THE UNIVERSITY OF ALBERTA

THE HIGH SCHOOL RECORD AS A PREDICTOR FOR SUCCESS IN THE ELECTRONIC TECHNOLOGY PROGRAM

by

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ABSTRACT

This study investigated the possibility of using the high school record and standardized test scores as predictors for success in the Electronic Technology program at the Northern Alberta Institute of Technology. In particular, it studied the influence of the entrance requirements and the kinds of high school preparation on success in the program, the entrance requirements being a high school diploma or its equivalent with minimum standings in Mathematics and Science.

The predictor variables were high school Mathematics, Physics, and average and the two scores in Numerical Ability and Verbal Reasoning from the Differential Aptitude Test battery. The criterion variable was the Electronic Technology graduating average. The program had three types of entering student, designated as pretechnology, vocational, and academic students.

The sample was made up from the graduating classes in Electronic Technology for three consecutive years. A standardizing subsample, based on half the sample, was used to establish a set of prediction equations. A cross-validation subsample, based on the other half of the sample, was used to check them.

To study the influence of the kind of high school preparation on success in the program, the mean technology graduating averages were found for the pretechnology, the

vocational, and the academic students forming the sample and the differences in the means were checked for significance.

Results of the study showed that:

1. It was possible to predict the graduating average of vocational and academic students in the Electronic Technology program on the basis of the high school record alone, as represented by high school Mathematics, Physics, and average, but it was not possible to make predictions for pretechnology students or for students in general on this basis.

2. Prediction was improved when standardized test scores in Numerical Ability and Verbal Reasoning, as well as the high school record, were used as predictor variables. It was possible to predict the graduating average of pretechnology, vocational, and academic students in the program either separately or jointly with the use of appropriate five-predictor equations.

3. It was not possible to discriminate between the suitability of the three types of high school preparation that serve as admission requirements for the Electronic Technology program.

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THE PROBLEM

I. INTRODUCTION

It is commonly assumed that successful college achievement has certain prerequisites, including mental ability, adequate academic background, and motivation. In recognition of this, most colleges make entrance to a program conditional upon a satisfactory high school record and/or acceptable scores in standardized tests.

The establishment of minimum admission requirements assumes that the high school record, amongst other things, will serve as a predictor for success in more advanced work. How well this will predict future success in a particular program has been the subject of many studies. This study examined the relationship between the high school record and success in an engineering technology program, namely Electronic Technology.

Admission requirements for the Electronic Technology program at the Northern Alberta Institute of Technology are, and have generally been, a high school diploma or its equivalent with 50% or better in Grade XII Mathematics 30, 32, 33 or 36 plus 40% or better in a Grade XII science subject, preferably Physics (NAIT, 1971).

In this study, the high school record was that of any student who held a high school diploma or its equivalent obtained through either the pretechnology, vocational, or academic route.

The high school record was represented by the marks obtained in high school Mathematics, Physics, and average. The high school average was found from the marks earned in Grade XII English, Mathematics, Social Studies, Biology, Chemistry and Physics, and in cases where a student had taken more than one Grade XII Mathematics course, his average in this subject was used as his Mathematics mark.

II. STATEMENT OF THE PROBLEM

The problem of this study is that at present there is no means of predicting success in the Electronic Technology program at NAIT based on entrance requirements and three different kinds of high school preparation.

The purpose of this study was:

1. to determine to what extent, if any, the high school scores in Mathematics, Physics, and average were able to predict the achievement of students in the Electronic Technology program at the Northern Alberta Institute of Technology,

2. to determine to what extent, if any, the addition of Differential Aptitude Test scores in Numerical Ability and Verbal Reasoning as predictor variables would improve prediction, and

3. to determine to what extent, if any, the pre-technology, vocational, and academic high school preparation affected the achievement of students in this program.

III. DELIMITATIONS

This study was delimited in the following ways:

1. It was restricted to one particular technology program that admits students who obtained a high school diploma or its equivalent by any one of three routes.

2. It was restricted to a technology program that is based on mathematics and science applied to technology.

3. It was restricted to a technology program that has a large enrollment so that the prediction study could be cross-validated against a second group of students.

4. It included only those students who entered the program directly from high school or from the pretechnology program. Students who had prior work experience of one year or more were excluded from the study.

IV. ASSUMPTIONS

The following assumptions were made:

1. The interests, motivation, and attitude of students would affect outcomes. No measure of these was available, but it was assumed that they would be reflected in the student's academic achievement, both in high school and the Institute.

2. There will be differences between the three types of student entering the Electronic Technology program. These differences may or may not be evident in the prediction equations developed in this study. It was further assumed that these differences would be evident on computing the mean graduating average for each subsample.

3. Guidelines for marking in the high school and the Institute were each standardizing measures and were equivalent. It was thus possible to compare high school marks with Institute marks.

4. Similarly, there was uniformity in marking throughout the high schools of Alberta, and throughout the different programs they offer.

5. The contribution that a subject or course of study makes to a balanced technology program could be measured in terms of the student-hours spent on it and weighted accordingly.

V. STATEMENT OF HYPOTHESES

The following null hypotheses were tested at the .05 level of significance:

1. It will not be possible to predict the graduating average in the Electronic Technology program on the basis of high school Mathematics, Physics and average.

2. Prediction will not be improved if standardized test scores in Numerical Ability and Verbal Reasoning, as

well as the high scool record, are used as predictors.

3. It will not be possible to discriminate between the suitability of the three types of high school preparation that serve as admission requirements for the Electronic Technology program.

VI. DEFINITION OF TERMS

Engineering Technician

Henninger (1959) defined the engineering technician as a person whose chief interest and activities lie in the direction of the testing and development; the application, and the operation of engineering and scientific equipment and processes. He classified the engineering technician operationally as one who performs semi-professional functions of an engineering or scientific nature, largely upon his own initiative and under only general supervision of a professional engineer or scientist: he assists the engineer or scientist and supplements his work.

Graduating Average

The Electronic student's weighted average in his graduating year at the Institute, made up almost entirely from electronics courses.

NAIT Graduate

The graduate of the Northern Alberta Institute of

Technology is one who holds a diploma in Electronic Technology from the Institute.

Pretechnology Student

The pretechnology student is one who attained an Alberta high school diploma or its equivalent through studies at the Northern Alberta Institute of Technology.

Vocational Student

The vocational student is one who attained an Alberta High school diploma through vocational studies at high school.

Academic Student

The academic student is one who attained an Alberta high school diploma through academic studies at high school.

Criterion Variable

The criterion variable, or outcome, was the Electronic student's weighted average in his graduating year at the Institute, described as the graduating average.

Predictor Variables

The predictor variables were the high school scores in Mathematics, Physics, and average and the scores in Numerical Ability and Verbal Reasoning from the Differential Aptitude Test battery.

VII. NEED FOR THE STUDY

This study investigated the possibility of using the high school record and a standarized test as predictors for success in the Electronic Technology program at the Northern Alberta Institute of Technology. In particular, it studied the influence of the entrance requirements and the kinds of high school preparation on success in the program.

The American Society of Engineering Education (1962, p. 6) stated:

> If an effective engineering technology curriculum hinges greatly upon the quality of faculty, it hinges perhaps even more upon the quality of its incoming students. If the students' high school backgrounds are inadequate, instructors will tend to adjust their course material to these inadequacies. The inevitable result will be that the courses will lose the depth and scope implied in the catalogue and faculty capabilities will not be fully utilized. Any discussion of academic standards, therefore, must be preceded by a statement on admission requirements and student selection.

The choice of a career, and the choice of a program of studies necessary for its preparation, will depend on many things. Aptitude, interest, values, and the influence of the home and high school experience all have a bearing on career selection, and on success in the chosen field of work. Most research studies that attempt to predict college success, however, use academic standards as criteria. Some of these are discussed under Review of the Literature.

Writing on prediction, Gleser (1960) discussed the types of prediction problems, one of which is relevant here. In selection, the aim is to obtain a group of individuals whose average probability of success is greater than that of the typical applicant. On the other hand, "selecting" a group of students for a special program in the school is really a classification problem, and not a selection one, because the students who are excluded must be provided for by some other type of program. Probably, the greatest number of prediction problems are subsumed under the heading of classification, by which an individual is assigned to that category in which he best fits, or where he has the greatest probability of success.

Although the Northern Alberta Institute of Technology does have categories for some of its technology programs, it does not attempt to select students for a particular program on the basis of their high school record. Any person who has the necessary entrance requirements, and makes application before the quota is filled, is accepted.

Information provided by this study could be useful when decisions have to be made on admission requirements, the need for remedial work, and student counseling in the high schools.

CHAPTER II

REVIEW OF THE LITERATURE

This study deals with the relationship between the high school record and success in the Electronic Technology program at the Northern Alberta Institute of Technology. To place the problem in perspective, a review of the literature was made. This has been divided into two parts. The first considers the technical institute program; the second deals with various studies on the prediction of student achievement.

The review is in summarized form except for those parts thought to be especially relevant to this study. A rationale for the research design is developed from the review.

I. THE TECHNICAL INSTITUTE PROGRAM

The Technical Institute Program

The technical institute is a post-secondary educational institution, designed primarily to develop qualified engineering technicians proficient in a selected field of technology. In most cases, high school graduation is a prerequisite and the programs are completed in two academic years (Graney, 1964).

The institute obtains its students from three main sources (Graney, 1964). The principal source is the high school, although high school counseling does not usually emphasize technical institute education. Some students come from industry after a period of work experience. Others come from engineering schools because of failure or through choice.

The engineering technician graduating from a technology program has a high level of knowledge and his marked ability in mathematics, science, and applied technology permits him to handle a wide range of tasks within his technology as an assistant to the engineer or scientist (Dobrovolony, 1960; Emerson, 1962; Porter, 1964; U.S. Office of Education, 1967).

Because the engineering technology program is based upon the knowledge and use of fundamental concepts in mathematics and science, it has long been recognized that a sound general education, especially in language, mathematics, and science is a basic requirement for entry into the program (Unesco, 1952). Indeed, the U.S. Office of Education (1967) has stated that the academic requirements for entering a high quality technology program are essentially the same as for an engineering degree program. It ought to be possible, therefore, to predict the likely success or failure of students in an engineering technology program on the basis of their high school record.

Guidance and the Technical Institute Program

Henninger (1959) noted that the demand for engineering technicians is increasing, but places at the institutes are not always filled. This may be due to misunderstanding and lack of knowledge about the nature and worth of technical institute education. Employers, engineers, engineering educators, high school teachers, and parents seem to have a misconception of the role of the engineering technician.

Graney (1964) stated that most high school teachers and counselors are not well informed about the technical institute or industry. They tend to counsel the better students to enter university and counsel the poorer ones to accept the terminal vocational programs in the high school.

Schill and Arnold (1965) had problems in locating engineering technicians for a study of curricula content because, in many cases, management, personnel managers, and chief engineers did not know the educational background of their employees or the true role of the technician. Schill and Arnold (1965, p. 18) discovered that "To find out what a technican does and what knowledges are related to his job, the place to go is to the employed technician."

This dearth of understanding of the role and education of the engineering technician has been deplored. Shippen (1967) stated that students planning to take technical education programs need realistic technical orientation to aid them in making decisions, especially if they have taken the academic route in high school. The purpose of orientation is twofold. Firstly, it would prepare a student for the best possible choice of a technical program on the basis of his aptitudes, interests, and information about himself, and secondly, it would achieve through testing a more reliable indication of the student's mechanical and mental aptitudes in his choice of program.

Porter (1964) and Schill and Arnold (1965) claimed that the "academic stream" in the high school is preferable to the "technological stream" and is more appropriate for the basic education of the engineering technician. If this, in fact, is the case there ought to be a difference in achievement in an engineering technology program according to the type of high school preparation that a student has undergone. Furthermore, a knowledge of the student's aptitude test scores should help in the prediction of success in the program.

Apart from aptitude and the high school record, there are many factors that influence a student's success in college. Smith (1965) showed that performance in college is affected by the student's interests, personality, and socioeconomic background. Others have shown that sex, college program, size of high school (Knowles & Black, 1965), and age of the student (Fleming, 1955; Astin, 1971) will affect outcomes, but often information on these factors is not available.

Although achievement depends on many things, it should be possible to predict the success of a student in an engineering technology program on the basis of his high school record, his aptitude test scores, and the type of high school preparation that he has.

II. PREDICTION OF STUDENT ACHIEVEMENT

Data Commonly Used in Prediction

The major student variables measured by testing are achievement, aptitude, interest and personality. All may be used in the prediction of future performance.

Achievement tests, either in the form of school examinations or standardized tests, are designed to measure how much one has accomplished as a result of past education. Standardized aptitude tests are designed to indicate the potential one has for learning in the future. Standardized interest and personality inventories measure certain personal-social characteristics.

Most prediction studies are based upon achievement test data obtained from standarized tests, the high school record, or both. Aptitude tests are used to a much lesser extent. Interest and personality inventories are used mainly for guidance when making a tentative career choice.

As Mack (1963) stated, it is now common practice to use multiple predictors and a specific criteria of success in order to see what combination of predictors is best suited for a particular situation.

Research Studies Using Standardized Tests

Smith and Adams (1966) noted that, although no test can serve as a perfect predictor of academic achievement, standardized tests now serve a major role in American college admissions. Almost invariably, they are achievement tests. Black (1959a), Knowles (1965), Butzow and Williams (1967), and others question the predictive ability of some of them. A review of the literature showed this criticism to be justified.

Prediction studies using standardized achievement tests showed that the achievement test can have predictive validity extending over several years of the college program (Pickle, 1967). Often, however, it does not predict with sufficient accuracy to serve as a basis for college admissions (Stone, 1965). In some cases, the correlation between standardized test scores and performance in a college program are so low that it must be concluded they measure two different things (Roemer, 1965).

Studies that related test scores to high school performance showed that the standardized test scores are affected by the student's aspirations for higher education (Gadzella & Bentall, 1966) and the type of program he wishes to enter (Obst, 1963).

Standardized aptitude tests are used more often for counseling than for prediction. This does not mean, however, that they cannot be used for prediction. In fact, Carrol and Frederiksen (1959) have explicitly recommended that the Differential Aptitude Tests (DAT) be used for this purpose.

Differential Aptitude Tests

The Differential Aptitude Tests are a multi-aptitude battery of standardized tests worthy of special mention, not only because of their wide acceptance, but because they are administered to newly registered students at the Northern Alberta Institute of Technology, mainly for counseling purposes.

The DAT tests were designed for grades 8 to 12, but can also be used for unselected adults. The battery contains the following eight subtests:

1. Verbal Reasoning. A series of verbal analogies intended to measure a combination of verbal ability and deductive reasoning.
2. Numerical Ability. A series of relatively simple numerical problems that give a measure of mental computational skill.
3. Abstract Reasoning. A nonverbal measure of reasoning ability based on selecting a fifth abstract figure that logically follows four others.
4. Mechanical Reasoning. Measures an understanding of physical principles through the use of drawings.
5. Space Relations. Measures the ability to visualize objects by relating surface developments to their solid figures.
6. Clerical Speed and Accuracy. Measures speed and accuracy of responses to letter and number combinations.

7. Language Usage. Part 1 is a spelling test.

8. Language Usage. Part 2 is a test in grammar, punctuation, and word usage.

Carrol and Frederiksen (1959) separately reviewed the Differential Aptitude Tests and agreed on several important points. They found the overlap of abilities measured by the subtests somewhat disturbing and questioned if the battery was truly differential. Frederiksen stated that the best three predictors for success in all of the four study areas of English, mathematics, science and social studies were Verbal Reasoning, Numerical Ability, and the sentence part of Language Usage. Both reviewers noted that the DAT authors strongly recommend the practice of counseling from profiles; in other words, the use of clinical prediction. The reviewers recommended the employment of statistical methods, at least for local situations, to discover how best to combine the scores so that statistical prediction can be made from prediction equations. Carrol completed his critique by stating that the DAT tests were the best available foundation battery for measuring the chief intellectual abilities and learned skills of the high school student.

If DAT scores are to be used in prediction, two of the most useful subtests are Verbal Reasoning and Numerial Ability (Carrol & Frederiksen, 1959; Price, 1971).

Research Studies Using the High School Record

Most prediction studies attempt to relate standardized achievement tests and/or the high school record to the college freshman grade-point average. In cases where standardized tests and the high school record have been used jointly, the high school record was found to be as good as, or better than, the standardized tests in predicting success in college (Doppelt & Stuit, 1953; Black, 1959a; Knowles, 1965; Lunneborg & Lunneborg, 1967; Fleming, 1962; Astin, 1971).

Studies using the high scool record as a predictor of success in college showed:

In some cases, the high school average was the best single predictor for success in the freshman year (Fleming, 1955; Mowat & Ross, 1962; Mack, 1963; Lunneborg & Lunneborg, 1967; Astin, 1971). In other cases, the high school course marks were the best discriminators (Black, 1959b; Knowles, 1965).

For Engineering, high school course marks in mathematics and science were better predictors of success than the high school average (Fleming, 1962; Jenkins & Prentice, 1968).

A freshman's grade point average can be predicted with moderate accuracy from a knowledge of his average grade in high school, and to a lesser extent, from college admission tests. Prediction beyond the first year in college can be made with only a low degree of accuracy when based on the high school record and standardized tests (Mowat, 1966; Astin, 1971).

Younger students who entered college immediately after high school did better than older students (Fleming, 1955). For a given ability, the successful student was young, had good study habits, and attended a highly selective college (Astin, 1971).

Conclusions

Most prediction studies deal with success in the college freshman year, measured by the grade-point average. Few go beyond the freshman year and few consider the engineering-based program at an institute of technology. Findings from existing studies, however, can serve as a basis for predicting the success of students in the Electronic Technology program at the Northern Alberta Institute of Technology.

Of particular interest is the work of Black (1959a, 1959b), Fleming (1962), and Jenkins & Prentice (1968). Black has studied the Alberta high school graduate's record and its relation to success in different faculties at the University of Alberta. The others have studied the requirements for success in Schools of Engineering. Their work is of interest because the present study is concerned with predicting the success of Alberta high school graduates in a technology program closely related to engineering.

From a review of the literature on prediction it seemed reasonable to use the high school average, and the Mathematics and Physics marks (in addition to two DAT scores) as the predictor variables because of the engineering nature of the Electronic Technology program and because of the entrance requirements for this program. The Electronic graduating average was chosen as the criterion variable because the study was concerned with success, not in the first year, but in the program as a whole. The sample was restricted to students who entered the program directly from high school in order to eliminate the effects of maturity and work experience.

CHAPTER III

STRUCTURE OF THE INVESTIGATION

This study sought a relationship between the high school record and success in the Electronic Technology program at the Northern Alberta Institute of Technology.

The study was divided into three parts, described as Part I. Prediction, Part II. Cross-Validation, and Part III. Discrimination. Part I established a set of prediction equations based on the high school record and aptitude test scores. In Part II, the prediction equations were cross-validated against a second subsample. Part III studied the influence of the kind of high school preparation on success in the technology program.

The structure of the investigation is given below. It describes the population and sample, the method of analysis for each part of the study, and the statistical data used.

I. POPULATION AND SAMPLE

The population was all students who applied, or who will apply, for entrance to the NAIT Electronic Technology program from the year 1968 onwards. The sample was made up from those students who completed the program in the years 1970, 1971, and 1972. It included all students who entered the program directly from high school or from pretechnology, provided their high school record was known. It excluded transfer students and those with one or more years of work experience.

Of the 174 students making up the sample 48 had come from pretechnology, 29 from the vocational, and 97 from the academic high school programs. Of these, 27 pretechnology, 25 vocational, and 91 academic students had written the DAT tests.

The sample was randomly divided into two subsamples having the same representation of pretechnology, vocational, and academic students in each. The first (standardizing) subsample was used to establish a set of prediction equations. The second (cross-validation) subsample was used to check them.

The standarizing and cross-validation subsamples were each subdivided into pretechnology, vocational, and academic subsamples. These in turn were further subdivided according to whether or not the student had written the DAT tests.

Thus, there was one set of subsamples containing all students making up the sample. This set was used in the three-predictor study. Another set, containing all students except those without DAT scores, was used in the five-predictor study.

For the discrimination part of the study, the sample as a whole was divided into pretechnology, vocational and academic subsamples.

Details of the sample and its subsamples are given in Table I.

The student's high school record was obtained from his application form seeking entrance to the Electronic Technology program, his DAT scores from the Counseling Department, and his technology graduating average from the Electronics Department at the Northern Alberta Institute of Technology.

II. METHOD OF ANALYSIS

Part I. Prediction

The five predictor variables were the high school scores in Mathematics, Physics, and average, and the scores in Numerical Ability and Verbal Reasoning from the Differential Aptitude Test battery. The criterion variable was the Electronic Technology graduating average.

In all, a total of eight prediction equations were found using stepwise multiple regression and employing the MULRØ 6 Computer Program developed by the Division of Educational Research at the University of Alberta. One set of four equations used the three predictors from the high school record. The other set used all five predictors to see if prediction could be improved by the inclusion of DAT scores.

Statistical data leading to the prediction equations

TABLE I

SAMPLE AND SUBSAMPLES USED IN THE PREDICTION STUDY

	Pretechnology		Vocational		Academic		Subtotal	
	N_1	N_2	N_1	N_2	N_1	N_2	N_1	N_2
Prediction	25		15		49		89	
Subsamples		14		13		46		73
Cross-Validation	23		14		48		85	
Subsamples		13		12		45		70
Subtotals	48		29		97		174	
		27		25		91		143

N_1 = number of subjects in each subsample used in the three-predictor study

N_2 = number of subjects in each subsample used in the five-predictor study were the means, standard deviations and a correlation matrix for the predictors and criterion, an analysis of variance table, and regression weights.

Part II. Cross-Validation

Prediction equations from Part I were applied to the cross-validation pretechnology, vocational, and academic subsamples thus allowing tables of observed and predicted technology graduating averages to be prepared. From these, the mean observed and predicted scores for each subsample and for the cross-validation subsample as a whole were found. The correlation between each pair of mean observed and predicted scores was tested for significance, with the probability level set at .05, by means of a t-test.

Part III. Discrimination

In the discrimination part of the study, the means and standard deviations of the observed technology graduating average were found for the sample and its pretechnology, vocational, and academic subsamples. A chi-square test was used to check the homogeneity of variance and a one-way analysis of variance was used to test for significance with the probability level set at .05 in both cases.

CHAPTER IV

RESULTS OF THE STATISTICAL ANALYSIS

This prediction study, and the statistical analysis that supports it, is in three parts. Part I. Prediction developed a set of prediction equations, Part II. Cross-Validation checked them for accuracy, and Part III. Discrimination studied the influence of the type of high school preparation on success in the technology program.

Development of the prediction equations are shown in Tables II to X, their cross-validation in Tables XI to XIV, and the results of the discrimination part of the study in Table XV.

Student records used in this investigation are given in the Appendix. Data for the standardizing subsample used in prediction are given in Table XVI to XVIII, and data for the cross-validation subsample in Tables XIX to XXIII. The two subsamples were combined to form the sample in the discrimination part of the study.

I. PREDICTION

A set of three-predictor equations was obtained for the standardizing subsample as a whole and for its pretechnology, vocational, and academic subsamples. The three predictor variables were the scores in high school

Mathematics, Physics, and average. The criterion variable was the Electronic Technology graduating average.

In an attempt to improve prediction with the use of standardized tests, a similar set of five-predictor equations was found by including DAT-Numerical Ability and Verbal Reasoning scores as predictor variables.

Steps leading to the prediction equations follow.

Means and Standard Deviations

Table II shows the means and standard deviations of the three predictor variables, high school Mathematics, Physics, and average, and the criterion variable, Electronic Technology graduating average, for the standardizing subsample. Table III shows similar data after adding DAT-Numerical Ability and Verbal Reasoning as predictor variables.

Sixteen subjects, mainly pretechnology students, did not write the Differential Aptitude tests, although all students are supposed to do so. Their records were deleted in the five-predictor study and, in consequence, the total number of observations fell from 89 to 73 after adding the DAT scores. After deleting pretechnology students without DAT scores, the pretechnology means of high school Mathematics, Physics and average, and of the technology graduating average, increased.

TABLE II

MEANS AND STANDARD DEVIATIONS OF THREE PREDICTOR VARIABLES AND OF THE CRITERION, GRADUATING AVERAGE

Variable	Pretechnology		Vocational		Academic		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Predictor Variables:								
High School Mathematics	69.5	9.64	68.9	10.64	66.3	10.67	67.6	10.38
High School Physics	74.0	9.38	70.8	9.54	68.3	9.32	70.3	9.59
High School Average	70.8	9.66	64.5	8.32	64.1	8.43	66.0	9.17
Criterion Variable:								
Graduating Average	63.5	11.32	65.6	7.54	64.4	11.32	64.3	10.70
Number of Observations, N	25		15		49		89	

TABLE III

MEANS AND STANDARD DEVIATIONS OF FIVE PREDICTOR VARIABLES

AND OF THE CRITERION, GRADUATING AVERAGE

Variable	Pretechnology		Vocational		Academic		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Predictor Variables:								
High School Mathematics	72.1	8.65	68.2	11.28	66.3	10.74	67.8	10.58
High School Physics	76.0	9.84	70.1	10.10	68.4	9.59	70.2	10.02
High School Average	74.1	11.08	64.5	8.99	64.5	8.51	66.3	9.76
DAT - Numerical Ability	34.6	3.11	35.5	4.93	35.1	2.78	35.1	3.27
DAT - Verbal Reasoning	37.5	5.87	36.5	8.82	38.0	6.81	37.6	6.96
Criterion Variable:								
Graduating Average	65.8	13.5	66.4	7.50	65.4	9.25	65.7	9.73
Number of Observations, N	14		13		46		73	

Intercorrelations

Table IV shows the intercorrelations of the three predictor variables, high school Mathematics, Physics and average and the criterion variable, technology graduating average, for the standardizing subsample. Minimum correlation coefficients required for significance at the .05 level were .34 for pretechnology, .44 for vocational, .24 for academic, and .18 for the total.

There were high correlations between the three predictor variables representing the high school record, especially between high school Mathematics and average, for which correlation coefficients ranged from .558 for vocational students to .838 for academic students. The high correlations between the predictor variables indicated they were measuring much the same thing.

There were smaller correlations between the predictors and the technology graduating average. Although not all were significant at the .05 level, they were high enough to indicate that a positive relationship existed between the high school record and success in the Electronic Technology program. The best single predictor for success was the high school average with correlation coefficients ranging from .360 for vocational students to .445 for pretechnology students.

Table V shows the intercorrelations of the five predictor variables, including DAT-Numerical Ability and

TABLE IV

INTERCORRELATIONS OF THREE PREDICTOR VARIABLES AND OF THE CRITERION, GRADUATING AVERAGE

Predictor Variables	High School Physics	High School Average	Criterion Graduating Average
Pretechnology (N = 25)			
High School Mathematics	.700*	.741*	.272
High School Physics		.665*	.442*
High School Average			.445*
Vocational (N = 15)			
High School Mathematics	.395	.558*	.239
High School Physics		.767*	.192
High School Average			.360
Academic (N = 49)			
High School Mathematics	.532*	.838*	.395*
High School Physics		.744*	.218
High School Average			.395*
Total (N = 89)			
High School Mathematics	.563*	.750*	.334*
High School Physics		.739*	.261*
High School Average			.366*

*Significant at the .05 level

TABLE V

INTERCORRELATIONS OF FIVE PREDICTOR VARIABLES

AND OF THE CRITERION, GRADUATING AVERAGE

Predictor Variables	High School Physics	High School Average	DAT - Numerical Ability	DAT - Verbal Reasoning	Criterion Graduating Average
Pretechnology (N = 14)					
High School Mathematics	.874*	.879*	.437	-.330	.635*
High School Physics		.792*	.463*	-.373	.567*
High School Average			.140	-.300	.477*
DAT - Numerical				.004	.236
DAT - Verbal					-.278
Vocational (N = 13)					
High School Mathematics	.372	.571*	-.207	.010	.334
High School Physics		.783*	-.105	.599*	.268
High School Average			-.092	.734*	.384
DAT - Numerical				.266	.129
DAT - Verbal					.373
Academic (N = 46)					
High School Mathematics	.562*	.871*	.244	.147	.389*
High School Physics		.756*	.193	.353*	.310*
High School Average			.277	.332*	.422*
DAT - Numerical				.197	.039
DAT - Verbal					.019
Total (N = 73)					
High School Mathematics	.597*	.801*	.125	.066	.411*
High School Physics		.785*	.131	.262*	.352*
High School Average			.081	.264*	.399*
DAT - Numerical				.184	.101
DAT - Verbal					.010

*Significant at the .05 level

Verbal Reasoning, and the criterion variable, technology graduating average. In this case, minimum correlation coefficients required for significance at the .05 level were .46 for pretechnology, .48 for vocational, .25 for academic, and .20 for the total.

Correlations between components of the high school record were higher than when only three predictors were used. Again, in general, the highest correlations were between high school Mathematics and average where values of the correlation coefficient ranged from .571 for vocational students to .879 for pretechnology students. Correlations between components of the high school record and the technology graduating average also increased. For example, for pretechnology students the correlation coefficient between high school Mathematics and the technology graduating average increased from .272 to .635.

For vocational and academic students and five predictor variables, the best single predictor for success in the technology program was the high school average with correlation coefficients of .384 and .422, respectively. For pretechnology students and the standardizing subsample as a whole, the best single predictor was high school Mathematics with correlation coefficients of .635 and .411.

Analysis of Variance

The analysis of variance tested the hypothesis that the means of all the variables are equal. If the test proved significant, it meant there was a significant difference between any two of the variables used, but a further test would be needed to find out which two. Ideally there should be differences between the predictor variables if each is to make an independent contribution to prediction, but there should be no difference between each predictor and the criterion variable.

Table VI shows that, for the three predictor variables and the criterion, there were significant differences at the .05 level between the means for the academic and total subsamples. Table VII shows that, for the five predictor variables and the criterion, there was a significant differnce only for the subsample as a whole.

Percent of Variance Accounted For

Table VIII lists the percents of variance accounted for, the multiple correlation coefficients, and the standard errors of predicted score derived from the analysis of variance tables for the standarizing subsamples and their three subsamples.

With three predictor variables, the values of the percent of variance accounted for were small, ranging from 14.22% for the standardizing subsample as a whole to 26.93% for the pretechnology students. The corresponding multiple correlation coefficients ranged from .378 to .518. The small values of the percent of variance accounted for indicated

TABLE VI

ANALYSIS OF VARIANCE TABLE FOR THREE PREDICTOR VARIABLES

AND THE CRITERION, GRADUATING AVERAGE

Subsample	N	Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value	Probability Level
Pretech	25	Regression	3	829.1	276.4	2.58	.080
		Residuals	21	2249.1	107.1		
		Total	24	3078.2			
Vocational	15	Regression	3	117.8	39.2	0.64	.607
		Residuals	11	677.8	61.6		
		Total	14	795.6			
Academic	49	Regression	3	1093.8	364.6	3.24	0.31*
		Residuals	45	5058.0	112.4		
		Total	48	6151.8			
Total	89	Regression	3	1431.3	477.4	4.70	.0044*
		Residuals	85	8636.9	101.6		
		Total	88	10068.2			

*Significant at the .05 level

TABLE VII

ANALYSIS OF VARIANCE TABLE FOR FIVE PREDICTOR VARIABLES

AND THE CRITERION, GRADUATING AVERAGE

Subsample	N	Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F-Value	Probability Level
Pretech	14	Regression	5	1122.7	224.5	1.44	.308
		Residuals	8	1247.7	156.0		
		Total	13	2370.4			
Vocational	13	Regression	5	163.1	32.6	0.45	.804
		Residuals	7	512.0	73.1		
		Total	12	675.1			
Academic	46	Regression	5	755.5	151.1	1.95	.107
		Residuals	40	3095.8	77.4		
		Total	45	3851.3			
Total	73	Regression	5	1358.3	271.7	3.28	.0104*
		Residuals	67	5547.8	82.8		
		Total	72	6906.1			

*Significant at the .05 level

TABLE VIII

PERCENT OF VARIANCE ACCOUNTED FOR, MULTIPLE CORRELATION COEFFICIENTS, AND STANDARD ERRORS OF PREDICTED SCORE

Subsample	N	Percent Variance Accounted For	Multiple Correlation Coefficient	Standard Error of Predicted Score
Using Three Predictors:				
Pretechnology	25	26.93	.518	10.35
Vocational	15	14.80	.384	7.85
Academic	49	17.78	.421	10.60
Total	89	14.22	.378	10.08
Using Five Predictors:				
Pretechnology	14	47.36	.687	12.49
Vocational	13	24.16	.491	8.55
Academic	46	19.62	.443	8.80
Total	73	19.7	.444	9.10

that other factors besides the predictor variables were affecting the student's technology graduating average.

The percent of variance accounted for increased with the use of the five predictor variables, justifying the inclusion of DAT scores as predictors. For example, the value for the total subsample increased from 14.22% to 19.7%. The range was from 19.62% for academic students to 47.36% for pretechnology students with multiple correlation coefficients from .443 to .687. The standard errors of predicted score decreased, except for pretechnology students where the value increased from 10.35 to 12.49.

Prediction Equations

Table IX gives the Beta weights and constants for the three-predictor equations. Table X gives the correspon-ding values for the five-predictor equations.

II. CROSS-VALIDATION

Cross-Validation

The prediction equations developed in Part I were applied to a cross-validation subsample. The results are shown in Tables XI to XIII in which the observed and predicted scores are those of the Electronic Technology graduating average. Two predicted scores were obtained for each subject using the three-predictor equations from Table IX, and two predicted scores were found using the five-predictor equations

TABLE IX

BETA WEIGHTS AND CONSTANT FOR THREE PREDICTOR VARIABLES AND THE CRITERION, GRADUATING AVERAGE

Criteria Y	N	Predictor Variables: H.S. Mathematics X_1	H.S. Physics X_2	H.S. Average X_3	Constant
Pretech., Y_P	25	.35	.45	.49	19.9
Vocational, Y_V	15	.03	-.16	.44	46.0
Academic, Y_A	49	.19	-.16	.47	33.3
Total, Y_T	89	.14	-.03	.33	35.1

NOTE: The prediction equations are

(a) for Pretechnology, $Y_P = .35X_1 + .45X_2 + .49X_3 + 19.9$

(b) for Vocational, $Y_V = .03X_1 - .16X_2 + .44X_3 + 46.0$

(c) for Academic, $Y_A = .19X_1 - .16X_2 + .47X_3 + 33.3$

(d) for Total, $Y_T = .14X_1 - .03X_2 + .33X_3 + 35.1$

TABLE X

BETA WEIGHTS AND CONSTANT FOR FIVE PREDICTOR VARIABLES AND THE CRITERION, GRADUATING AVERAGE

Criteria Y	N	Predictor Variables: H.S. Math X_1	H.S. Physics X_2	H.S. Average X_3	DAT-Num. X_4	DAT-Verb. X_5	Constant
Pretech., Y_P	14	1.81	.28	-.82	-1.18	-.04	17.1
Vocational Y_V	13	.25	.01	-.10	.14	.33	37.9
Academic, Y_A	46	.03	.018	.47	-.15	-.17	43.9
Total, Y_T	73	.20	.12	.15	.19	-.12	31.9

NOTE: The prediction equations are

(a) for Pretechnology, $Y_P = 1.81X_1 + .28X_2 - .82X_3 - 1.18X_4 - .04X_5 + 17.1$

(b) for Vocational, $Y_V = .25X_1 + .01X_2 - .10X_3 + .14X_4 + .33X_5 + 37.9$

(c) for Academic, $Y_A = .03X_1 + .018X_2 + .47X_3 - .15X_4 - .17X_5 + 43.9$

(d) for Total, $Y_T = .20X_1 + .12X_2 + .15X_3 + .19X_4 - .12X_5 + 31.9$

TABLE XI

OBSERVED AND PREDICTED SCORES FOR PRETECHNOLOGY STUDENTS

USING THREE AND FIVE PREDICTOR VARIABLES

Student Identification Number	Observed Score, Y	3 Predictor Variables: Predicted Score, Y_P	3 Predictor Variables: Predicted Score, Y_T	5 Predictor Variables: Predicted Score, Y_P	5 Predictor Variables: Predicted Score Y_T
1	61	65	67	83	68
2	64	72	71	87	71
3	64	60	65	60	66
4	66	60	63	52	60
5	64	67	64	45	64
6	71	66	66	53	68
7	28	58	61	47	61
8	59	70	72	74	73
9	69	69	73	105	78
10	72	73	73	76	73
11	61	66	64	58	67
12	54	60	64	83	65
13	50	59	61	51	62
14	57	59	61		
15	60	55	62		
16	59	54	68		
17	66	58	61		
18	56	62	67		
19	47	54	61		
20	56	55	60		
21	68	65	71		
22	61	58	68		
23	64	69	71		

TABLE XII

OBSERVED AND PREDICTED SCORES FOR VOCATIONAL STUDENTS

USING THREE AND FIVE PREDICTOR VARIABLES

Student Identification Number	Observed Score, Y	3 Predictor Variables		5 Predictor Variables	
		Predicted Score, Y_V	Predicted Score, Y_T	Predicted Score, Y_V	Predicted Score, Y_T
24	65	67	62	58	63
25	60	65	63	66	65
26	60	66	68	67	71
27	72	70	67	69	67
28	54	64	61	64	61
29	58	61	62	66	67
30	64	67	66	65	65
31	50	66	64	66	65
32	70	65	65	66	68
33	74	67	64	59	64
34	55	67	65	64	66
35	55	69	66	63	66
36	57	65	63		
37	55	62	58		

TABLE XIII

OBSERVED AND PREDICTED SCORES FOR ACADEMIC STUDENTS

USING THREE AND FIVE PREDICTOR VARIABLES

Student Identification Number	Observed Score, Y	3 Predictor Variables		5 Predictor Variables	
		Predicted Score, Y_A	Predicted Score, Y_T	Predicted Score, Y_A	Predicted Score, Y_T
38	69	65	64	66	66
39	61	63	62	63	63
40	63	61	61	62	64
41	66	65	63	63	63
42	78	63	61	63	60
43	70	67	67	72	71
44	63	60	60	62	61
45	70	62	60	58	63
46	87	65	64	67	65
47	70	65	63	66	63
48	62	59	60	62	64
49	60	62	62	64	62
50	68	60	60	61	59
51	54	64	63	64	63
52	65	58	58	60	58
53	84	70	69	71	71
54	60	70	68	70	69
55	58	70	67	67	65
56	66	69	68	70	70
57	63	64	63	64	62
58	60	62	63	64	67
59	58	63	59	60	59
60	61	65	64	64	63
61	62	66	65	68	64

TABLE XIII (Continued)

Student Identification Number	Observed Score, Y	3 Predictor Variables: Predicted Score, Y_A	3 Predictor Variables: Predicted Score, Y_T	5 Predictor Variables: Predicted Score, Y_A	5 Predictor Variables: Predicted Score, Y_T
62	64	60	60	63	59
63	72	65	65	68	69
64	70	66	64	64	64
65	85	71	69	70	69
66	70	61	62	64	63
67	78	67	66	66	67
68	70	60	60	60	59
69	68	65	63	64	63
70	52	69	66	68	64
71	73	62	61	61	58
72	70	66	63	63	62
73	66	64	63	63	63
74	74	70	68	71	69
75	73	63	63	66	63
76	68	61	60	62	60
77	72	64	64	64	64
78	58	65	64	68	63
79	74	65	63	63	62
80	44	66	64	67	67
81	68	69	67	68	68
82	76	69	67	68	67
83	76	67	68		
84	62	61	61		
85	66	54	54		

from Table X.

Correlations Between Observed and Predicted Scores

Table XIV shows the analysis of the cross validation in which the means and standard deviations for the observed and predicted scores, the correlation coefficients, t-values, and probability levels are given.

In general, the means and standard deviations of the observed scores for the cross-validation subsample were less than for the standardizing subsample given in Tables II and III, especially for pretechnology and vocational students. For example, with three predictors, pretechnology students in the cross-validation subsample had a mean technology graduating average of 59.9 with a standard deviation of 9.13. The corresponding values in the standardizing subsample were 63.5 and 11.32.

Correlations between observed and predicted scores were small. For the set of three-predictor equations, values of the correlation coefficient ranged from .196 for academic students to .532 for pretechnology students. For the five-predictor equations, the range was from -.178 for vocational students to .343 for pretechnology students. However, the t-test showed there was no significant difference between the means of the observed and predicted scores, except in two cases. There were significant differences at the .05 level when the three-predictor equations were applied to the

TABLE XIV

CORRELATIONS BETWEEN OBSERVED AND PREDICTED SCORES

USING THREE AND FIVE PREDICTOR VARIABLES

Subsample	N	Means		Standard Deviations		Correlation Coefficient	t-Value	Probability of t
		Observed Score	Predicted Score	Observed Score	Predicted Score			
Using Three Predictors:								
Pretech.	23	59.9	62.3	9.13	5.77	.532	2.88	.009*
Voc.	14	60.6	65.9	7.07	2.27	.367	1.37	.196
Academic	48	67.2	64.3	8.20	3.53	.196	1.35	.183
Total	85	64.2	64.0	9.01	3.54	.227	2.12	.037*
Using Five Predictors:								
Pretech.	13	60.2	67.3	11.07	17.75	.343	1.21	.251
Voc.	12	61.4	64.4	7.34	3.00	-.178	-.57	.580
Academic	45	67.2	65.0	8.33	3.30	.133	.88	.383
Total	70	64.9	64.9	9.28	3.84	.168	1.41	.164

*Significant at the .05 level

pretechnology subsample and to the cross-validation subsample as a whole.

The first hypothesis stated that it will not be possible to predict the graduating average in the Electronic Technology program on the basis of high school Mathematics, Physics, and average. This hypothesis cannot be rejected for the pretechnology students and the subsample as a whole, but is rejected for the vocational and academic students.

The second hypothesis stated that prediction will not be improved if standardized test scores in Numerical Ability and Verbal Reasoning, as well as the high school record, are used as predictors.

The computer program for the stepwise regression was designed to add or delete predictor variables at the .05 level of significance. Neither of the two DAT scores was deleted in the five-predictor equations, indicating that they made a significant contribution to prediction. Table VIII also shows that on adding the DAT scores the percent of variance accounted for increased from 14.22% to 19.7% for the standardizing subsample as a whole and from 26.93% to 47.36% for pretechnology students with corresponding increases in the multiple correlation coefficients. A further indication of improvement in prediction is given in Table XIV which shows that with five predictors, the probability values of t were higher than the corresponding values with three predictors. The higher probability values of t indicated that the predicted and observed cores were more nearly alike than when only three predictors were used.

For these reasons, the second hypothesis is rejected.

III. DISCRIMINATION

To study the influence of the type of high school preparation on the Electronic Technology graduating average, the means and standard deviations of the observed technology graduating average were determined for the pretechnology, vocational, and academic students forming the sample. The results are shown in Table XV.

A chi-square homogeneity of variance test was applied to see if the variances for the three subsamples were equal. The probability level was .204, and thus it was concluded that the variances were equal, indicating that the three subsamples came from the same sample.

The mean graduating averages were 61.8, 63.2, and 65.8% for the pretechnology, vocational, and academic subgroups, respectively, but an analysis of variance test showed that the differences in the scores were not significant at the .05 level.

The third hypothesis stated that it will not be possible to discriminate between the suitability of the three types of high school preparation that serve as admission requirements for the Electronic Technology program. As no significant difference was found in the means of the graduating average, this hypothesis cannot be rejected.

TABLE XV

MEANS AND STANDARD DEVIATIONS OF THE OBSERVED TECHNOLOGY GRADUATING AVERAGE FOR THE SAMPLE

Subsample	N	Mean	Standard Deviation
Pretechnology	48	61.8	10.47
Vocational	29	63.2	7.73
Academic	97	65.8	9.99
Total	174	64.3	9.88

Chi-Square Homogeneity Test: Probability = .204

Analysis of Variance Test: Probability = .055

CHAPTER V

SUMMARY, DISCUSSION, AND RECOMMENDATIONS

I. SUMMARY OF THE RESULTS

This study sought to relate the high school record and standardized aptitude test scores to success in the Electronic Technology program at the Northern Alberta Institute of Technology. In particular, it considered the admission requirements for the program and their influence on three kinds of entering student. Findings from a study of this type could be useful when decisions have to be made on admission requirements, the need for remedial work, and student counseling in the high school.

The study is in three parts. Part I. Prediction established a set of prediction equations, Part II. Cross-Validation checked them for accuracy, and Part III. Discrimination studied the influence of the type of high school preparation on success in the Electronic Technology program.

Results of the study showed that:

1. It was possible to predict the graduating average of vocational and academic students in the Electronic Technology program on the basis of their high school record alone, as represented by high school Mathematics, Physics and average, but it was not possible to make predictions for pretechnology students or for students in general on this

basis.

2. Prediction was improved when standardized test scores in Numerical Ability and Verbal Reasoning, as well as the high school record, were used as predictor variables. It was possible to predict the graduating average of pre-technology, vocational, and academic students in the program either separately or jointly with the use of appropriate five-predictor equations.

3. It was not possible to discriminate between the suitability of the three types of high school preparation that serve as admission requirements for the Electronic Technology program. Although the pretechnology, vocational, and academic students had mean technology graduating averages of 61.8, 63.2, and 65.8% respectively, the differences were not significant at the .05 level.

II. DISCUSSION

Certain assumptions were made in this study. Among them was the uniformity in marking throughout the high schools and for different programs. Table II, for example, shows that the mean high school marks for Mathematics, Physics, and average for pretechnology students were higher than for academic students, but the academic students obtained a slightly higher technology graduating average. This would suggest that uniform marking did not exist in the high schools. It is because high school grades often lack a high degree of comparability that standardized tests are used as supplementary criteria of performance. In the present study, the use of two scores from the standardized DAT tests improved prediction.

Correlation coefficients in Tables IV and V showed that selected components of the high school record, especially Mathematics and the high school average, were significantly related to success in the program, but neither of the DAT scores were. The DAT scores did contribute to prediction, however, when used with other predictors since they were not deleted from the prediction equations at the .05 level of significance.

Wurfel (1969) showed that of all the subtests of the DAT battery, when used separately, only Numerical Ability had some predictive power in predicting success in the Electronic Technology program at NAIT. Price (1971) found that it was not possible to predict the success of students in a technology program on the basis of DAT scores alone. The present study showed that selected DAT scores, when used with other predictors, can have value in prediction.

Similarly, components of the high school record for vocational students were not significantly related to the graduating average until combined in a prediction equation.

The generally high correlation coefficients between components of the high school record showed that they were measuring much the same quantity. Further evidence of this is given in the Analysis of Variance Tables VI and VII which show that in most cases there was no significant difference between any of the variables used. It also explains the small percent of variance accounted for in Table VIII.

If this study had been concerned with finding the best combination of predictors, the high correlation coefficients between high school Mathematics, Physics, and average would indicate a poor selection of predictors. However, this study dealt primarily with the relationship between admission requirements and success in the program, and thus the predictors were already established.

Perhaps the relationship between academic studies in high school and success in the Electronic Technology program is recognized by students. In this study there were 48 pretechnology, 29 vocational, and 97 academic students.

Of the eight prediction equations developed, six were found to be accurate, giving no significant difference between observed and predicted scores at the .05 level. Table XIV shows that in terms of the probability of t, the two best equations were the five-predictor equations for the vocational and academic students. The results for vocational students are surprising. As stated earlier, Table V showed that for the voc tional students no single predictor was significantly related to success in the technology program, but when combined to form a prediction equation, they were able to predict with considerable accuracy.

The two prediction equations that did not pass the requirements of cross-validation were the three-predictor equations for the pretechnology students and for the subsample as a whole. A t-test showed that the differences in the means of the graduating average for the pretechnology students used in prediction and cross-validation were not significant, indicating they came from the same subsample. The same results were obtained for the subsample as a whole, thus the failure of the two prediction equations was not because the prediction and cross-validation subsamples were different.

In the prediction subsample there were 14 pretechnology students who wrote the DAT tests and 11 who did not. The corresponding numbers in the cross-validation subsample were 13 and 10. It is suspected that the differences in the records between pretechnology students who wrote and those who did not write the DAT tests were the reason the two equations were not validated, although no tests were made to see if the differences were significant.

All students with a complete high school record were included in the three-predictor study, whether they had written the DAT tests or not, on the assumption that prediction would be improved with the use of large numbers. The results now indicate that a better study would have resulted if only those students who had written the DAT tests were included in both the three-predictor and five-predictor parts of this work.

Tables II and III, as well as Tables XXII and XXIII in the Appendix, show there was all-round improvement in the performance of pretechnology students when the records of those without DAT scores were deleted. This suggests that pretechnology students without DAT scores are students who try to avoid formal evaluation where possible.

This study showed that admission to the Electronic Technology program is rightly based on the completion of the high school diploma or its equivalent, with a specified standing in Mathematics and Science. The type of high school preparation is not significant.

Lee (1974) conducted a study on Electronic Technology students at the Northern Alberta Institute of Technology that was similar to this but differed from it in several important respects. His study was concerned with the influence of high school Electronics and Electricity on performance in each of the two years of the technology program, the determination of the best single predictor for success in each of the two years, and the establishment of prediction equations for each year using the best combination of predictor variables from the high school records and the two DAT tests. Lee did not cross-validate his equations nor did he specifically differentiate between the three types of high school preparation.

III. RECOMMENDATIONS

Unlike most, this prediction study did not attempt to find the best set of predictors for success, but used data from the high school record representing the admission requirements to the technology program, and data from a standardized aptitude test administered by the Counseling Department at NAIT.

It is recommended that any study directed to finding the best combination of independent predictors for success in [illegible]ronic Technology program recognize that:

[illegible] high school Mathematics, Physics and average are [illegible]ated and do not make truly independent contributions to prediction.

2. While the DAT scores in themselves may not provide a useful means of prediction, they can be useful when employed with other predictors.

3. To ensure accuracy in the results, only those students with a complete record should be included in the study.

Although this study showed that it is possible to predict the success of students in this program on the basis of the high school record and DAT scores, other factors are involved. This was indicated by the relatively low percent of variance accounted for. It is recommended that a study be made to determine what these other factors are, particularly those relating to the students' attitudes and personality.

This study considered only those students who succeeded in the program. It is recommended that an alternative study consider the students who did not succeed and, in particular, examine the attrition rates of pretechnology, vocational, and academic students in this program.

Finally, it is recommended that those associated with admissions, remedial work, and high school counseling recognize the importance of high school Mathematics as a predictor of success in this program.

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APPENDIX

TABLE XVI

PRETECHNOLOGY STUDENT RECORD USED IN PREDICTION

Student Identification Number	High School Mathematics Percent	High School Physics Percent	High School Average Percent	DAT - Numerical Ability Score	DAT - Verbal Reasoning Score	Graduating Average Percent
1	66	73	71	29	39	57
2	81	80	84	36	40	55
3	65	68	67	34	32	61
4	74	82	80	36	35	75
5	65	65	65	37	42	63
6	76	68	83	30	38	80
7	78	85	78	34	20	75
8	81	88	82	39	38	75
9	70	73	75	32	39	61
10	81	88	82	39	38	75
11	86	90	88	37	37	75
12	57	62	61	33	41	28
13	68	79	74	32	43	74
14	62	63	47	36	43	67
15	76	71	67			51
16	72	71	68			48
17	59	77	56			61
18	54	54	65			70
19	62	63	64			59
20	70	71	72			63
21	57	82	65			73
22	85	79	72			59
23	71	72	62			56
24	69	81	76			64
25	52	64	65			62

See Tables II and III for the means and standard deviations

TABLE XVII

VOCATIONAL STUDENT RECORD USED IN PREDICTION

Student Identification Number	High School Mathmatics Percent	High School Physics Percent	High School Average Percent	DAT - Numerical Ability Score	DAT - Verbal Reasoning Score	Graduating Average Percent
26	71	90	70	40	37	61
27	59	68	62	34	36	62
28	55	64	64	39	40	55
29	68	64	67	35	41	62
30	90	72	71	32	38	64
31	58	67	61	39	43	76
32	66	73	69	40	47	76
33	67	62	59	31	19	69
34	59	76	63	36	41	70
35	75	80	69	23	35	67
36	90	80	82	39	46	80
37	60	65	59	34	32	58
38	68	50	43	40	19	63
39	75	75	64			55
40	73	76	65			66

See Tables II and III for the means and standard deviations

TABLE XVIII

ACADEMIC STUDENT RECORD USED IN PREDICTION

Student Identification Number	High School Mathematics Percent	High School Physics Percent	High School Average Percent	DAT - Numerical Ability Score	DAT - Verbal Reasoning Score	Graduating Average Percent
41	72	69	65	38	34	53
42	68	70	70	35	38	76
43	55	60	57	32	38	69
44	59	71	60	38	43	64
45	83	89	76	37	44	81
46	51	60	50	36	25	54
47	71	70	73	36	33	78
48	55	70	57	32	32	52
49	50	43	49	34	34	57
50	51	57	54	36	43	77
51	52	52	51	37	43	30
52	62	62	62	33	43	55
53	71	65	66	36	39	64
54	87	85	82	36	42	73
55	55	67	58	36	30	62
56	51	62	56	37	48	70
57	70	85	78	38	41	57
58	90	61	70	34	36	69
59	82	64	71	35	44	78
60	59	70	49	38	32	60
61	61	71	66	37	46	70
62	59	70	58	33	32	63
63	87	88	81	32	31	78
64	74	82	75	39	48	69
65	59	60	59	32	29	73

TABLE XVIII (Continued)

Student Identification Number	High School Mathematics Percent	High School Physics Percent	High School Average Percent	DAT - Numerical Ability Score	DAT - Verbal Reasoning Score	Graduating Average Percent
66	64	72	66	32	34	73
67	70	67	67	32	37	67
68	79	65	72	38	43	67
69	52	62	53	27	33	57
70	74	73	71	36	42	63
71	55	70	59	32	44	65
72	67	75	66	39	45	71
73	75	85	79	39	40	71
74	75	56	60	39	17	71
75	72	70	66	37	46	62
76	68	60	68	35	36	54
77	61	75	62	36	44	63
78	75	72	70	31	41	60
79	63	67	61	30	33	66
80	54	58	56	31	33	75
81	68	61	64	38	35	73
82	60	69	63	33	45	62
83	74	80	71	35	42	62
84	76	77	70	36	44	71
85	73	70	70	35	41	58
86	62	60	60	37	24	67
87	53	71	57			18
88	76	66	60			57
89	68	64	55			71

See Tables II and III for the means and standard deviations

TABLE XIX

PRETECHNOLOGY STUDENT RECORD USED IN CROSS-VALIDATION

Student Identification Number	High School Mathematics Percent	High School Physics Percent	High School Average Percent	DAT - Numerical Ability Score	DAT - Verbal Reasoning Score	Graduating Average Percent
1	75	82	71	28	39	61
2	81	90	81	29	41	64
3	67	66	69	33	33	64
4	55	61	66	22	32	66
5	57	73	70	31	34	64
6	67	75	73	38	38	71
7	57	62	61	33	41	28
8	82	84	83	38	39	59
9	93	90	84	31	14	69
10	82	85	88	33	41	72
11	60	76	68	27	11	61
12	67	70	65	18	12	54
13	57	65	60	31	32	50
14	57	66	60			57
15	59	56	62			60
16	87	67	70			59
17	58	65	60			66
18	76	75	71			56
19	62	60	58			47
20	51	54	59			56
21	84	80	79			68
22	79	70	71			61
23	77	82	82			64

See Tables XXII and XXIII for the means and standard deviations

TABLE XX

VOCATIONAL STUDENT RECORD USED IN CROSS-VALIDATION

Student Identification Number	High School Mathematics Percent	High School Physics Percent	High School Average Percent	DAT - Numerical Ability Score	DAT - Verbal Reasoning Score	Graduating Average Percent
24	52	64	66	35	25	65
25	70	60	59	37	31	60
26	80	90	72	31	34	60
27	74	66	72	35	42	72
28	60	61	57	29	35	54
29	70	80	58	35	31	58
30	80	67	66	15	33	64
31	75	55	60	35	30	50
32	66	85	69	39	35	70
33	64	68	67	22	24	74
34	65	75	69	34	35	55
35	70	60	69	33	27	55
36	72	55	58			57
37	55	50	51			55

See Tables XXII and XXIII for the means and standard deviations

TABLE XXI

ACADEMIC STUDENT RECORD USED IN CROSS-VALIDATION

Student Identification Number	High School Mathematics Percent	High School Physics Percent	High School Average Percent	DAT - Numerical Ability Score	DAT - Verabl Reasoning Score	Graduating Average Percent
38	66	73	66	37	36	68
39	61	62	60	37	36	62
40	65	67	57	38	34	6[illegible]
41	64	62	63	36	46	60
42	53	57	62	38	42	78
43	75	86	73	35	29	70
44	59	58	55	32	30	63
45	57	51	56	55	40	70
46	64	73	68	35	41	87
47	67	62	62	28	33	70
48	61	70	56	36	32	62
49	53	62	63	37	35	60
50	52	60	58	36	44	68
51	66	62	61	32	37	54
52	45	52	54	38	32	65
53	80	85	76	37	42	84
54	78	71	72	35	36	60
55	70	59	71	36	43	58
56	82	83	73	34	42	66
57	59	64	64	34	43	63
58	69	72	60	39	30	60
59	62	34	50	33	25	58
60	65	64	65	36	46	61
61	66	67	67	26	36	62

TABLE XXI (Continued)

Student Identification Number	High School Mathematics Percent	High School Physics Percent	High School Average Percent	DAT - Numerical Ability Score	DAT - Verbal Reasoning Score	Graduating Average Percent
62	50	61	58	31	34	64
63	72	80	67	35	30	72
64	68	66	65	38	48	70
65	80	76	75	34	43	85
66	60	72	61	34	38	70
67	72	76	69	38	44	78
68	53	60	57	35	45	70
69	69	55	60	33	33	68
70	67	63	71	30	43	52
71	56	53	58	32	47	73
72	65	54	63	36	46	70
73	65	65	63	36	45	66
74	71	80	78	38	41	74
75	63	70	63	29	36	73
76	56	57	56	33	36	68
77	64	68	65	38	43	72
78	66	67	65	26	34	58
79	59	60	66	39	47	74
80	73	63	62	33	23	44
81	77	61	68	36	31	68
82	72	72	72	37	43	76
83	84	90	71			76
84	54	62	60			62
85	45	51	44			66

Tables XXII and XXIII for the means and standard deviations

TABLE XXII

MEANS AND STANDARD DEVIATIONS OF THE THREE PREDICTOR VARIABLES AND OF THE CRITERION, GRADUATING AVERAGE, FOR THE CROSS-VALIDATION SUBSAMPLE

Variable	Pretechnology		Vocational		Academic		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Predictor Variables:								
High School Mathematics	69.1	12.00	68.1	[illegible]10	64.6	9.11	66.4	10.05
High School Physics	71.9	10.23	66.9	11.36	65.4	10.33	67.4	10.85
High School Average	70.0	8.85	63.8	6.27	63.5	6.84	65.3	7.90
Criterion Variable:								
Graduating Average	59.9	9.13	60.6	7.07	67.2	8.20	64.2	9.01
Number of Observations, N	23		14		48		85	

TABLE XXIII

MEANS AND STANDARD DEVIATIONS OF THE FIVE PREDICTOR VARIABLES AND OF THE CRITERION, GRADUATING AVERAGE, FOR THE CROSS-VALIDATION SUBSAMPLE

Variable	Pretechnology		Vocational		Academic		Total	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Predictor Variables:								
High School Mathematics	69.2	11.81	68.8	7.78	64.8	8.31	66.3	9.20
High School Physics	75.3	9.82	69.2	10.46	65.2	9.78	67.8	10.64
High School Average	72.2	8.69	65.3	5.20	63.9	6.31	65.7	7.38
DAT – Numerical Ability	30.1	5.40	31.7	6.53	35.1	4.36	33.6	5.42
DAT – Verbal Reasoning	31.3	10.89	31.8	4.79	38.2	6.26	35.8	7.83
Criterion Variable:								
Graduating Average	60.2	11.07	61.4	7.34	67.2	8.33	64.9	9.28
Number of Observations, N	13		12		[illegible]5		70	