AN EXAMINATION OF RELATIONSHIPS BETWEEN MATHEMATICS ABILITY AND ACHIEVEMENT IN AN ELECTRONICS PROGRAM AT OKLAHOMA STATE TECH

By

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Rapid technological advances have generated thousands of jobs for qualified electronic technicians. These jobs are continuing to increase as technology builds greater technology. The electronic technicians needed to fill these jobs must possess the ability to use both hand and mind in analysis, problem solving and repair. The educational institutions have been striving to provide such technicians for industry as fast as time will permit. However, many factors must be considered and overcome before these institutions can produce the needed technicians.

The proper placement of the new student into a selected electronic program of coursework has been a crucial task. Allowing a student to enroll in a program if his academic background is weak could result in the student having to struggle to survive in such a course or withdraw from the course completely.

The acceptance of a student into an electronics technology program has been based primarily on the academic achievement of the student prior to his enrollment. Many problems arise when an advisor needs to evaluate the student's high school transcript and determine if he should be permitted

to enroll in a particular electronics program. A better understanding of the relationship between the student's academic ability and success within the program will enable the advisor to properly select appropriate coursework for the student.

Problem Statement

Students with varied backgrounds in mathematics have enrolled in the electronics department at Oklahoma State Tech, Okmulgee, Oklahoma. The electronics department needs to be better informed as to the real importance that the student's background in mathematics has on success within the electronics program. Without sufficient information as to the probable success of the student within an electronics program, the student might enroll in a program and, being unable to complete it due to a deficiency in background mathematics, be forced to withdraw. If the advisor had been made aware of the probable success of the student within a program by evaluation of his background mathematics ability then the student could have been offered a program within the electronics department requiring less mathematics or the student might pursue another area of technology requiring less mathematics.

Purpose of the Study

The purpose of this study was to evaluate selected variables to determine if a relationship exists between high school mathematics and student achievement in the Industrial Electronics

program offered at Oklahoma State Tech, Okmulgee, Oklahoma. This study evaluated the degree of success that students had in the program and compared this degree of success with their entrance mathematics background.

Definition of Terms

Technical Institute

Technical institute is a post high school institution offering training for occupations in which emphasis is placed on the application of the functional aspects of mathematics and science, or an officially designated, separately organized technical institute division of a four-year institution. The primary purpose of the technical institute is training for an objective other than the baccalaureate degree (1).

Technician

A technician is a specialist in the technical details of a subject or occupation; one who has acquired the technique of an art or other area of specialization (2).

High School Mathematics Grade Point Average (GPA)

High school mathematics GPA is to be understood to mean the average grade of all mathematics courses taken during high school. For the purpose of this study high school mathematics GPA was quantified as follows: A was given a numerical grade of 4, B the value of 3, C the value of 2, D the value of 1 and F the value of 0.

High School Mathematics Level

High school mathematics level is to be understood to mean the highest level mathematics course completed by the student. For the purpose of this study high school mathematics levels were quantified as follows:

Level 1	General Math
Level 2	Algebra I
Level 3	Geometry
Level 4	Algebra II
Level 5	Trigonometry

Industrial Electronics Grade Point Average (GPA)

Industrial Electronics GPA is to be understood to mean the average grade of all electronics courses taken which were necessary to graduate from the program. The GPA does not include additional electronics course work taken after these requirements were met.

Industrial Electronics Additional Course Level

Industrial Electronics additional course level is to be understood to mean the highest level electronics course completed after all requirements were met to graduate in the initial selected program. Each level consisted of an additional 150 to 160 hours of training in electronics.

CHAPTER II

REVIEW OF LITERATURE

Research studies which have been conducted concerning mathematical ability of students have been many in number. Many studies show an interest in the students' mathematical ability in high school. In addition a great concern for the students' success within a technical institute program is seen by studies done in the remedial/developmental mathematics area. Also there is a concern for the students' mathematical ability within the program itself as several such studies have been conducted. Few studies, however, have evaluated a student's overall performance in a technical program, specifically an industrial electronics program, based upon selected high school mathematic entrance variables.

Many two-year programs are needed to educate technicians to meet the technological needs of industry. The two-year programs needed to educate these technicians must be carefully planned and organized to provide the student with the best opportunities for maximum learning within a limited two years of training. An important requirement for these technicians to be fully qualified is that they must have a strong background in mathematics.

Supporting the need for mathematics in technological

programs a U.S. Office of Education publication (3) incorporates "a facility with mathematics" as one of the five special abilities required of a technician.

Braden and Roney (4) in stating the specifics to describe a formal program of occupational studies at the associate degree level cited as one of five specifics that mathematics and the physical or biological sciences are integral parts of the program; technical study is mathematics and science-based at all levels of the program.

Ulam (5, p. 4) indicated "that the development and use of mathematical tools were a prerequisite to development of present-day technology."

Venables (6) explores the necessity for a variety of levels of mathematic courses within a technical college.

Perhaps at this point one should observe that a technician requires a certain level of mathematics. Certainly not the highest level, but a substantial level.

Harris in his study showed that the student with the greater mathematics ability attended a four year program. He hypothesized that the student choice of two-year technical programs over four-year related programs was dependent upon the number of high school math and science courses completed. He also hypothesized that the success in a two-year technical program is dependent upon the number of high school math and science courses. The results indicated that two characteristics were accepted as significant indicators of two-year technical program preference. Of these two, one of the characteristics that was

accepted as a significant indicator was high school math and science background as measured by number of math and science courses taken in high school. Harris shows that the math and science background showed a clear indication to deviate from the expected values in the manner predicated, i.e., the fewer the number of math and science courses the greater the probability of two-year technical program selection (7).

One solution used to prevent technology students from failing to complete their coursework due to an inadequate background in mathematics is to offer pre-technology programs. These programs are designed to prepare high school students to meet their entrance requirements of technical institute programs. One such program presently being offered is at Cogswell Polytechnical College in California. This program started in the year 1961, and has shown great success. The existence of these pre-technology programs is substantiated by the fact that too many students entering engineering technology programs in technical institutes were ill prepared for the demands and rigors of those programs. They were extremely weak in mathematics, physical science, and, most of all, in their ability to express themselves, both orally and in writing (8).

Seeger (9) in his study was concerned with how to effectively serve students with inadequate backgrounds. He indicated that most two-year colleges which include community colleges, junior colleges, and technical institutes operate "under the open door concept" and thousands of poorly prepared students are taking advantage of this opportunity "to

enter higher education".

Seeger (9) feels that:

> Whether it is, in fact, an opportunity for the student or just a deadend path depends, to a certain extent, on the remedial activities the institution is prepared to provide and the effectiveness of their efforts (p. 1).

The purpose of Seeger's study then was to analyze the academic records of students who have already enrolled in a two-year program and who have completed remedial courses in mathematics at Oklahoma State University Technical Institute, Oklahoma City, Oklahoma, and to determine the degree of success or lack of success that they have experienced as compared with other students who were not required to take remedial mathematics courses. His concern also was to determine if more students graduate and go out into the technical area of their speciality by offering these weaker students remedial courses within the program. He concluded that students do attain an adequate level of success in remedial courses (9).

Matthews in his study of vocational and technical education realized that the prime purpose was in preparing students for the rapidly changing field of work today. He indicated that in order to prepare a student for his occupational choice, knowledge of his mathematical needs and his competency level in the needed area is necessary. He felt that identification and correction of the students' deficiency in needed mathematics concepts was also of prime importance. His study provided schools with some additional knowledge in the identification and correction of mathematics deficiencies (10).

Matthews (10) stated that:

> The purpose was to provide schools and administrators with a model for the identification and correction of mathematics deficiencies through the use of a concept diagnostic and individually prescribed concept correction package approach. It was found that occupations could be analyzed so that mathematical competencies needed for successful performance could be determined, that mathematical concepts needed in occupations could be identified and individual deficiencies could be isolated for each student, that needed mathematics concept correction packages could be organized or constructed, and that it could be demonstrated that the students, who have deficiencies in needed mathematics concepts, have reached set performance standards after completion of concept correction packages (p. 79, 80).

The Fayetteville Technical Institute (11) in North Carolina has an open door admission policy and they also found that:

> Recruitment of qualified students with adequate background in mathematics, science, and communicative skills is becoming an increasingly difficult task. Great numbers of students are applying for entrance into the fields of technology; but after careful testing and counseling many of them fail to meet the minimum admissions requirements established by the colleges and accreditation agencies (p. TE 1).

To overcome problems of ill-prepared students entering coursework at their institute, a pre-technical program was instituted and the results of this program were that many students were helped by overcoming their deficiencies. These students were willing to accept this program when they understood that it was an integral part of the school's total educational program and that they were classified as full time students with the same status of their peers (11).

Boudreau (11 p. TE 2) indicates that "there is nothing sacred about finishing an associate degree curriculum in two

years. If it takes three years or if it takes four years to complete this requirement" this does not matter as long as the end result is that the student succeeds in his chosen field. In addition Boudreau (11) indicates that the program served as a salvage function. Students who were failing in the engineering technology could move into the pre-technical program rather than drop from school. After gaining confidence and ability, the student could again enter into his chosen field and succeed. Without this program these students had to change to a vocational field where math and science requirements were less restrictive or leave school.

Tinnell (12) also shows concern with the area of realizing that mathematics is essential for success within a program. His study "examined the strength of the relationship between mathematics ability and student achievement in the first year of electromechanical technology at Oklahoma State University."

Tinnell (12) concluded that:

> On the basis of these results one could conclude that high school background in mathematics would offer the most promise as a tool for identifying potentially successful students for electromechanical technology (p. 22).

Darby (13) indicated an interest with "the lack of information relative to the advisement of beginning engineering technology students at Oklahoma State University in the selection of the appropriate mathematics courses." He indicated that at best the evaluation of student entry parameters and subsequent recommendation of courses for the beginning college student is a difficult decision.

Darby (13) specifically states that:

> Since the variables selected (for his study) were of minimal predictive value, other entry factors should be considered. Further consideration of high school background, to include mathematics level and grade average may be worthwhile (p. 37, 38).

Not only has the concern for the technicians' background in mathematics been of primary importance in both high school and pre-technical or post-secondary remedial courses or even during the technical electronic coursework itself, but this concern continues even beyond graduation when the technician is working in industry.

Gillie (14) in his study of continuing education characteristics of selected associate degree graduates discovered that there is a basis to examine the continuing education activities of the Pennsylvania State Associate Degree graduates. The study was conducted as part of a larger study to:

> Determine characteristics common to associate degree graduates of six technical education programs at Pennsylvania State University so as to determine the relevance and relative effectiveness to the population it served (p. 1).

Gillie's (14, p. 130) findings disclosed that of the "coursework taken upon graduation from their institution, mathematics courses were taken most often by the graduates with the intentions of increasing expertise in their specialities."

Some authors, however, in examining various entrance mathematics variables concluded that mathematics offers little promise in determining student success.

Roberts (15) determined that a weak though positive

relationship existed between technical courses grade point average (GPA) and American College Test (ACT) mathematics scores.

In addition to other areas, Chin included the determination of the following relationships:

(1) ACT mathematics score and the first year GPA at three junior colleges;

(2) High school GPA and the first year GPA at the same junior colleges;

(3) Level of mathematics taken prior to admission and the first year GPA at the three junior colleges.

The results of the study showed that none of these relationships showed a significant correlation with the criterion (16).

Summary

From the review of the literature the need can be seen that mathematics does play an important part in the role of a technician. This study will examine the relationship between the students' background in mathematics and his overall success within the Industrial Electronics program at Oklahoma State Tech and to attempt to determine if a weak background in mathematics will not only affect the academic performance of the student but cause the student to not elect to take any additional electronic related coursework.

Statement of Hypotheses

Based on a review of literature and with the scope of this study the following hypothese are stated:

(1) There is no statistically significant correlation between high school mathematics grade point average (GPA) and the GPA earned in technical courses in the Industrial Electronics program at Oklahoma State Tech (O.S.T.).

(2) There is no statistically significant correlation between high school mathematics level and the GPA earned in technical courses in the Industrial Electronics program at O.S.T.

(3) There is no statistically significant correlation between high school mathematics GPA and additional course levels completed in the Industrial Electronics program at O.S.T.

(4) There is no statistically significant correlation between high school mathematics level and additional course levels completed in the Industrial Electronics program at O.S.T.

CHAPTER III

METHODOLOGY

Data for fifty-two students was collected to be used in this study. These students represented all graduates for the year 1975, in the Industrial Electronics program at Oklahoma State Tech. Of this total number, twenty-five students were excluded from the sample. The most common reasons for rejection were that no high school transcript was available or course-work credit was given due to military training, transfer credit, etc. Only those students whose high school transcripts were complete and had concluded all electronic coursework at O.S.T. were included in this study.

Statistical Method

For this study, the Pearson product moment correlation, designated r, was used to provide information regarding the relationship between the two variables. The Fisher t-test was used to test the null hypothesis.

The null hypothesis was rejected if the calculated value of t was greater than the table value at the 1% level (t=2.787). The null hypothesis was not rejected if the calculated value was greater than the table value at the 5% level (t = 2.060). If the calculated value of t was significant between the 1%

and 5% levels then the hypothesis was or was not rejected depending upon the value of r and the significant level. If the null hypothesis was rejected, by the use of linear regression, the high school mathematics GPA and high school mathematics level can be used as predictors for success in the electronics program for future students.

Although the correlation coefficient and significant levels are necessary in testing the null hypotheses, they offer little to educators in actually providing a visual concept of the relationship between variables. Therefore, the correlation diagrams (scatter diagrams) have been provided. These diagrams are represented by Figures 1 through 4 in Chapter IV.

TABLE I

COLLECTED DATA FROM OKLAHOMA STATE TECH

Student Number	High School Math GPA	High School Math Level	O.S.T. Electronics GPA	O.S.T. Electronics Level
1	2.00	4	2.58	3
2	2.67	4	3.28	2
3	1.50	4	2.16	4
4	2.00	4	2.50	3
5	2.33	4	2.72	4
6	2.00	3	2.00	2
7	2.00	1	2.30	2
8	1.50	3	2.40	4
9	1.00	3	2.88	4
10	2.67	4	3.23	6
11	2.00	1	2.43	4
12	2.50	3	3.22	6
13	1.67	4	2.69	4
14	3.00	2	2.99	2
15	3.00	2	2.06	2
16	1.50	2	2.33	4
17	1.50	2	2.27	4
18	1.00	4	2.78	4
19	2.67	3	1.31	4
20	2.00	4	1.82	4
21	1.00	2	2.52	2
22	3.00	2	3.49	6
23	3.00	1	3.44	2

TABLE I (Continued)

Student Number	High School Math GPA	High School Math Level	O.S.T. Electronics GPA	O.S.T. Electronics Level
24	1.67	3	2.56	4
25	3.33	4	3.73	2
26	1.67	3	2.33	2
27	3.00	5	2.87	2

CHAPTER IV

RESULTS OF INVESTIGATION

Pearson's product moment correlation was used to determine the relationship between high school mathematics GPA and O.S.T. electronics GPA, high school mathematics GPA and O.S.T. electronics course level, high school mathematics level and O.S.T. electronics GPA, and high school mathematics level and O.S.T. electronics course level. These correlations were tested by t tests at the one percent confidence level. The results are shown in Table II.

Table II reveals that no test was significant at the one percent level. Thus the null hypotheses were not rejected. High school mathematics GPA vs O.S.T. electronics GPA was significant, however, at the five percent level. No other relationship was significant at the five percent level.

TABLE II

COEFFICIENT OF CORRELATION AND
T-TEST RESULTS

Name of Test	r	t-Test	Hypothesis Disposition
High School Math GPA/ O.S.T. Electronics GPA	0.397	2.160	Not Rejected
High School Math Level/ O.S.T. Electronics GPA	0.082	0.409	Not Rejected
High School Math GPA/ O.S.T. Electronics Level	0.133	-0.670	Not Rejected
High School Math Level/ O.S.T. Electronics Level	0.111	0.558	Not Rejected

In each case the rejection level was 0.01

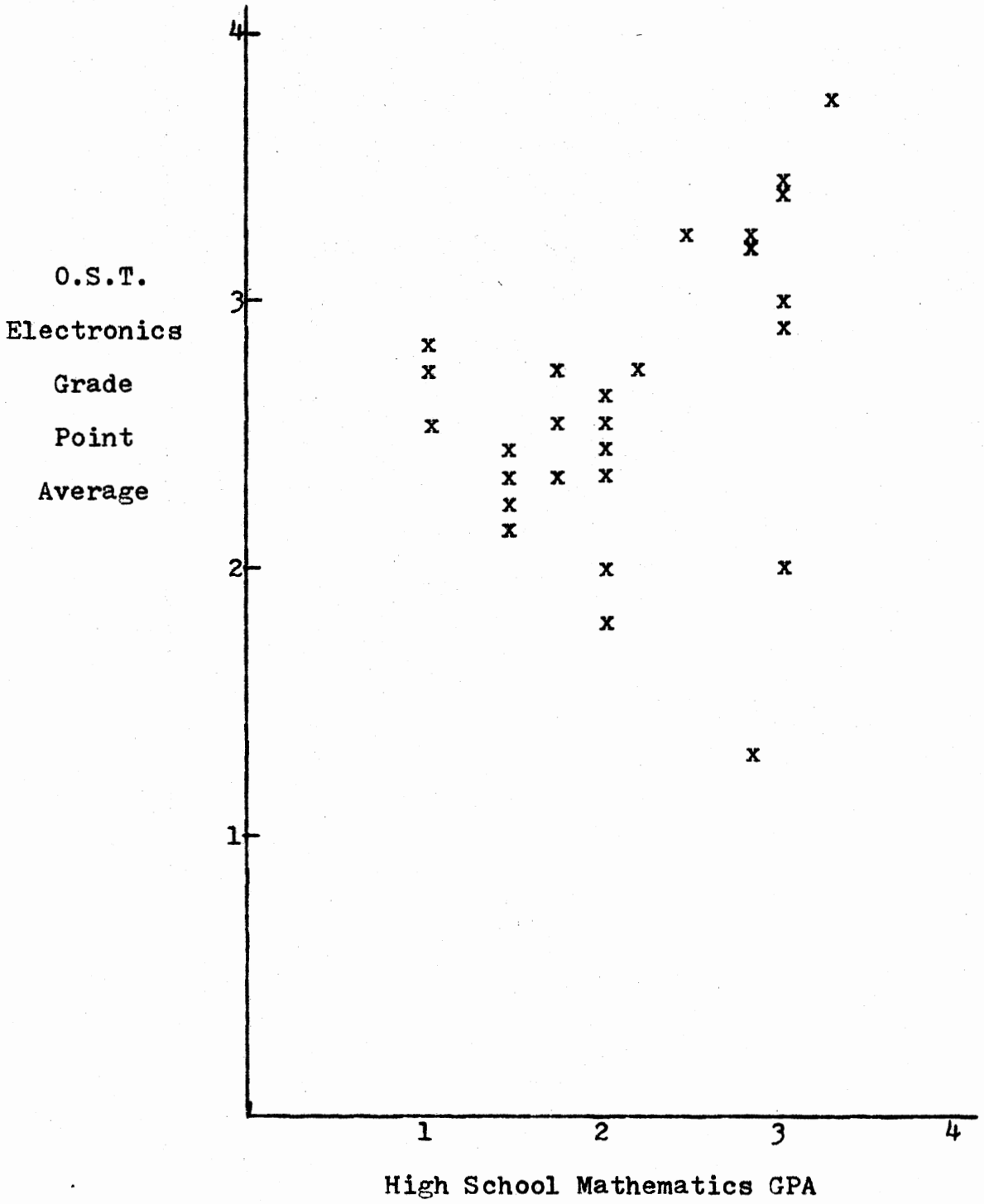

Figure 1. Scatter Diagram of O.S.T. Electronics Grade Point Average vs High School Mathematics GPA

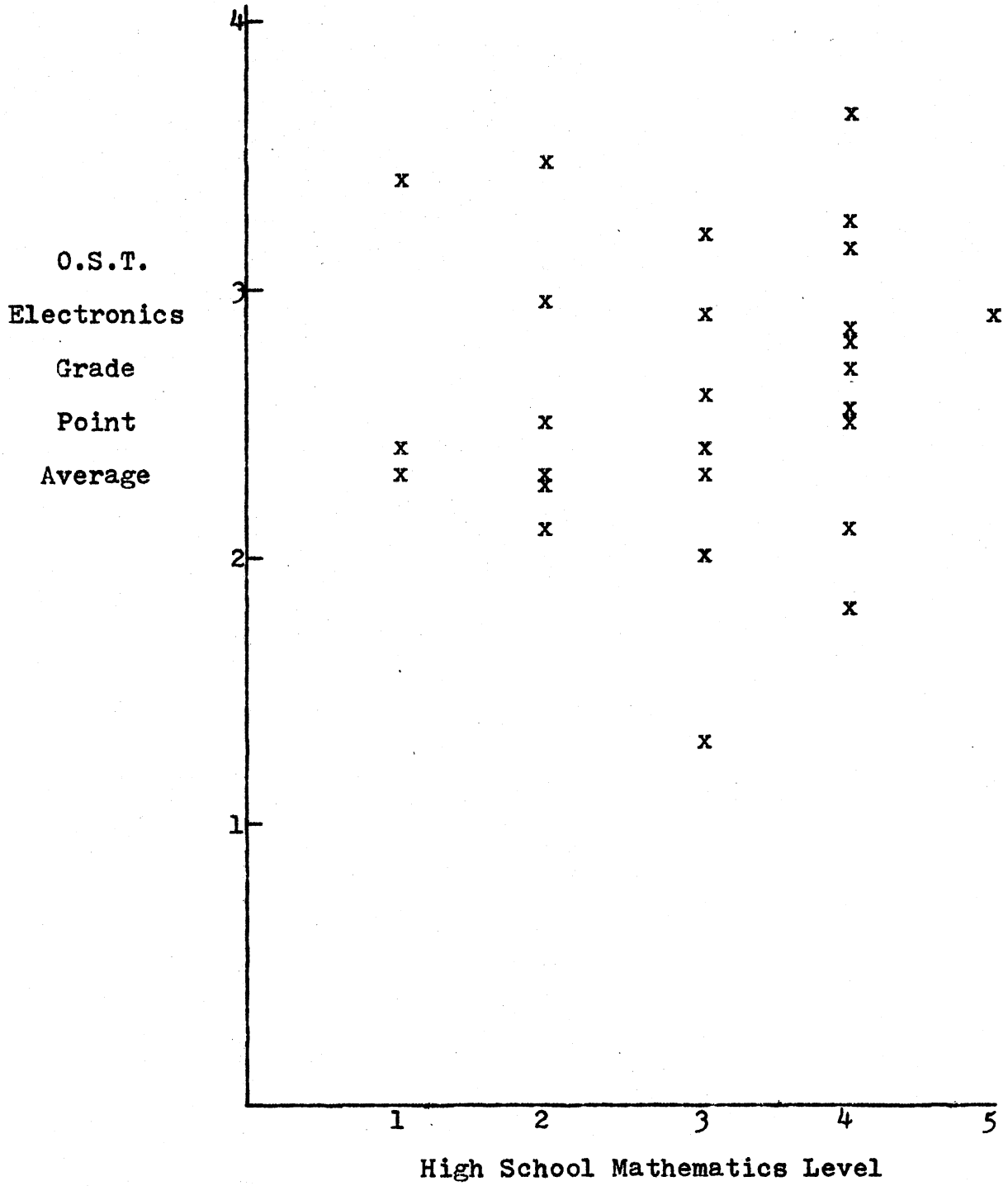

Figure 2. Scatter Diagram of O.S.T. Electronics Grade Point Average vs High School Mathematics Level

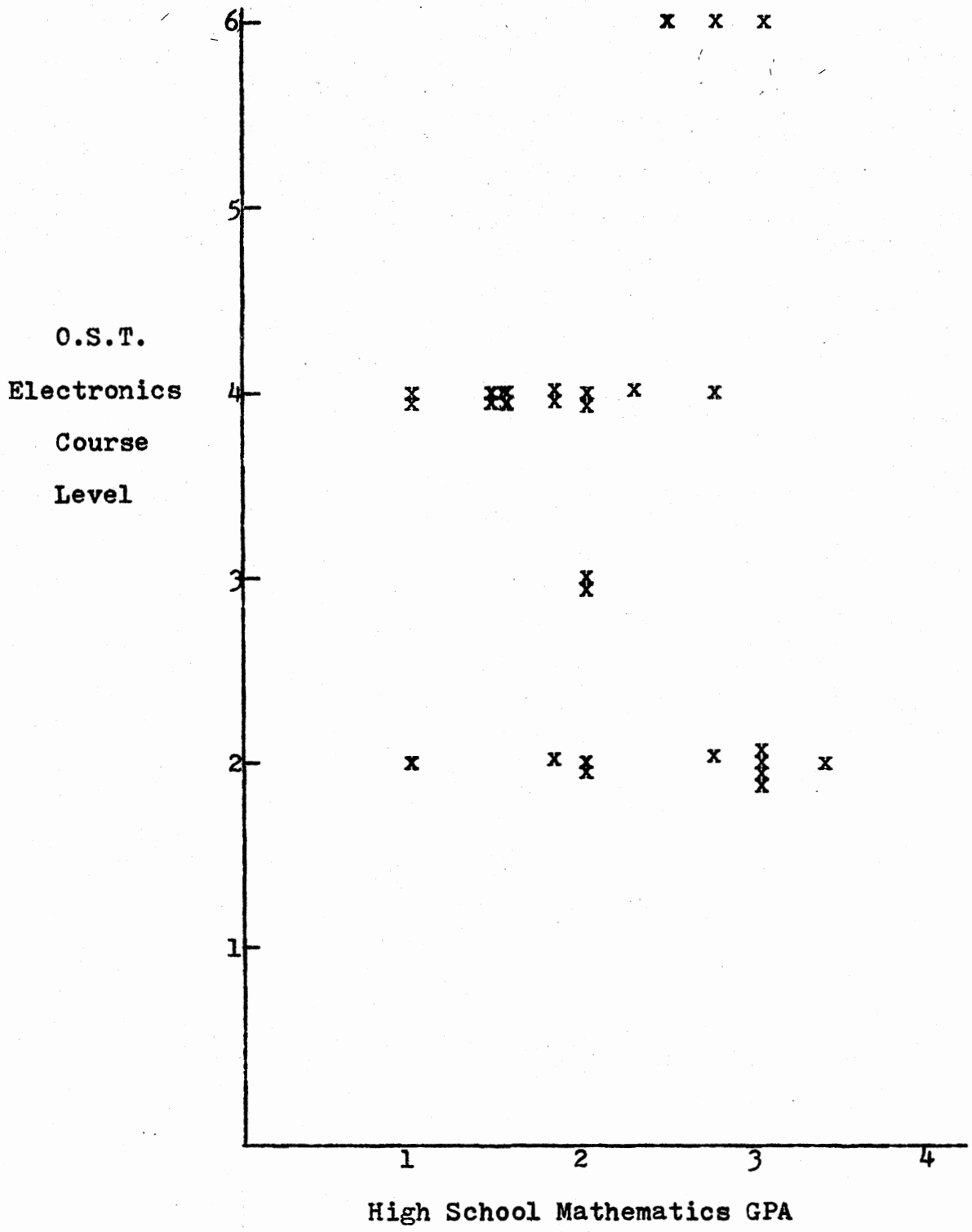

Figure 3. Scatter Diagram of O.S.T. Electronics Course Level vs High School Mathematics GPA

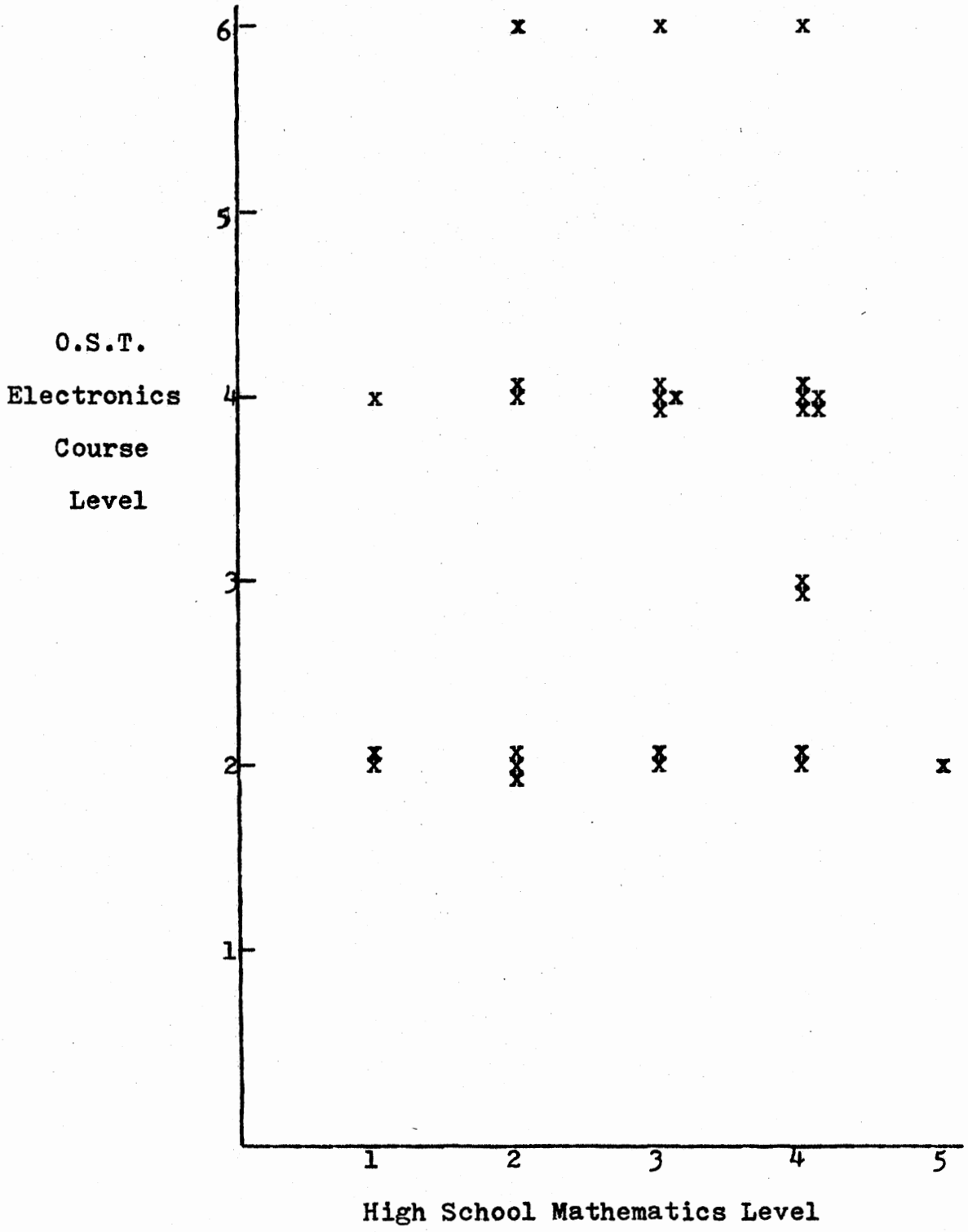

Figure 4. Scatter Diagram of O.S.T. Electronics Course Level vs High School Mathematics Level

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This study sought to examine the relationship between mathematics ability and achievement in an electronics program at Oklahoma State Tech. More specifically, the study sought to:

1. Determine if there was a significant relationship between high school mathematics GPA and the GPA earned in technical courses in the Industrial Electronics program at O.S.T.

2. Determine if there was a significant relationship between high school mathematics level and the GPA earned in technical courses in the Industrial Electronics program at O.S.T.

3. Determine if there was a significant relationship between high school mathematics GPA and additional course levels taken in the electronics program at O.S.T.

4. Determine if there was a significant relationship between high school mathematics level and additional course levels taken in the electronics program at O.S.T.

The statistical tool used in the investigation of the data was the Pearson product moment coefficient of correlation.

Additionally, Fisher's t test was then used to determine whether the null hypotheses would be rejected or not rejected.

Findings

Briefly the results of this study are as follows:

1. The high school mathematics GPA showed an insignificant correlation with Industrial Electronics GPA at the 1% level. However, it was significant at the 5% level.

2. The high school mathematics level showed an insignificant correlation with Industrial Electronics GPA.

3. The high school mathematics GPA showed an insignificant correlation with Industrial Electronics additional course levels.

4. The high school mathematics level showed an insignificant correlation with Industrial Electronics additional course levels.

Conclusions

The results of this study indicate that only the relationship between high school GPA and Industrial Electronics GPA offered any significant relationship. This relationship was, however, significant at the 5% level. For the purpose of this study judgment was made to not reject the null hypothesis. An examination of the scatter diagram (Figure 1.) reveals that this variable would be a poor indicator to identify potential students for the Industrial Electronics program. For example, a student with a high school GPA of 1.0 appears

to be more successful in terms of electronics GPA than the 2.0 student. Secondly, the small number of subjects involved coupled with the level of significance would seem to indicate that these variables could not effectively be used to identify potential students for the Industrial Electronics program at Oklahoma State Tech.

Recommendations

The results of this study indicate that high school mathematics and the student's overall achievement in an Industrial Electronics program have a minimal correlation. Therefore, there seems to be little need for other studies of this nature to be conducted which consider high school mathematics background. Perhaps subject areas other than mathematics, such as science or physics, might be considered for future studies.

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