and $X_3$). The multiple regression formula developed from the three significant ACT predictor variables for the freshmen Chemistry I grades was as follows:

$$X_6 = b_2X_2 + b_4X_4 + b_3X_3 + a$$

$$X_6 = 0.10252X_2 + 0.05175X_4 + 0.03039X_3 - 2.38166$$

where $X_6$ is the predicted Chemistry I grade for the freshmen using just the ACT variables ($X_2$, $X_4$ and $X_3$) which contribute significantly to this prediction.

TABLE VI

F VALUES, b COEFFICIENTS, STANDARD ERROR OF b COEFFICIENTS, AND THE BETA COEFFICIENTS AFTER THE INSIGNIFICANT VARIABLES WERE ELIMINATED FOR THE FRESHMEN IN CHEMISTRY I

N = 633

| ACT Variables | F Values | b Coefficients | Standard Error b Coefficients | Beta Coefficients |
|---|---|---|---|---|
| Mathematics ($X_2$) | 252.14* | 0.10252 | 0.00998 | 0.39061 |
| Natural Sciences ($X_4$) | 43.234* | 0.05175 | 0.01282 | 0.17911 |
| Social Studies ($X_3$) | 8.3348* | 0.03039 | 0.01052 | 0.12306 |

$R' = 0.5832$; $R'^2 = 0.34013$; y-intercept = −2.38166

*Significant at the 0.01 level of confidence

The final multiple correlation coefficient (R') was calculated between the predicted Chemistry I grade and the Chemistry I grade earned by the freshmen. This R' was found to be 0.5832, which indicates a high relationship between the predicted Chemistry I grade and the earned Chemistry I grade for the freshmen student. $R^2$ for the three ACT predictor variables was 0.34013.

The variables that contribute significantly to the prediction of Chemistry I grades for freshmen have now been established. They are the ACT Mathematics ($X_2$), ACT Natural Sciences ($X_4$), and ACT Social Studies ($X_3$) tests. The R' between predicted and earned Chemistry I grades for freshmen was equal to 0.5832. With this high R' and the small standard error of the estimated Chemistry I grade, which was 1.0254, the writer felt that this was strong enough evidence to justify the use of $X_2$, $X_4$ and $X_3$ in the multiple regression equation to compute a predicted Chemistry I grade for the freshmen.

The same procedure was used to find the significant variables that were used to predict the Chemistry I grades for the non-freshmen. Table VII gives the F values calculated to find which ACT variables contributed significantly to the prediction of non-freshmen Chemistry I grades ($X_7$). The F values of $X_2$ and $X_4$ are the only ACT variables which were significant at the 0.01 level of confidence. It can be noted that as the standard error of estimate was computed for each added ACT variable, it decreases as long as the F value of the added ACT variable was

TABLE VII

F VALUES AND STANDARD ERROR OF ESTIMATE BEFORE INSIGNIFICANT VARIABLES WERE ELIMINATED FOR THE NON-FRESHMEN IN CHEMISTRY I

N = 89

| ACT Variables | F Values | Standard Error of Estimate |
|---|---|---|
| Mathematics ($X_2$) | 30.404* | 1.1220 |
| Natural Sciences ($X_4$) | 5.8256** | 1.0921 |
| Social Studies ($X_3$) | .92315 | 1.0926 |
| English ($X_1$) | .52015 | 1.0957 |

*Significant at the 0.01 level of confidence

**Insignificant at the 0.01 level of confidence but much more significant than at the 0.05 level (must be at least 3.84 to be significant at the 0.05 level) and therefore $X_4$ was considered significant enough to be used as a predictor in this study.

significant. After the addition of $X_3$, the standard error rises from 1.0921 to 1.0926. This indicates that $X_3$ was not a significant predictor of Chemistry I grades for non-freshmen and for the same reason neither was $X_1$.

Table VIII shows R before eliminating the two insignificant ACT variables for the prediction of non-freshmen Chemistry I grades equal to 0.5547. The variance, $R^2$, was 0.30766. Table VIII contains the beta coefficients used to calculate the b coefficients used in the following multiple regression equation:

$$X_7 = b_2X_2 + b_4X_4 + b_3X_3 + b_1X_1 + a$$

$$X_7 = 0.08070X_2 + 0.08180X_4 + 0.03457X_3 + 0.02664X_1 - 1.35353$$

where $X_7$ is the predicted Chemistry I grade for non-freshmen before the insignificant ACT variables had been removed and $X_2$, $X_4$, $X_3$ and $X_1$ are the standard ACT test scores for each of the four ACT tests taken by the student.

From the F values, it was determined that $X_3$ and $X_1$ do not significantly contribute to the multiple correlation coefficient (R) or to the predicted Chemistry I grade for non-freshmen. Table IX gives the recalculated beta and b coefficients for the two ACT predictor variables $X_2$ and $X_4$. The final multiple correlation coefficient (R') for the non-freshmen was found to be 0.5532 after the elimination of the two insignificant ACT variables, $X_3$ and $X_1$. The variance, $R^2$, was 0.30598.

With this high R' value of 0.5532, the writer felt that this was strong enough evidence to use the two ACT variables,

TABLE VIII

b COEFFICIENTS, STANDARD ERROR OF b COEFFICIENTS, AND THE BETA COEFFICIENTS BEFORE THE INSIGNIFICANT VARIABLES WERE ELIMINATED FOR THE NON-FRESHMEN IN CHEMISTRY I

N = 89

| ACT Variables | b Coefficients | Standard Error b Coefficients | Beta Coefficients |
|---|---|---|---|
| English ($X_1$) | 0.02664 | 0.03694 | 0.08526 |
| Mathematics ($X_2$) | 0.08070 | 0.02834 | 0.35678 |
| Social Studies ($X_3$) | 0.03457 | 0.03138 | 0.14311 |
| Natural Sciences ($X_4$) | 0.08180 | 0.03455 | 0.30989 |

R = 0.5547; $R^2$ = 0.30766; y-intercept = -1.35353

TABLE IX

F VALUES, b COEFFICIENTS, STANDARD ERROR OF b COEFFICIENTS, AND THE BETA COEFFICIENTS AFTER THE INSIGNIFICANT VARIABLES WERE ELIMINATED FOR THE NON-FRESHMEN IN CHEMISTRY I

N = 89

| ACT Variables | F Values | b Coefficients | Standard Error b Coefficients | Beta Coefficients |
|---|---|---|---|---|
| Mathematics ($X_2$) | 30.404* | 0.07662 | 0.02582 | 0.33877 |
| Natural Sciences ($X_4$) | 5.8256** | 0.07275 | 0.03014 | 0.27559 |

R' = 0.5532; $R'^2$ = 0.30598; y-intercept = -1.29858

*Significant at the 0.01 level of confidence

**Insignificant at the 0.01 level of confidence but much more significant than at the 0.05 level (must be at least 3.84 to be significant at the 0.05 level) and therefore $X_4$ was considered significant enough to be used as a predictor in this study.

ACT Mathematics ($X_2$) and ACT Natural Sciences ($X_4$), as predictors of non-freshmen Chemistry I grades. Along with the evidence of R', a relatively small standard error of the estimated Chemistry I grade, which was 1.0921, also improves the predictors.

The following multiple regression equation was found for the prediction of non-freshmen Chemistry I grades:

$$X_8 = b_2X_2 + b_4X_4 + a$$

$$X_8 = 0.07662X_2 + 0.07275X_4 - 1.29858$$

where $X_8$ is the predicted Chemistry I grade for non-freshmen after the elimination of the two insignificant ACT variables.

Those variables that contributed significantly to the prediction of Chemistry I grades for non-freshmen were ACT Mathematics ($X_2$) and ACT Natural Sciences ($X_4$) tests. It was previously established in this study that three ACT variables were needed to predict the Chemistry I grades for freshmen. They were $X_2$, $X_4$ and $X_3$ (Social Studies). Therefore, the third hypothesis (3) was rejected because there were different predictors for freshmen and non-freshmen Chemistry I grades. Because of this fact, two different multiple regression equations must be used when trying to predict the Chemistry I grades, for all students enrolled in Chemistry I, by using the standard ACT scores of the four ACT tests.

The following multiple regression equation was for the freshmen:

$$X_6 = 0.10252X_2 + 0.05175X_4 + 0.03039X_3 - 2.38166$$

where $X_6$ is the predicted Chemistry I grade and $X_2$, $X_4$ and $X_3$ are the standard ACT test scores for the respective ACT tests.

The multiple regression equation for the non-freshmen was:

$$X_8 = 0.07662X_2 + 0.07275X_4 - 1.29858$$

where $X_8$ is the predicted Chemistry I grade and $X_2$ and $X_4$ are the standard ACT test scores for the respective ACT tests.

The fourth hypothesis, that the ACT predictors for non-freshmen success in Chemistry I will be no better, that is, will carry no more weight, than those predictors used to predict the success of freshmen in Chemistry I, was rejected when it was discovered that the predictors were different for the two groups. The weight of each predictor within each group can be compared by the beta coefficients. The size of the beta coefficient determines the weight that the variable contributes in the prediction of Chemistry I grades, therefore, the beta coefficient is often called the beta weight.[1]

Table VI gives the beta weight (coefficient) for each of the three ACT variables that proved to be significant predictors of freshmen Chemistry I grades. The beta weight for the ACT Mathematics ($X_2$) variable is by far the largest at 0.39061 and therefore $X_2$ carries the most weight in the multiple regression equation. The variable $X_4$ is the next best predictor and $X_3$

---

[1]Henry E. Garnett, Statistics In Psychology and Education (New York: Longmans, Green and Co., 1939), p. 454.

contributes the least amount of weight to the multiple regression equation for the freshmen. It must be remembered that the beta weights are used to calculate the b coefficients used in the regression equation.

These b coefficients are multiplied by the standard ACT test scores. Therefore, the numerical value of the standard ACT test score must also be considered in each case. If a student has a very high standard ACT test score on the ACT Natural Science ($X_4$) test, it could be possible that this score may be enough larger than the ACT Mathematics ($X_2$) test score that $X_4$ may carry the most weight in the multiple regression equation. In this case the calculated beta weight could be a little misleading. Table I shows the means of the four ACT test scores for both the freshmen and the non-freshmen and the mean of $X_2$ is larger than the mean of $X_4$. But in some individual cases, the reverse of this is true and the above exception could be realized.

The beta weights for the predictors of non-freshmen Chemistry I grades are given in Table IX. Only two ACT variables proved to be significant predictors for this group, $X_2$ and $X_4$. Once again $X_2$ was the largest contributor to the multiple regression equation, but the exception discussed above may again exist under certain conditions.

Because of the different number of variables that predict for each group, the direct comparison of beta weights was impractical and the fourth hypothesis (4) was rejected. There were some definite similarities in the beta weights of the two groups. In each sample the $X_2$ beta weight was the largest. This was expected after the inspection of Table II and Table III which shows that the variable, $X_2$, has the largest simple correlation coefficient with Chemistry I grade. These two tables also indicate that $X_4$ would be the second best single predictor of Chemistry I grades for both groups and would therefore have the second largest beta weight in each multiple regression equation. This has been shown to be true.

CHAPTER V

# SUMMARY AND CONCLUSIONS

The purpose of this study was to find a method for predicting the grades of non-freshmen enrolled in Chemistry I at Kansas State University, to increase the overall effectiveness of the ACT test scores used to guide and direct the placement of students, and to perhaps decrease the percentage of students failing and withdrawing from Chemistry I. The data for this study were obtained from the student's permanent records on file in the Office of Admissions and Records and from the records of the Student Counseling Center at Kansas State University. Multiple regression equations were used to predict Chemistry I grades. The variables used in these multiple regression equations were the four ACT tests [English ($X_1$), Mathematics ($X_2$), Social Studies ($X_3$), and Natural Sciences ($X_4$)].

It was found that there was no significant difference in the Chemistry I grades for freshmen and non-freshmen, but that there was a significant difference between the means of each of the four ACT test scores for the freshmen and the non-freshmen. The freshmen had significantly higher ACT test scores than did the non-freshmen enrolled in Chemistry I at Kansas State University.

Several observations can be made by looking at Table I. Most of these students entered college in the fall of 1964 and are 1964 graduates of Kansas high schools. In looking at the means of the ACT test scores for the two groups of students, it could be said that those students with higher ACT test scores enrolled in Chemistry I as freshmen and that the means of their ACT test scores are significantly higher than those who waited a year and then enrolled in Chemistry I. From the above information it could be concluded that the freshmen should do significantly better in Chemistry I than the non-freshmen or those students who waited a year before enrolling in Chemistry I. This was not the case. In studying the first hypothesis (1), it was found that there was no significant difference in the grades earned in Chemistry I by freshmen and non-freshmen.

The writer believes that there are several reasons as to why there was no significant difference in the success of these two groups in Chemistry I, even though the indications from the ACT test scores means are that there should be a difference other than pure chance. Some of these reasons are as follows:

1. The non-freshmen may be older and more mature. They may have developed study habits that enable them to do better work than they could have done as freshmen.
2. Many freshmen do not work up to their potential during their first semester in college, even though they are very intelligent, they have not made the adjustment to college life.

3. Due to the counseling and guidance that freshmen receive as they enter Kansas State University, the non-freshmen in this study were probably advised as freshmen not to enroll in Chemistry I during their first semester. Therefore, these non-freshmen students know that they will have to put out an extra effort in order to pass Chemistry I when they enroll for the class. Those non-freshmen that are still in college after their freshmen year will probably put out that needed effort.

It was found, from the simple correlation coefficients in Table II and Table III, that the best single ACT predictor of Chemistry I grades for each group was the ACT Mathematics ($X_2$) test and the ACT Natural Sciences ($X_4$) test was second best in each group. The third and fourth best predictors for the freshmen were Social Studies ($X_3$) and English ($X_1$) respectively and for the non-freshmen, third and fourth were $X_1$ and $X_3$ respectively. A greater relationship was found to exist between a combination of these ACT variables used in a multiple regression equation to predict a Chemistry I grade for both groups and the Chemistry I grade earned by these students. The final multiple correlation coefficient for the freshmen was 0.5838 and for the non-freshmen, R was equal to 0.5532. Both of these R's were higher than any of the zero-order Pearson product-moment correlation coefficients.

The final multiple regression equation developed for the freshmen was:

$$X_6 = 0.10252X_2 + 0.05175X_4 + 0.03039X_3 - 2.38166$$

where $X_6$ is the predicted Chemistry I grade with the insignificant variables eliminated.

The final multiple regression equation developed for the non-freshmen was:

$$X_8 = 0.07662X_2 + 0.07275X_4 - 1.29858$$

where $X_8$ is the predicted Chemistry I grade with the insignificant variables eliminated.

The three predictors of freshmen Chemistry I grades were ACT Mathematics ($X_2$), ACT Natural Sciences ($X_4$), and ACT Social Studies ($X_3$). $X_2$ and $X_4$ are the only two predictors of non-freshmen Chemistry I grades. In both groups, the ACT English ($X_1$) test was not a significant predictor of Chemistry I grades.

In considering the results of this study, it must be realized that the population was restricted to Kansas State University students and that the non-freshmen group was relatively small. The types of variables that were used in this study were the four ACT test scores. Some of the students enrolled in Chemistry I when these subjects were taken did not have ACT test scores available and therefore were not included in this study.

Recommendations. The writer feels that the results of this study can be used to prevent the misplacement of some students in Chemistry I. A counselor could use the predicted grades to show the probable achievement of the entering student. The two predicted Chemistry I grades, $X_6$ and $X_8$, would have to be calculated for each student, using the different significant predictors and the calculated b coefficients for each multiple regression equation. The student could then be counseled to enroll in Chemistry I when he has the best chance of successfully completing the course.

Due to the slow, but constant change in the entering student at Kansas State University, the two multiple regression equations developed in this study should be developed again within three or four years. Variables that predict in this study may, at that time, be found to be insignificant as predictors and new variables may take their place. Also as university records become more complete, other variables may be used such as high school rank, the last high school grade earned in English, Social Studies, Mathematics, and Natural Sciences, and the high school grade point average.

The writer also recommends that this type of study be expanded at Kansas State University to include courses other than Chemistry I. This could greatly improve the counseling and guidance of entering freshmen at Kansas State University.

# BIBLIOGRAPHY

## BIBLIOGRAPHY


American College Testing Program, Inc. Using ACT on the Campus. Iowa City, Iowa: American College Testing Program, Inc., 1965-66.

_______. ACT, Technical Report, 1965 edition. Iowa City, Iowa: Research and Development Division, American College Testing Program, Inc., 1965.

Angell, M. A. "Multiple Differential Prediction: significance for college academic counseling," Personnel and Guidance Journal, 37:418-23, February, 1959.

Betts, Merle E. "High School Chemistry for College Preparation," The Agriculture Education Magazine, 25:233, April, 1953.

Blackwell, E. B. "An Evaluation of the Immediate Effectiveness of the Testing and Guidance Bureau of the University of Texas," Journal of Education Research, 40:302-8, 1946.

Blommers, Paul, and E. F. Lindquist. Elementary Statistical Methods in Psychology and Education. Boston: Houghton Mifflin Company, 1960.

Brown, F. G., and L. Wolins. "Empirical Evaluation of the American College Testing Program," Personnel and Guidance Journal, 43:451-6, January, 1965.

Brumbraugh, A. J. Review of Educational Research. 6:202-3, April, 1936.

Burns, Richard Leo. "An Investigation of the Value of the American College Testing Program, The Scholastic Aptitude Tests, and the Purdue Placement Tests as Predictors of Academic Success of Purdue University Freshmen," Dissertation Abstracts, 24:1477, 1963.

Byrns, R., and V. A. C. Henmon. "Long-range Prediction of College Achievement," School and Society, 41:877-80, June, 1935.

Clark, P. E. "The Effect of High-School Chemistry on Achievement in Beginning College Chemistry," Journal of Chemical Education, 15:285-9, June, 1938.

Cornog, Jacob, and George D. Stoddard. "Predicting Performance in Chemistry," Journal of Chemical Education, 2:701-8, August, 1925.

Doleys, E. J., and G. A. Renzaglia. "Accuracy of Student Prediction of College Grades," Personnel and Guidance Journal, 41:528-30, February, 1963.

Durflinger, G. W. "The Prediction of College Success," Education Digest, 9:30-1, December, 1943.

Efroymsen, M. A. Mathematical Methods For Digital Computors. Edited by A. Ralston and H. Wilf. New York: John Wiley and Sons, Inc., 1950.

Endler, N. S., and D. Steinberg. "Prediction of Academic Achievement at the University Level," Personnel and Guidance Journal, 41:694-9, April, 1963.

Faries, Miriam. "Short-term Counseling at the College Level," Journal of Counseling Psychology, 2:182-4, 1965.

Foster, James M. "Predicting Course Grades with the ACT," Research Report Number 20, Student Counseling Center, Kansas State University, 1962. (Mimeographed.)

_______. "Further Investigation of the ACT as a Predictor of Academic Success at KSU," Research Report Number 22, Student Counseling Center, Kansas State University, 1962. (Mimeographed.)

_______, and David G. Danskin. "American College Test (ACT) Tested Three Ways," Personnel and Guidance Journal, 43:904-9, May, 1965.

Funches, De Lars. "A Correlation Between the ACT Scores and the Grade Point Averages of Freshmen at Jackson State College," College and University, 40:321-6, Spring, 1965.

Garard, Ira D., and Thalia B. Gates. "High School Chemistry and Student's Record in College Chemistry," Journal of Chemical Education, 6:514-7, March, 1929.

Garrett, Henry E. Statistics in Psychology and Education. New York: Longmans, Green and Company, 1939.

Griffiths, I. A., and M. L. Bigge. "Educational Guidance and Quality Education," Education, 83:556-9, May, 1963.

Guilford, J. P. Fundamental Statistics in Psychology and Education. New York: McGraw-Hill Book Company, Inc., 1942.

Hackett, Herbert R. "Use of M. M. P. I. Items to Predict College Achievement," Personnel and Guidance Journal, 39:215-7, November, 1960.

Hadley, E. H., R. A. Scott, and K. A. Van Lente. "The Relation of High-School Preparation to College Chemistry Grades," Journal of Chemical Education, 30:311-3, June, 1953.

Hake, Dorothy Terry, and C. H. Ruedisili. "Predicting Subject Grades of Liberal Arts Freshmen with the Kuder Preference Record," Journal of Applied Psychology, 33:553-8, December, 1949.

Herrmann, G. A. "An Analysis of Freshmen College Chemistry Grades with Reference to Previous Study of Chemistry," Journal of Chemical Education, 8:1376-85, July, 1931.

Hills, J. R., and others. "Admissions and Guidance Research in the University System of Georgia," Personnel and Guidance Journal, 39:452-7, February, 1961.

Hoveg, Nelson W., and Albertine Krohn. "An Evaluation of the Toledo Chemistry Placement Examination," Journal of Chemical Education, 40:370-2, July, 1963.

Ivey, Allen E. "The Academic Performance of Students Counseled at a University Counseling Service," Journal of Counseling Psychology, 9:347-52, Winter, 1962.

Jackson, Robert. "The Selection of Students for Freshmen Chemistry by Means of Discriminant Functions," Journal of Experimental Education, 18:209-14, March, 1950.

James, Glenn, and Robert C. James. Mathematics Dictionary. New York: D. Van Nostrand Company, Inc., 1962.

Kansas State University. Kansas State University Bulletin: General Catalog, 1964-1966. Manhattan, Kansas: Kansas State University of Agriculture and Applied Science, 1964-1966.

Kirchheimer, B. A., D. W. Axelrod, and G. X. Hickerson, Jr. "An Objective Evaluation of Counseling," Journal of Applied Psychology, 33:249-57, 1949.

Kirk, B. A., R. W. Cummings, and L. D. Goodstein. "The College Qualification Tests and Differential Guidance of University Freshmen," Personnel and Guidance Journal, 42:47-51, September, 1963.

Leaf, C. T. "Prediction of College Marks," *Journal of Experimental Education*, 8:303-7, March, 1940.

Lennon, Roger T. "A Glossary of 100 Measurement Terms," *Test Service Notebook*, Number 13. New York: World Book Company.

Lester, Robert A. "The Relationship of S. V. I. B. and A. C. T. Scores to Differential Academic Achievement," *Dissertation Abstracts*, 24:1076, 1963.

Lewis, J. W. "Pre-college Variables as Predictors of Freshman, Sophomore, and Junior Achievement," *Educational and Psychological Measurement*, 24:353-6, Summer, 1964.

Lindquist, E. F. *Statistical Analysis in Educational Research*. Boston: Houghton Mifflin Company, 1940.

Mac Phail, A. H., and L. S. Foster. "Placement in Beginning Chemistry Courses at Brown University," *Journal of Chemical Education*, 16:270-3, June, 1939.

Meyer, Herbert A. "What Value High School Chemistry to the Freshmen College Chemistry Student?" *School Science and Mathematics*, 62:410-4, June, 1962.

Miller, C. H. "Guidance and Programs of Testing," *School Life*, 42:18-20, September, 1959.

Oakley, W. J. "A Study of the Relationship Between Certain Factors and Achievement in College Freshmen Chemistry," *Louisiana State University Bulletin*, 32:45-6, 1939.

Otis, Arthur S. *Statistical Method in Educational Measurement*. New York: World Book Company, 1925.

Peters, F. R., and E. L. Plog. "Effectiveness of the ACT for Selection and Placement at the Ohio State University," *Educational Research Bulletin*, 40:232-41+252, December, 1961.

Reusser, W. C., V. Brinegar, and G. Frank. "Predicting Success in First-Year College Chemistry," *School and Society*, 40:197-200, August, 1934.

Rothney, J. W., and B. A. Roens. *Guidance of American Youth*. Cambridge, Massachusetts: Harvard University Press, 1950.

Runde, Robert M. "Freshman Placement Uses of a Nationwide Test," *College and University*, 41:190-8, Winter, 1966.

Scofield, M. B. "Further Studies on Sectioning in General Chemistry," _Journal of Chemical Education_, 7:117-26, January, 1930.

Staton, Jon Tom. "The Relationship of Selected Factors to Academic Success for Beginning Freshmen," _Dissertation Abstracts_, 23:1564, 1962.

Steiner, L. E. "Contribution of High-School Chemistry Toward Success in the College Chemistry Course," _Journal of Chemical Education_, 9:530-7, March, 1932.

Tiedeman, D. V. "American College Testing Program Examination," _Personnel and Guidance Journal_, 41:814-9, May, 1963.

Toven, J. R. "Appraising a Counseling Program at the College Level," _Occupations_, 23:459-66, 1945.

Ward, J. R., and Leona E. Tyler. "A Preliminary Report of an Evaluation of the Veterans Administration Counseling Service in the University of Oregon," _American Psychology_, 2:416, 1947.

Watson, Gladys H. "An Evaluation of Counseling with College Students," _Journal of Counseling Psychology_, 8:99-104, 1940.

Wesman, A. G., and G. K. Bennett. "Multiple Regression vs. Simple Addition of Scores in Prediction of College Grades," _Educational and Psychological Measurement_, 19:243-6, Summer, 1959.

West, G. A. "Influence of High School Science on Grades in College Chemistry," _School Science and Mathematics_, 32:911-3, November, 1932.

Williamson, E. G., and E. S. Bordin. "Evaluating Counseling by Means of a Control Group Experiment," _School and Society_, 52:434-40, 1940.

Wrenn, C. G. "Counseling Theory," _Encyclopedia of Educational Research_, pp. 341-50. New York: The Macmillan Company, 1960.

# PREDICTING CHEMISTRY GRADES OF NON-FRESHMEN WITH THE ACT AT KANSAS STATE UNIVERSITY

by

LARRY MICHAEL COSTIGAN

B. S., Mankato State College, 1964

---

AN ABSTRACT OF A MASTER'S THESIS

submitted in partial fulfillment of the

requirements for the degree

MASTER OF SCIENCE

College of Education

KANSAS STATE UNIVERSITY
Manhattan, Kansas

1966

The use of the American College Testing Program tests has increased enormously over the last six years. It has been used as a counseling tool, as an entrance requirement, and to predict academic success of freshmen in many colleges and universities. The ACT has been previously used extensively with freshmen. This study deals with the ACT as a predictor of non-freshmen academic success.

The purpose of this study was to investigate whether the ACT would significantly predict non-freshmen success in Chemistry I at Kansas State University. This would help in the counseling, guidance, and placement of students in chemistry, thus preventing, to some extent, the many problems that can develop for students withdrawing or failing Chemistry I.

The data for this study was obtained from the university records of each student and from the records kept by the Student Counseling Center at Kansas State University. A multiple regression technique was used to develop the prediction equations. The variables studied in this study were the four ACT test scores (English, Mathematics, Social Studies, and Natural Sciences).

Chemistry I grades of the freshmen and non-freshmen were compared by means of a t-test. It was found that there was no significant difference between the two groups in Chemistry I grade.

The arithmetic means of each of the four ACT tests for the two groups were compared in the same manner. It was found that there was a significant difference in the means of each of the four ACT test scores.

Zero-order correlation coefficients between the ACT test scores and Chemistry I grades were calculated for both groups. The best single predictor, for both groups, was the ACT Mathematics test. The zero-order correlation coefficient was 0.53 for the freshmen and 0.50 for the non-freshmen.

Multiple correlation coefficients were calculated using all four ACT test variables and the Chemistry I grade. These variables were then tested for the significance of their contribution to the multiple correlation coefficient. The insignificant variables were eliminated in the final multiple regression equations.

Greater accuracy was found, for both the freshmen and non-freshmen, by using the multiple regression equation derived from the significant ACT variables. Three ACT variables were found to be significant for the freshmen. They were Mathematics, Natural Sciences, and Social Studies. The multiple correlation coefficient between the predicted grade, from the combination of variables, and the earned Chemistry I grade was 0.5838.

Two ACT variables were found to contribute significantly for the non-freshmen. They were Mathematics and Natural Sciences. The multiple correlation coefficient of 0.5532 was again higher than the best zero-order correlation coefficient.

It would seem from this study, that Chemistry I grades of non-freshmen at Kansas State University can be predicted from the student's ACT test scores on the Mathematics and Natural Sciences tests. These scores would be substituted into the multiple regression equation developed in this study.

The results of this study seem to indicate that for students other than just entering freshmen, the ACT tests may be used for the prediction of academic success. The writer recommends that further studies of this same nature be conducted. These further studies may prove the ACT to be one of the best predictors of academic success.