A STATISTICAL ANALYSIS OF SHORTHAND GRADES AS RELATED TO GRADES IN ACADEMIC SUBJECTS ON THE COLLEGE LEVEL

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L. B. S.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF GRAPHS

GRAPHS

CHAPTER I

INTRODUCTION

Guidance of students into courses for which they are most suited and into avenues of work where they may best gain a livelihood has become an increasingly difficult and interesting problem for educators. It is hoped that this study will bring to light further facts that will aid in the broad field of guidance. Numerous statistical studies in shorthand have been made on the high school level, but few have been done with the work of college students as the criteria. A casual survey of the research done in this field brings many questions to mind.

If certain facts hold true on the high school level, do they still hold on the college level? How does a statistical analysis of shorthand grades as related to grades in academic subjects in Oklahoma Agricultural and Mechanical College compare with those of secondary schools, or with those of other colleges? This thesis has been written as a partial answer to these questions and to others of a similar nature. Herein, an attempt is made to arrive at the truth concerning grade relationships, for "Research is nothing more than a careful, systematic search for truth."[1]

Purpose

It is the purpose of this study to establish correlations between grades in shorthand and grades in the following college academic subjects: accounting, economics, English, foreign language, geography,

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[1] E. G. Blackstone, "Evaluation of Research Techniques," The National Business Education Quarterly, 10 (May, 1942), 8.

history, mathematics, science (general), typewriting, and total grade point average. A careful examination of each correlation, along with other statistical compilations will be made in order to arrive at certain deductions in regard to the following: To ascertain if there is any significant correlation between shorthand grades and grades in the listed academic subjects of college students. To find if the correlation between shorthand grades of college students and the composite average, or grade point average, is greater or less than that of individual subjects. To determine to what extent and with what degree of accuracy shorthand grades of college students can be predicted from grades in these academic subjects. To discover if there are any appreciable differences in the correlations found in grades of Oklahoma Agricultural and Mechanical College students of commerce and those found in previous studies of high school students, or of other colleges. Aside from the examination of the statistical data collected, it is the purpose of this study to recommend that further studies be made, especially along lines other than with academic subjects; and, that this study be used to assist in setting up more definite guidance programs.

Scope and Delimitation

Instruction in the Division of Commerce of Oklahoma Agricultural and Mechanical College of Stillwater, Oklahoma, is offered in two separate schools, the School of Commerce and the School of Intensive Business Training.

> These two schools are maintained for the purpose of serving the needs of two groups of students who desire to continue their formal education beyond the secondary school—the School of

> Commerce for students who desire to pursue a collegiate course of study leading to the bachelor's degree; the School of Intensive Business Training for students who are not interested in a degree course, but who desire specific vocational training designed to prepare for the various types of routine jobs with business concerns and with public agencies.
>
> Training for the broad field of business pursuits on the higher or professional level is offered in the collegiate School of Commerce, while so-called practical or vocational training for these same pursuits is offered in the School of Intensive Business Training.[2]

It is with the former group that this study is made, for here certain academic subjects are required. An attempt was made to include subjects that were studied by a majority of those enrolled in the School of Commerce, and subjects dealing with as many phases of the educational field as possible.

Only students who have graduated from the School of Commerce with six or more hours in shorthand during the years 1936-1941 inclusive, will be included. Two hundred cases have been chosen at random upon which to base the findings.

Teachers' grades are used as the criteria upon which the study is based. Because of the widespread criticism of teachers' grades in recent years, it is recognized that their use for criteria is one of the limitations of the study. However, in the Oklahoma Agricultural and Mechanical College, they are the only accepted measures of pupil achievement. Graduation from college depends entirely on grades given by teachers. Pupils are ranked for honors and for recommendations on the basis of teachers' grades. Despite the fact that such grades are likely to be subjective and may be unjust, they are still the criteria of success in rating pupils in most of the schools and colleges of the country. McCall says,

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[2] General Catalogue, Bulletin, Oklahoma Agricultural and Mechanical College, 41:8 (March, 1944), 138.

"Teachers' marks are important because they are now, and will continue for some time to be, the most universal method of rating pupils. In fact, they may continue forever to be the criterion for classification."[3] That the factors which they measure vary from teacher to teacher and from time to time for the same teacher does not alter the fact that the accepted measure of how successful a pupil is in any given course is the teacher's estimate of that pupil's success. As a matter of fact, where a number of teachers' grades in a number of courses are concerned, they have been found to be valid measures for predicting subsequent academic success.

Teachers of commercial subjects often insist that their grades are quite objective. They claim that pupils are graded strictly on the basis of performance and that performance in stenography is easily and objectively measured.

Sources of Data

The data for this study were obtained from the personal record files in the office of the School of Commerce and from records in the Registrar's Office. Permission was granted by the respective Deans to pull record sheets from their files for the purpose of securing the teachers' grades for the two hundred students used.

Methods and Procedure

The correlation method is used primarily in preparing this study. It is, according to Good, Barr, and Scates,

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[3] Howard J. Banker, "The Significance of Teachers' Marks," Journal of Educational Research, 16 (October, 1927), 160.

> of modern origin, but is already ranked high among the important research methods in education. It enables one to approach the problems of causal relationships in terms of degrees of both the contributing and the dependent factors, rather than in terms of the dichotomies upon which one must rely in the use of various other methods.[4]

In order that the findings of others might be compared with the findings of this study, the library method was used also. The reading of the research done by others served as an inspiration in this work as well as an aid in interpretation.

The procedure is based upon the collection of facts necessary for a statistical analysis. A list of those who had graduated with a major in Business Education and Secretarial Administration during the years 1936-1941 inclusive, was made. Since this list did not give the two hundred names desired for the study, it was necessary to pull through the other record sheets to find sufficient students with the required six hours to complete the list. After a complete list was made of the two hundred students, a tally sheet was made of all grades required in the study. All grades were figured on an hourly average basis. The mathematical figures from the tally sheet were transferred to a Pearsonian Worksheet, and the following mathematical computations were made: arithmetical means of both the dependent and independent variables ($\overline{X}$ and $\overline{Y}$), regression equation ($Y = a + bX$), the standard error of estimate (Sy), coefficient of correlation (r), coefficient of determination (r^2), and the standard error of coefficient of correlation (σr). Graphs showing information brought out in the computations are inserted after each table so as to give a more pertinent picture of some of the findings.

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[4] C. V. Good, A. S. Barr, and D. E. Scates, Methodology of Educational Research, p. 548.

Information and findings acquired through the mathematical computations and through the study of other research work will be used to make up the balance of this study.

Definitions

So as to make for clearness throughout the discussion in the following pages, a few of the terms will be discussed here. A statistical analysis is the analyzing of the arithmetical computations made from the data or statistics collected. Grades refer to the system used in the college for rating students as to the type of work they are doing. In the Oklahoma Agricultural and Mechanical College grades run as follows: Grade A, 93-100; grade B, 85-92; grade C, 77-84; grade D, 70-76; and grade F is anything below 70.

The academic subjects used in this study as a basis of correlation with shorthand are accounting, economics, English, foreign language, geography, history, mathematics, science (general), and typewriting.

A number of terms common to statistical studies are used. No attempt will be made to go into a study of these terms, but for the sake of clearness a few words will be said about each. For a more complete explanation of these terms, any text on statistics may be used.

Regression is the measure of the average relationship found between the two variables in terms of the given grades.

The coefficient of correlation is a measure of the amount of variation in shorthand that is associated with or accounted for by the variation in the academic subject, expressed in terms of unity.

The coefficient of determination is a true percentage of the portion of one variable that is associated with the other. It is simply the

square of correlation and is usually more easily understood. The relationship of correlation and determination may be expressed as follows:

Coefficient of Correlation	Coefficient of Determination
1.00	100%
.90	81
.80	64
.70	49
.60	36
.50	25
.40	16
.30	9
.20	4
.10	1

The standard error of estimate measures the scatter of the data on either side of the regression line, and in a normal distribution this includes about 68.27 per cent of the items.

The standard error of the coefficient of correlation measures the amount that the original computation may vary, both plus and minus. The probable error is used in most statistical studies, but it measures only a 50-50 probability while the standard error measures a 68-32 probability. This makes the standard error a much more desirable measure.

CHAPTER II

SURVEY OF RELATED MATERIALS

Much research and study have been done dealing with the relationship found between shorthand grades and those received in other subjects on the high school level, especially from the standpoint of prognostic tests and the study of English. Only one other study has been found that used the work of college students as a basis. Lists of commercial education research were found in the United States Office of Education Bulletins for the years 1929 through 1941; in the "Commercial Education Research Abstracts," by Dr. E. G. Blackstone of the University of Iowa in the Business Education World for October, 1933, and April, 1934; in a bibliography completed by Dr. Blackstone and published in the Business Education World in March, 1934; and in the Bibliography of Research Studies in Business Education, 1920-1940, published by Delta Pi Epsilon in 1943. A further study of articles pertaining to the subject in periodicals was made.

The thesis of Fairah Cruzan, "Predicting Shorthand Ability by Prognostic Testing,"[1] was based upon tests and grades of students in the School of Intensive Business Training of Oklahoma Agricultural and Mechanical College. Miss Cruzan found the correlations to be so low that the tests were little better than guesses in prognostic work.

Published abstracts of theses on the general subject of prognosis for stenography may be classified as (1) those which deal with the

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[1] Fairah Cruzan, "Predicting Shorthand Ability by Prognostic Tests," Master's Thesis, Oklahoma Agricultural and Mechanical College, 1942.

relationship of intelligence, as determined by I. Q., to stenography; and (2) those which deal with the predictive value of teachers' grades in other school subjects, or with the predictive value of certain objective tests, for stenography. The only conclusion that may be made at present with regard to the relation of I. Q. and stenography is that low but significant correlation exists between scores on existing intelligence tests and teachers' grades as indices of success in shorthand. Mazie R. Cooley,[2] in her study on "Relation of the I. Q. Success in Learning Shorthand and Typewriting," found that the correlation between shorthand and I. Q. scores was .22. The range of I. Q. was from 81 to 119, the median was 99, and 50 per cent of the cases were between 94 and 106. The girl with the highest I. Q., 119, failed in shorthand.

There is a larger group of studies on the subject of prognosis in stenography on the basis of various objective prognostic or predictive tests. But as brought out by Dr. Wagner and Miss Strebel in their study:

> The measure which best predicts beginning shorthand examination grades or term averages is the previous year's school average or the average of all final examinations taken by the student during high school. It is a bit surprising to find that the best predictive measure for a subject which depends as much upon finger dexterity and eye-hand coordination as shorthand is an average of all previous secondary school work. . . . The importance of motivation, application, and academic interest is hereby more and more emphasized in contrast with measures of so-called intelligence. [3]

In order to get paired groups, these investigators sought the best predictive measures possible for school grades in shorthand. They correlated teacher's grades on the first-semester shorthand examination

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[2] Mazie R. Cooley, "Relation of the I. Q. Success in Learning Shorthand and Typewriting," Master's Thesis, University of Pittsburgh, 1928.

[3] Mazie Earle Wagner and Eunice Strabel, "Improving Shorthand Grades," Business Education World, 15-10 (June, 1935), 827.

and the term averages as represented by teachers' grades for first-semester shorthand with sophomore school averages, total Regents' average, sophomore average in English, Terman Group Test of mental age, Inglis Vocabulary Test, Hoke Prognostic Test of Stenographic Ability, a ten-minute opposites test, Buffalo Reading Comprehension Test, and Buffalo Reading Raw Scores. Correlations ranged from .14 between the Buffalo Reading Raw Score and term average in beginning shorthand to .65 between the shorthand term examination and sophomore school average. The conclusion of Dr. Wagner and Miss Strabel was:

> It will be readily seen that the most predictive measures available, prior to actual shorthand experience, are the school average for the previous year and the Regents' or final examination average of all examinations taken before studying this subject.[4]

A thesis, unpublished but very briefly discussed in the United States Office of Education Bulletin in which it is listed, is entitled "The Relationship of Intelligence and the Relationship of the Knowledge of English Minimum Essentials to the Student's Ability to Transcribe Shorthand." It was written as a master's thesis in 1931 by Frances I. Kinne. One hundred twenty subjects were involved in the study. The abstract says:

> The coefficient of correlation (in every comparison) is so very low that the only conclusion which can be drawn is that there is apparently no relationship between intelligence and the ability to transcribe shorthand or between knowledge of English minimum essentials and the ability to transcribe shorthand as determined by the study.[5]

There is marked similarity between the investigation reported by Raymond J. Worley in his thesis entitled, "Relative Value of the I. Q.

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[4] Ibid., pp. 825-826.

[5] United States Bureau of Education Bulletin, No. 16, 1932, p. 355.

and Teachers' Marks for Predicting Success in Shorthand," and the thesis of Margaret Ellen Heil entitled, "The Value of the I. Q. and Teachers' Marks in Certain High School Subjects for Predicting Teachers' Marks in Stenography." In an article, "Prognosis in Shorthand," Mr. Worley discusses the findings of his study.[6] He wanted to find out "how well the marks in shorthand as given can be predicted from other marks as given and from the I. Q."[7] He correlated marks in shorthand with the I. Q. and with marks in junior high school English, senior high school English, penmanship, modern language, science and mathematics. He also used the multiple correlation technique to determine whether a combination of modern language and junior high school English showed any higher correlation. Correlations in this study ranged from .398 between the I. Q. and grades in shorthand, to .759 between grades in modern languages and grades in shorthand. He found that grades in modern language (French, Spanish, and German) had seven times the weight of the I. Q. rating and about twice the value of grades in junior high school English in determining the probable marks in shorthand. A multiple correlation of modern language, junior high school English, and the I. Q. with shorthand gave an index of .709. It is evident, in Mr. Worley's study, that teachers' grades in modern language have the highest predictive value of any single high-school subject for stenography, and teachers' grades in junior high school English the next greatest predictive value.

Harold E. Cowan, in his article entitled "Vocational Business Ability Testing from the Schoolman's Viewpoint," makes the statement that:

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[6] Raymond J. Worley, "Prognosis in Shorthand," The Journal of Business Education, 6:4 (September, 1931), 15-16.

[7] Ibid., p. 15.

> Perhaps one means of meeting business standards in our schools would be to develop a better system of guidance in the choices of courses by students themselves; and that school boards are approachable with respect to this matter, because they make it their business to consider what teachers bring before them.[8]

A number of people believe that, for one to be "successful" in the study of shorthand, he must have a high I. Q., and that, to be able to learn and use shorthand, one must be well learned in English. According to Howard M. Munford,[9] the key to skill in shorthand, as in English, is the acquisition of an adequate vocabulary.

It is true that stenographers do have occasion to check numbers and names, and use English in office work, and some are given the opportunity to use their better judgment—not necessarily requiring a high I. Q., but of such sufficiency that intelligent decisions can be made.

A number of educators have designated success in English a prerequisite to the study of shorthand. Paul L. Turse says that,

> general English marks may give a clue as to the effective use of language in shorthand transcription, but they do not give much clue to the pupil's potential resourcefulness in learning, recording, combining and interpreting shorthand symbols. Therein, probably lies the chief weakness of English marks as a predictive instrument.[10]

Marson A. Sherman,[11] in his study, analyzed shorthand for the purpose of determining the actual mental and physical activities participated in by first year students. Some of his correlations ran much

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[8] Harold E. Cowan, "Vocational Business Ability Testing from the Schoolman's Viewpoint," Education, 58:4 (December, 1937), 209.

[9] Howard M. Munford, "Present Day Trends in Business Training," The American Shorthand Teacher, 10 (March, 1930), 249.

[10] Paul L. Turse, "The Selection of Pupils for Stenographic Courses," Eastern Commercial Teachers Association, Fourteenth Yearbook, (1941), 308.

[11] Marson A. Sherman, "A Study of Prognosis in Shorthand," Business Education World, 22:8 (April, 1942), 697.

higher than those of most other research workers. Among some of the significant factors chosen, his correlations were:

Shorthand and general grade-point average	.606
Shorthand and English	.543
Shorthand and typewriting	.443
Shorthand and speed of motion reaction	.401
Shorthand and spelling	.382
Shorthand and penmanship quality	.179
Shorthand and reading comprehension	.017

From these figures it can be seen that the English achievement correlation with shorthand, as found by Sherman, varies to a great extent from the findings of Raymond J. Worley. This could, of course, be the result of a number of factors, including the number of cases, previous training, and the quality of teaching.

In seeking a valid basis for prognosis, John Whalen writes:

> Surveys have revealed positive correlation between success in the mastery of shorthand and success in the mastery of foreign languages. The mastery of these subjects requires a strong English background which should include an extensive vocabulary, English sense, an ability to construct sentences and an ability to punctuate properly. Unless, then, a pupil possesses this English background it seems useless for him to attempt the study of shorthand.[12]

Imogene Pilcher[13] made a study of shorthand and finally came to the conclusion that the best medium of selection is by pupil trial and experience under careful teacher observation and selection. Kaiser Gordon agrees with Miss Pilcher by saying, "In the light of a conflicting opinion as to the validity of prognostic objective tests, one is forced to the conclusion that Miss Pilcher's suggestion offers the best medium yet presented for pupil selection."[14]

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[12] Kaiser Gordon, "A Commercial Teacher Looks at Prognosis," Business Education World, 21:5 (January, 1941), 410.

[13] Imogene Pilcher, "Vocational Guidance in Shorthand," Business Education World, 17:2 (October, 1936), 106.

[14] Kaiser Gordon, op. cit., 21:5, 411.

The most applicable and detailed plan thus far worked out and applied seems to be that of Elvin S. Eyster which is described in detail in "Prognosis of Scholastic Success in Shorthand."[15] He made a study of 617 pupils based upon five different ratings: intelligence, average English grade during the time the pupil has been in school, average of all grades, excluding English, during time pupil has been in school, score on Hoke's Prognostic Test of Stenographic Ability, and subjective personal trait rating based on a composite average of work habits traits, character traits, and personality traits. The 617 pupils were carefully studied and analyzed from the above viewpoints. In the study, 317 of them were "approved" for shorthand; 138 were marked as having a fifty-fifty chance; and 109 were marked as "not advisable." Of the 317 "approved," 2.4 per cent failed; of the 138 given a fifty-fifty chance, 49.2 per cent failed; and of the 109 marked as "not advisable," 100 per cent failed.

Summary

In perusing the literature of the field in theses and in periodicals, one must conclude that on the basis of studies made and reported, there is evidence that intelligence, as measured by intelligence tests, does not determine achievement in shorthand, as measured by teachers' grades. Most of the attempts to formulate a set of tests of mental ability that would predict success in shorthand resulted in very low correlations. The average of all high school subjects for the year preceding the election of shorthand, and the average of all examinations taken before studying shorthand were found by two investigators, working together, to

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[15] Elvin S. Eyster, "Prognosis of Scholastic Success in Shorthand," National Business Education Quarterly, 7 (December, 1938), 31-34.

be among the best predictive measures. In one study a significant relationship was found to exist between teachers' grades in junior high school English. The highest correlation, as found by several studies, was in foreign languages.

Mathilde Hardaway, in "Prognostic or Aptitude Tests for Skill Subjects," discusses the value of predictive measures. For the past several years a tremendous amount of research effort has been expended in attempts to find predictive measures for business subjects. Many "prophets of gloom" say that it has all been useless. Miss Hardaway says, "the few moderately successful efforts and the many failures to find measures that relate to achievement in the skill subjects very likely have pointed the way to a greater degree of success in the future."[16] In some cases where zero correlations have been found and accepted as conclusive, some possibilities have been eliminated which need not be investigated further. Inadequacies of criteria have been exposed; it has been found that teachers' grades for one or two semesters are not enough; and that theory tests in shorthand are usually subjective and, therefore, have little reliability. These are not adequate measures but through them, perhaps, clearer measures may be found.

All these findings seem to indicate that much remains to be done in singling out those factors which do contribute to success in shorthand. They leave the way open to further investigation of the relationships which have been found to be of some significance in order to lend further weight to the already existing evidence. The present study seems

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[16] Mathilde Hardaway, "Prognostic or Aptitude Tests for Skill Subjects," Business Education World, 27:8 (March, 1945), 371.

to be unique in that it deals only with the work of the student on the college level in shorthand and certain academic subjects and is based wholly on teachers' grades in the various subjects. The tables and graphs in Chapter III will show what relationship, if any, exists between the grades in shorthand and the grades in academic subjects on the college level.

CHAPTER III

ANALYSIS OF DATA

This chapter deals with the correlations of grades between shorthand and certain academic subjects taken up in the order of their correlation. As mentioned in the introduction, the data is made up of the grades of 200 graduates of Oklahoma Agricultural and Mechanical College of Stillwater, Oklahoma. These students were graduated during the years 1936-1941 inclusive. Students graduateing since 1941 were not used because of possible influences of the war on education. Teachers' grades were secured from the permanent record files in the office of the School of Commerce and from the Registrar's Office.

It must be remembered that all statistical data are affected by a multiplicity of factors which may obscure the meaning of the relationship found between two observed variables. Karl J. Holsinger,[1] for example, found that the correlation between high school and university grades was .612, a result doubtless due in part to the mentality of the student. However, many other factors such as his age, sex, nationality, interest, ambition, perseverance, health, attendance, internal drive, and personal appearance, as well as the type of examinations and reaction of the instructors, doubtless contribute also to the observed correlation. Scholarship as measured by grades is thus a variable made up of a large number of other variables, and the correlation found is sometimes of doubtful meaning so far as causes are concerned.

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[1] Karl J. Holsinger, Statistical Methods for Students in Education, Chapter X, p. 164.

Bearing these facts in mind, the statistical data are presented for the following subjects in the order given: (1) foreign language, (2) typewriting, (3) accounting, (4) English, (5) science, (6) history, (7) mathematics, (8) economics, (9) geography, (10) total grade point average.

As an aid in interpreting the ten statistical tables in this chapter, the grades shown on the x-axis represent the letter grades in the above mentioned subjects, as awarded by the teachers of Oklahoma Agricultural and Mechanical College, or by the colleges from which credits may have been transferred. The y-axis represents the grades given in shorthand by the same institutions. The letter grades as awarded in this college are represented by the numeric quality of 93-100 for A; 85-92 for B; 77-84 for C; 70-76 for D; and below 70 for F.

Various kinds of devices might be used in setting up the data for finding a correlation. In this study the correlation table for computing two standard deviations at the same time is set up, one on $\underline{x}$, the other on $\underline{y}$. The unit by which the correlation is measured is known as the coefficient of correlation and the computations made give what is known as the "product-moment" or the Pearson coefficient of correlation. The coefficient of correlation runs from -1.00 to +1.00. A -1.00 correlation signifies perfect negative correlation; a .00 correlation signifies a chance relationship; while a +1.00 signifies perfect correlation between the two variables.

The captions (fy, dy, fdy, fdy^2, Edxfy, Edxdy) and the stubs (fx, dx, fdx, fdx^2, Edxfy, Edxdy) of the various lines of the tables are self-explanatory. The totals along the right hand side of the lower part of the table give the Y (or shorthand) standard deviation while the totals

along the bottom line of the right hand side of the table give the X (or subject other than shorthand) standard deviation. Below each table on both the left and right are formulas with their computations for coefficient of correlation (r), standard deviation of y (σy), standard error of estimate for y (Sy), standard error of correlation (σr), the regression equation ($Y = a + bX$), and the means of X and Y ($\overline{X}$, $\overline{Y}$). If there is any doubt as to the meanings of these formulas, the definitions given in Chapter I may be of help.

Foreign language, as given in Table I on page 21, represents the highest correlation in the study. This agrees with the results found on the high school level in that foreign languages held the highest correlations in all instances where correlated. The correlation obtained here between foreign language and shorthand is .458 ± .114. McCall[2] says that a correlation of ±.4 to ±.7 is substantial and its reliability for prognostic work is 21 per cent better than a mere guess. In a few of the high school studies made, the correlation ran as high as .7, but was around .5 in most of them. There were only 48 students, about 25 per cent, out of the 200 used in this study who completed six or more hours in foreign language. This is a small number to use in establishing a coefficient, yet many complete studies have been based on no more than fifty.

Although the arithmetic means of foreign language and shorthand are very close, 89 and 87.5 respectively, the correlation is low. By noting the scatter of the items in the table, it can be easily seen that nearly equal means signifies nothing as far as likeness or variation is

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[2] William A. McCall, How to Measure in Education, pp. 392-393.

concerned. The number of A's in foreign language, 33 1/3 per cent of the total grades, are double the number of A's in shorthand, 16 2/3 per cent. This tends to skew the correlation considerably. It is skewed again in the opposite direction in that 8 1/3 per cent of the foreign language grades are D's while there are no D's in shorthand.

Graph I (a) at the top of page 22 shows the regression line as represented by the regression equation solved on page 21 ($Y = 56.35 + .35X$). There is a close relationship between the regression line and the coefficient of correlation for any specific data. The coefficient of correlation definitely depends upon the regression line. Dr. Blair says,

> A full and adequate measure of correlation is dependent on a full and adequate measurement of the regression. If you fail to get a correct regression line, you cannot get a full measure of correlation.[3]

Their differences lie principally in the fact that regression is measured in terms of the original units of the data, percentages in this case, while correlation is expressed as a ratio or abstract number. The regression line is a straight line and if perfect correlation exists, the line will pass through the intersection of the x- and y-axes, keeping an equal distance from both axes as it is prolonged in either direction. In this graph, it will be noted that the line crosses the y-axis at 56.85 on the y-axis. The standard error of estimate of ± 4.91 on either side of the regression line includes 68 out of 100 items of data.

Graph I (b) is a simple graphic representation of the grades in foreign language and shorthand, and the number of students in each class interval.

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[3] Morris M. Blair, Elementary Statistics, p. 269.

TABLE I

SHORTHAND Y	X FOREIGN LANGUAGE 93–100	85–92	77–84	69–76	fy	dy	fdy	fdy^2	Edxfy	Edxdy
93–100	5	3			8	1	8	8	5	5
85–92	10	8	2	2	22	0			4	
77–84	1	8	6	2	17	-1	-17	17	-9	9
69–76										
fx	16	19	8	4	48		-9	25	0	14
dx	1	0	-1	-2						
fdx	16		-8	-8	0					
fdx^2	16		8	16	40					
Edyfx	4	-5	-6	-2	-9					
Edydx	4		6	4	14					

	Efdx	Efdy	Edx^2	Edy^2	Edxdy
Sums	0	-9	40	25	14
Means	0	-.19			
Correction			0	1.68	0
Corrected Value			40	23.32	14

$$r = \frac{Exy}{\sqrt{Ex^2 \cdot Ey^2}} = \frac{14}{\sqrt{40 \times 23.32}} = .458$$

$$Sy = \sigma y\sqrt{1 - r^2}$$

$$\sigma y = i\sqrt{\frac{Ey^2}{N}} = 8\sqrt{\frac{23.32}{48}} = 5.52$$

$$Sy = 5.52\sqrt{1 - (.458)^2} = 4.91$$

$$\sigma r = \frac{1 - r^2}{\sqrt{N}} = \frac{1 - (.458)^2}{\sqrt{48}} = .114$$

$$Y = a + bX$$

$$b = \frac{Exy}{Ex^2} = \frac{14}{40} = .35$$

$$a = \bar{Y} - b\bar{X}$$

$$\bar{Y} = A + \frac{Efy \cdot i}{N}$$

$$= 89 + \frac{-9}{48}.8 = 87.5$$

$$\bar{X} = A + \frac{Efx \cdot i}{N}$$

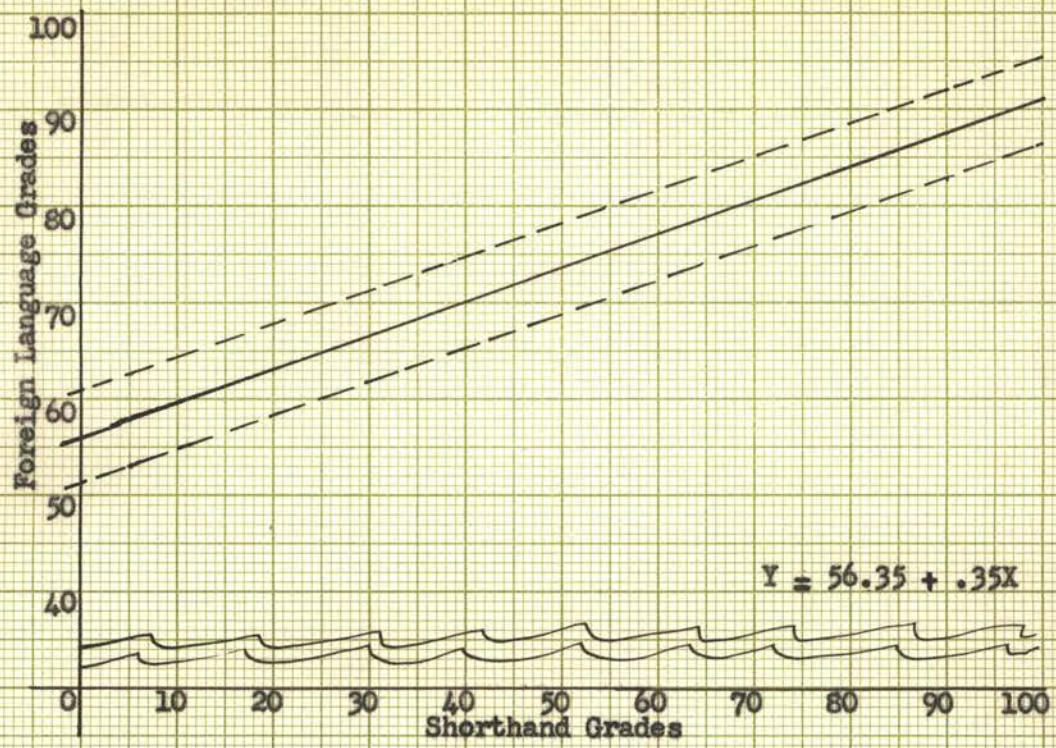
$$= 89 + \frac{0}{48}.8 = 89$$

$$a = 87.5 - .35 \times 89$$

$$= 56.35$$

$$Y = 56.35 + .35X$$

(a) REGRESSION LINE RELATIONSHIP BETWEEN FOREIGN LANGUAGE GRADES AND SHORTHAND GRADES



(b) LINE GRAPH OF FOREIGN LANGUAGE GRADES, SHORTHAND GRADES, AND NUMBER OF STUDENTS

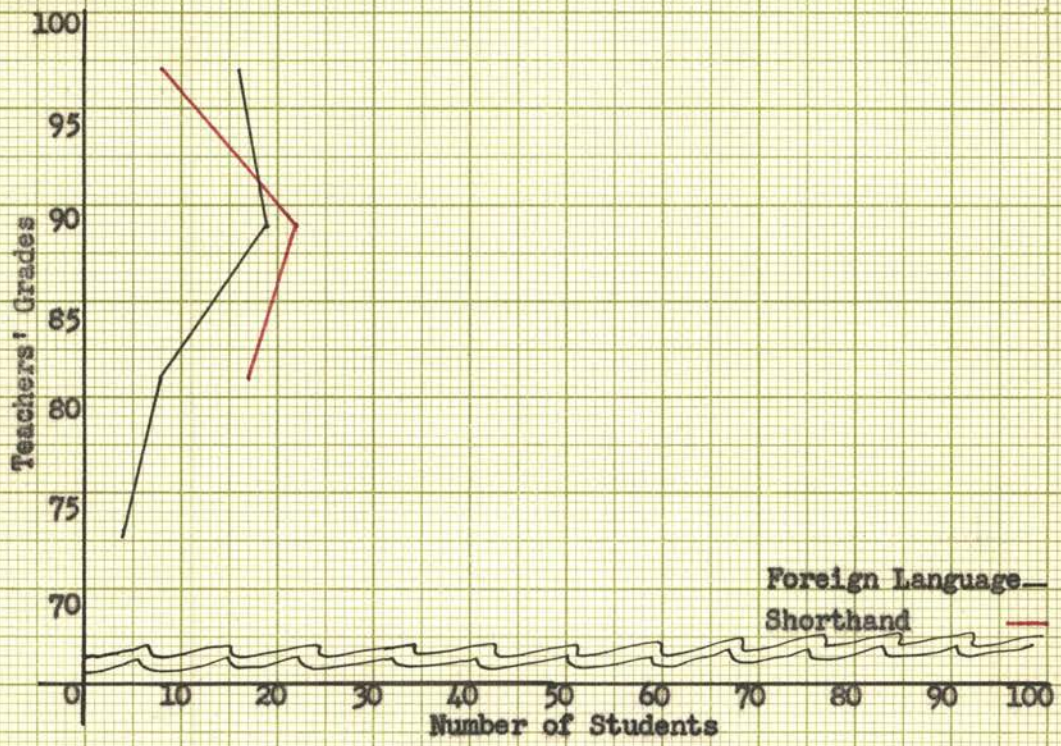


Table II, page 24, shows typewriting to be second in correlation in this study. Both typewriting and shorthand are, to a certain degree, coordination subjects and a higher correlation might be expected. Evidently many of the factors other than coordination must enter into the study of both subjects. The correlation of .385 ± .065 is near that found in studies on the high school level. According to ODell, little prognostic value could be found in these figures.

> A coefficient of .30 or .40 is high enough to indicate a definite relationship between the two things correlated, but it is so low that estimates of one of the traits from the other are scarcely better than mere guesses.[4]

There were 173, 86.5 per cent, of the students studied who had been enrolled for both typewriting and shorthand. This gives a sufficiently large number to make the results authentic.

The arithmetic means of 86.69 in shorthand and 88.4 in typewriting would tend to make one untrained in statistics think there is a great similarity, but again looking at the table, it can be seen that the A's in typewriting are double the number in shorthand, tending to skew in the direction of typewriting, but the B's, C's, and D's show up to a much greater extent in shorthand. There is only one F in typewriting but this is enough to greatly decrease the correlation since this same student made a C in shorthand.

Graph II (a) on page 25 shows the regression line with a standard error of estimate of ±4.32. The line crosses the y-axis at 55.93, far above the zero point. At a point one hundred units out to the right on the x-axis it lifts only 34.86 units on the y-axis. Sixty-eight per cent of the data, or 118 cases, fall within a ±4.91 units on either side

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[4] Charles W. ODell, Statistical Methods in Education, p. 190.

TABLE II

SHORTHAND Y	X TYPEWRITING 93–100	85–92	77–84	69–76	61–68	fy	dy	fdy	fdy^2	Edxfy	Edxdy
93–100	16	7	3			26	1	26	26	13	13
85–92	25	32	18	3		78	0			1	
77–84	9	26	26		1	62	-1	-62	62	-20	20
69–76			7			7	-2	-14	28	-7	14
fx	50	65	54	3	1	173		-50	116	-13	47
dx	1	0	-1	-2	-3						
fdx	50		-54	-6	-3	-13					
fdx^2	50		54	12	9	125					
Edxfy	7	-19	-37		-1	-50					
Edxdy	7		37		3	47					

	Efdx	Efdy	Edx^2	Edy^2	Edxdy
Sums	13	50	125	116	47
Means	.08	.29			
Correction			.98	14.5	3.76
Corrected Value			124.02	101.5	43.24

$$r = \frac{Exy}{\sqrt{Ex^2 \cdot Ey^2}} = \frac{43.24}{\sqrt{124.02 \times 101.5}} = .385$$

$$Sy = \sigma y \sqrt{1 - r^2}$$

$$\sigma y = i \sqrt{\frac{Ey^2}{N}} = 8 \sqrt{\frac{101.5}{173}} = 4.6768$$

$$Sy = 4.68 \sqrt{1 - (.385)^2} = 4.32$$

$$\sigma r = \frac{1 - (.385)^2}{173} = .065$$

$$Y = a + bX$$

$$b = \frac{Exy}{Ex^2} = \frac{43.24}{124.02} = .3486$$

$$a = \bar{Y} - b\bar{X}$$

$$\bar{Y} = A + \frac{Efy}{N} \cdot i$$

$$= 89 + \frac{-50}{173} \cdot 8 = 86.69$$

$$\bar{X} = A + \frac{Efx}{N} \cdot i$$

$$= 89 + \frac{-13}{173} \cdot 8 = 88.4$$

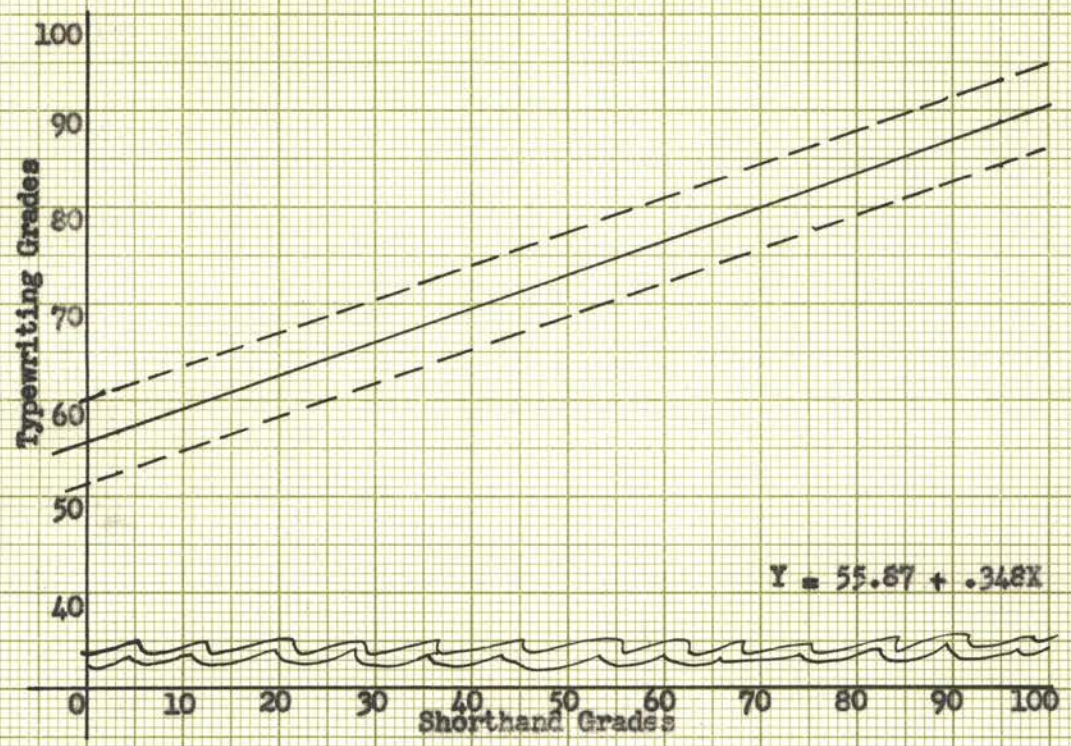
$$a = 86.69 - .3486 \times 88.4$$

$$= 55.87$$

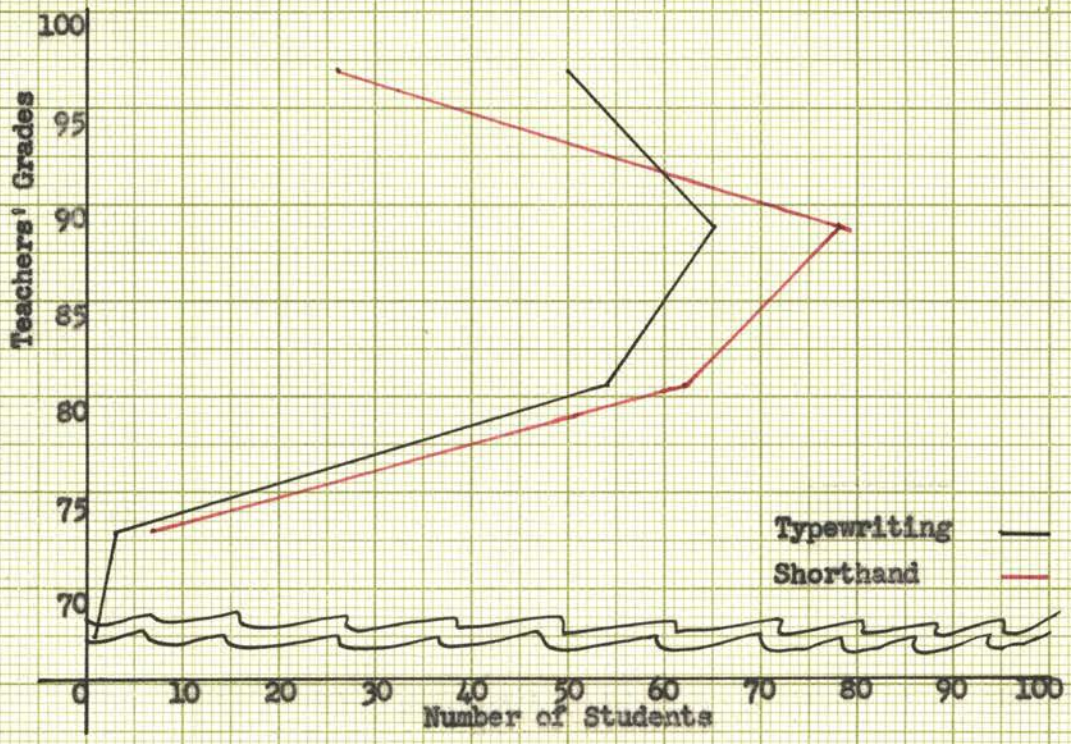
$$Y = 55.87 + .3486X$$

GRAPH II

(a) REGRESSION LINE RELATIONSHIP BETWEEN TYPEWRITING GRADES AND SHORTHAND GRADES



(b) LINE GRAPH OF TYPEWRITING GRADES, SHORTHAND GRADES, AND NUMBER OF STUDENTS



of the regression line. This indicates that only 55 of the 173 items would fall outside the two dotted lines on the graph.

Graph II (B), page 25, is a graphic representation of the grades in typewriting and in shorthand, and the number of students in each class interval.

Accounting, as shown by Table III on page 27, has a correlation of .348 with shorthand. The standard error of correlation is ±.063 showing that 68 per cent of the 197 items of data fall between .348 + .063 and .348 - .063. A study of the table shows that the data are well scattered with about 5 per cent of the 197 students receiving an A in both subjects. The total number of A's in accounting is 1.5 per cent greater than the number in shorthand. The higher grades tend to be in the direction of shorthand in the remainder of the table. The subject matter of accounting requires much reasoning and does not depend so much upon a memorization as does shorthand, therefore, a high correlation might not be expected. The correlation, however, is positive and is 12 per cent better than guessing in prognostic work.

The arithmetic means of 86.81 and 85.87, in shorthand and accounting respectively, indicate that the mean averages are about the same, but the low correlation shows that those excelling in one subject do not necessarily excel in the other.

The regression line in Graph III (a), page 28, crosses the y-axis at 59.93 and tends upward only .313 in each unit along the x-axis, reaching a high of 91.23 at one hundred on the x-axis. If the individual items were plotted on a scatter-graph, it would be found that 134 fall within a ±5.989 units of the regression line. Only 63 items would fall outside the two dotted lines.

TABLE III

SHORTHAND Y	X ACCOUNTING 93-100	85-92	77-84	69-76	fy	dy	fdy	fdy^2	Edxfy	Edxdy
93-100	10	13	6		29	1	29	29	4	4
85-92	16	36	37	3	92	0			-27	
77-84	6	18	36	9	69	-1	-69	69	-48	48
69-76		2	4	1	7	-2	-14	28	- 6	12
fx	32	69	83	13	197		-54	126	-77	64
dx	1	0	-1	-2						
fdx	32		-83	-26	-77					
fdx^2	32		83	52	167					
Edyfx	4	-9	-38	-11	-54					
Edxdy	4		38	22	64					

	Edx	Edy	Edx^2	Edy^2	Edxdy
Sums	-77	-54	167	126	64
Means	- .39	-.27			
Correction			30.03	14.8	21.1
Corrected Value			136.97	111.2	42.9

$$r = \frac{Exy}{\sqrt{Ex^2 \cdot Ey2}} = \frac{42.9}{\sqrt{136.97 \times 111.2}} = .348$$

$$Sy = \sigma y\sqrt{1 - r^2}$$

$$\sigma y = i\sqrt{\frac{Ey^2}{N}} = 8\sqrt{\frac{126}{197}} = 6.392$$

$$Sy = 6.39\sqrt{1 - (.348)^2} = 5.989$$

$$\sigma r = \frac{1 - r^2}{\sqrt{N}} = \frac{1 - (.348)^2}{\sqrt{197}} = .063$$

$$Y = a + bX$$

$$b = \frac{Exy}{Ex^2} = \frac{42.9}{136.97} = .313$$

$$a = \bar{Y} - b\bar{X}$$

$$\bar{Y} = A + \frac{Efy}{N}.i$$

$$= 89 + \frac{-54}{197}.8 = 86.81$$

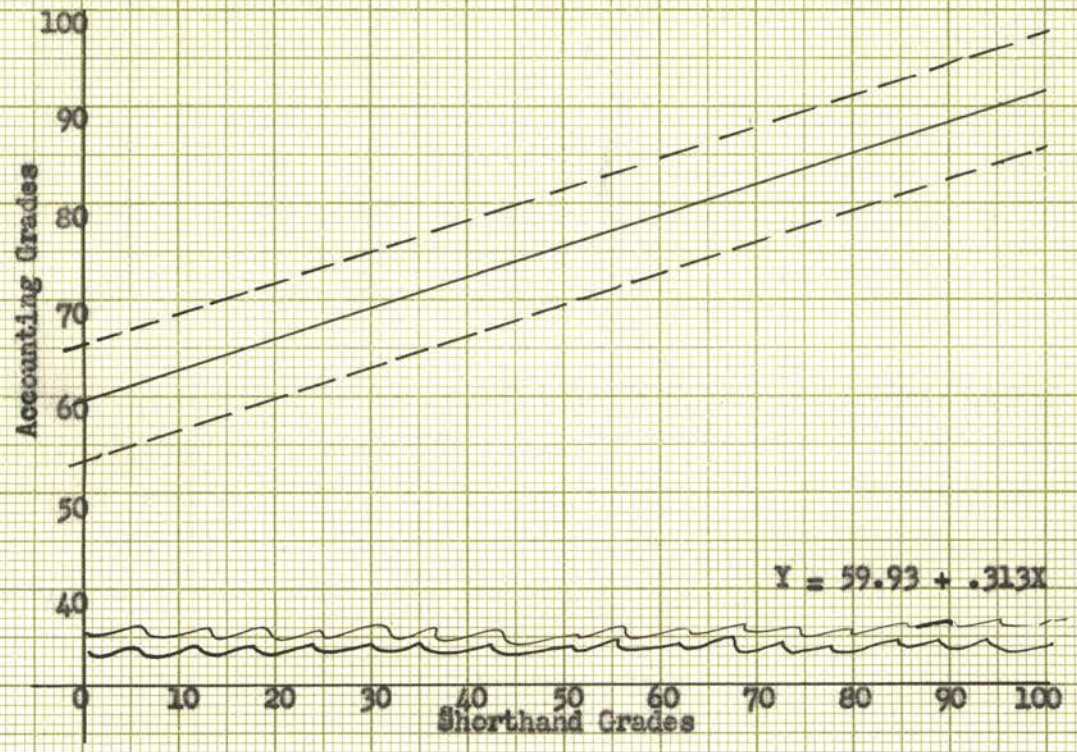
$$\bar{X} = 89 + \frac{-77}{197}.8 = 85.87$$

$$a = 86.81 - .313 \times 85.87$$

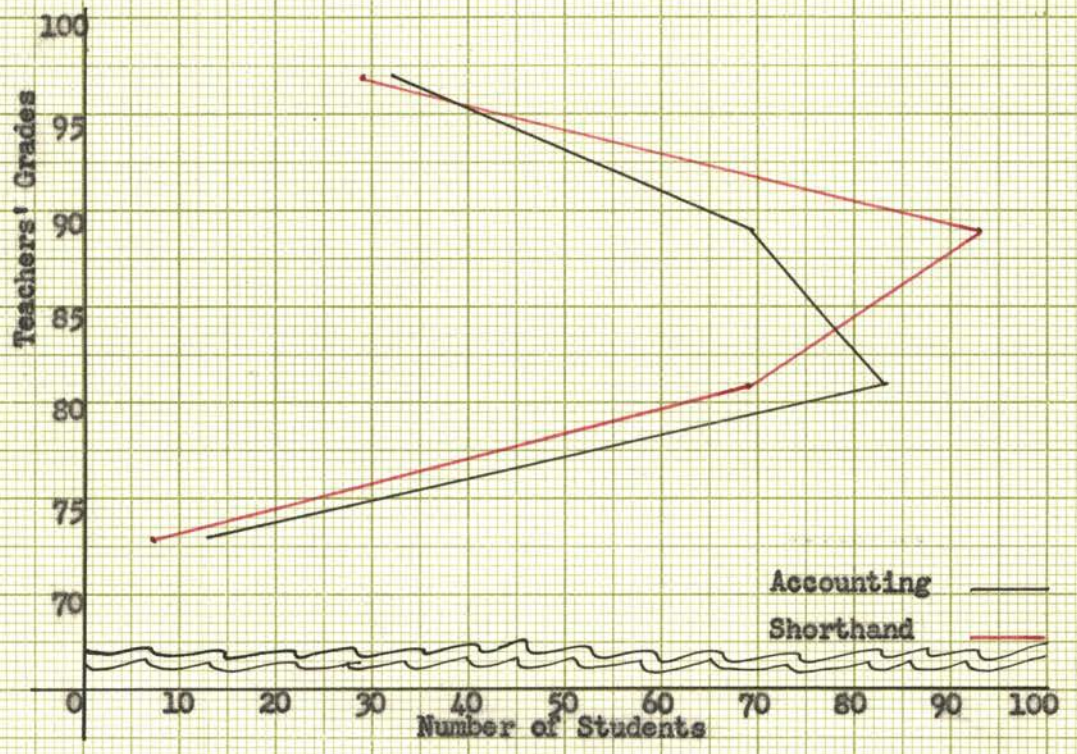
$$= 59.933$$

$$Y = 59.93 + .313X$$

(a) REGRESSION LINE RELATIONSHIP BETWEEN ACCOUNTING GRADES AND SHORTHAND GRADES



(b) LINE GRAPH OF ACCOUNTING GRADES, SHORTHAND GRADES, AND NUMBER OF STUDENTS



Graph III (b), page 28, is a graphic representation of the grades in accounting and in shorthand, and the number of students in each class interval.

Table IV, page 30, shows a correlation of .346 between English and shorthand with a standard error of ±.062. More studies have been made using English as a basis for academic work than any other one subject. In discussing his study, Mr. Worley makes an interesting comment on the use of English as a predictive measure for stenography.

> Just why marks in English should be taken in preference to other marks does not seem to be clear in the minds of those who advocate this policy. It is true that a prospective stenographer (carrying the shorthand writing a number of steps farther) to be successful must be proficient in English grammar and composition and must be able to recognize, spell, and use properly a rather large vocabulary of words spoken by others. So far as these factors are significant, there should be a correlation to the extent that the English covered approximates "English situations" which arise in stenographic work.[5]

All students of Oklahoma Agricultural and Mechanical College are required to take English so the correlation of English and shorthand was based on the total number of students in the study—200. Grades ran much higher in English than in shorthand, as is shown by the table. Approximately one-half of the grades fall on a line through the center of the table, in other words, 100 students made the same grade in English that they made in shorthand.

The arithmetic means of 86.76 and 87, in shorthand and in English respectively, are within .24 of a point of each other, yet their correlation is not high enough to be of much value in prognostic work. It is quite evident here that there are factors governing the learning of

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[5] Raymond J. Worley, "Prognosis in Shorthand," The Journal of Business Education, 6:4 (September, 1931), 14.

TABLE IV

SHORTHAND Y	X ENGLISH 93-100	85-92	77-84	69-76	fy	dy	fdy	fdy^2	Edxfy	Edxdy
93-100	13	13	3		29	1	29	29	10	10
85-92	16	58	17	2	93	0			-5	
77-84	6	36	26	3	71	-1	-71	71	-26	26
69-76		3	4		7	-2	-14	28	- 4	8
fx	35	110	50	5	200		-56	128	-25	44
dx	1	0	-1	-2						
fdx	35		-50	-10	-25					
fdx^2	35		50	20	105					
Edxfy	7	-27	-31	-3	-56					
Edxdy	7		31	6	44					

	Efdx	Efdy	Edx^2	Edy^2	Edxdy
Sums	-25	-56	105	128	44
Means	- .125	- .28			
Correction			3.13	15.68	7
Corrected Value			101.88	112.32	37

$$r = \frac{Exy}{\sqrt{Ex^2 \cdot Ey^2}} = \frac{37}{\sqrt{101.88 \times 112.32}} = .346$$

$$Sy = \sigma y\sqrt{1 - r^2}$$

$$y = i\sqrt{\frac{Ey^2}{N}} = 8\sqrt{\frac{112.32}{200}} = 5.992$$

$$Sy = 5.992\sqrt{1 - (.346)^2} = 5.62$$

$$\sigma r = \frac{1 - r^2}{\sqrt{N}} = \frac{1 - (.346)^2}{\sqrt{200}} = .062$$

$$Y = a + bX$$

$$b = \frac{Exy}{Ex^2} = \frac{37}{101.88} = .363$$

$$a = \bar{Y} - b\bar{X}$$

$$\bar{Y} = A + \frac{Efy}{N} \cdot i$$

$$= 89 + \frac{56}{200} \cdot 8 = 86.76$$

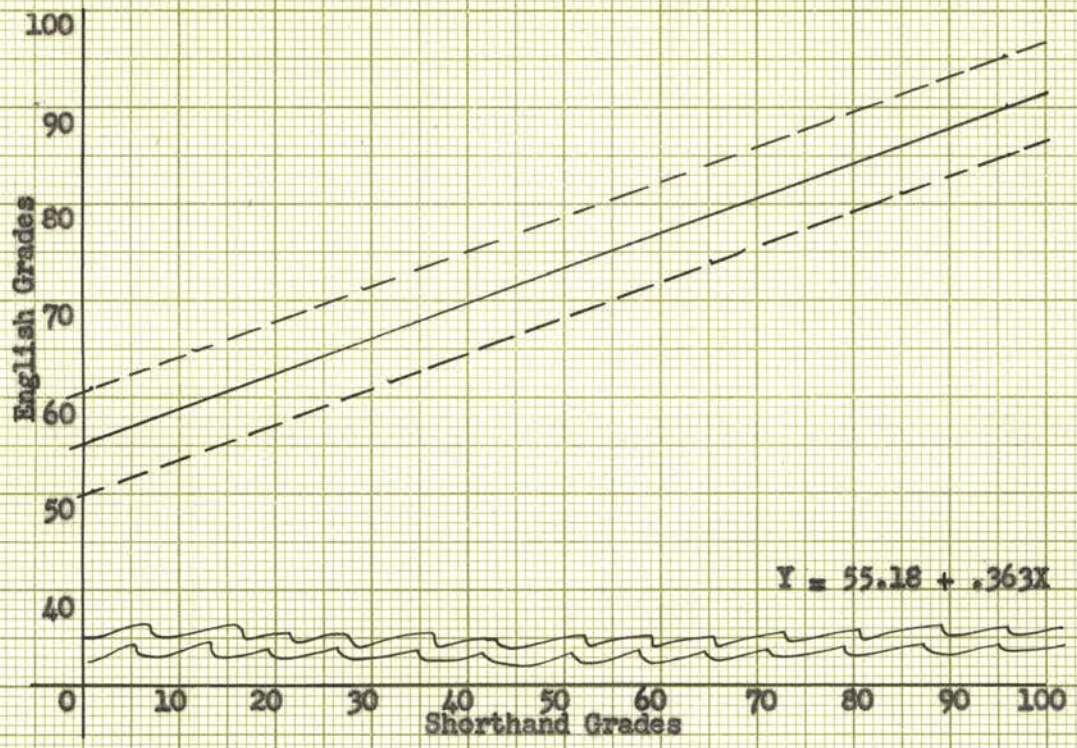
$$\bar{X} = 89 + \frac{25}{200} \cdot 8 = 87$$

$$a = 86.76 - .363 \times 87$$

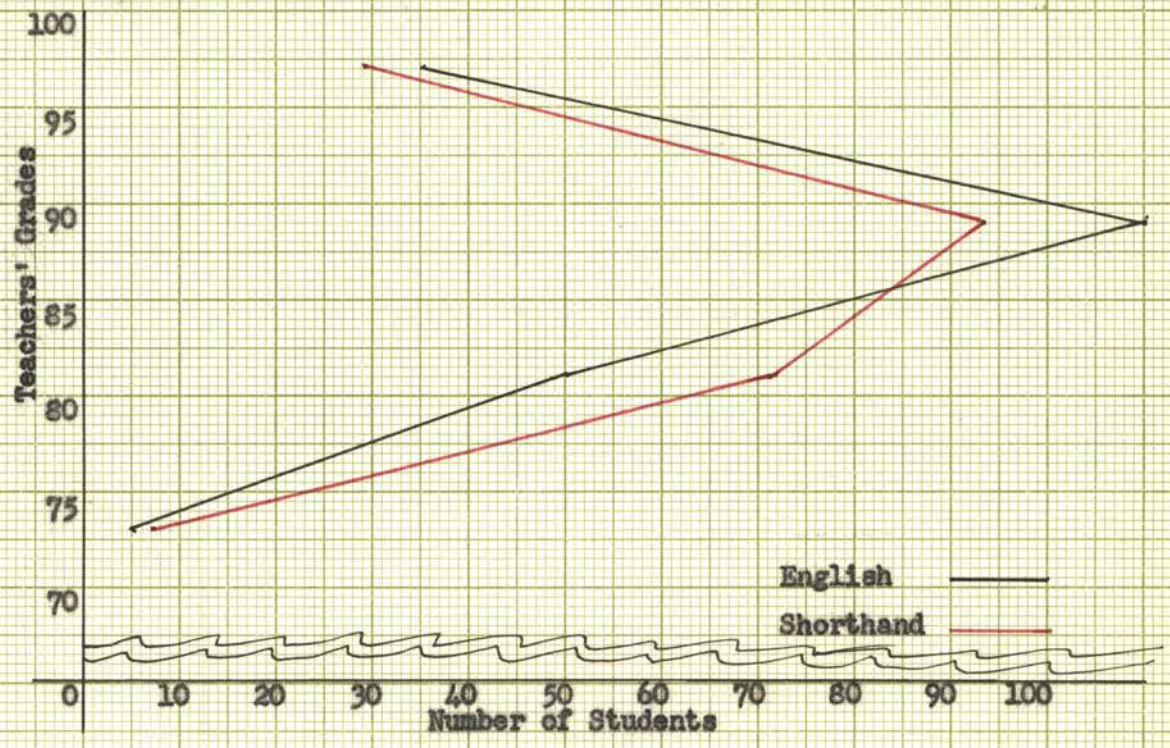
$$= 55.18$$

$$Y = 55.18 + .363X$$

(a) REGRESSION LINE RELATIONSHIP BETWEEN ENGLISH GRADES AND SHORTHAND GRADES



(b) LINE GRAPH OF ENGLISH GRADES, SHORTHAND GRADES, AND NUMBER OF STUDENTS



shorthand that do not seem to affect the learning of English, and vice versa. Closely related arithmetic means with a high correlation would indicate that those students who made high grades in one subject also made high grades in the other subject.

The regression line as shown in Graph IV (a), page 31, shows that on the average the grades in shorthand change at the rate of .363 per unit of change in the English grades. The line crosses the y-axis at 55.18 and tends upward to 91.48 at one hundred on the x-axis. The standard error of estimate, $\pm$5.99, shows that 68 per cent, or 136, of the items fall between +5.99 and -5.99 on either side of the regression line.

Graph IV (b), page 31, is a graphic representation of the grades in English and in shorthand, and the number of students in each class interval.

The correlation of science with shorthand, as shown by Table V, page 33, is .309 with a standard error of $\pm$.079. Science, as used in this study, includes biology, chemistry, and general science. Since science is not a required subject, the number of datum is only 131, or 65.5 per cent of the total. This, however, is a sufficient number to indicate authentic results. As shown by the table, the number of A's in science is 2.3 times the number in shorthand. This tends to skew the correlation considerable at that point. The grades in the lower part of the grade-scale tend to be about the same. Prediction from science grades would be 9 per cent better than a mere guess.

The arithmetic means of 87.05 and 88.94, in shorthand and science respectively, indicate that the mean averages are about the same, but the low correlation indicates that the associated factors in the two fields of study have little similarity.

TABLE V

SHORTHAND Y	X SCIENCE 93–100	85–92	77–84	69–76	fy	dy	fdy	fdy^2	Edxfy	Edxdy
93–100	11	6	2		19	1	19	19	9	9
85–92	24	23	16	2	65	0			4	
77–84	9	17	14	3	43	-1	-43	43	-11	11
69–76		1	3		4	-2	- 8	16	- 3	6
fx	44	47	35	5	131		-32	78	- 1	26
dx	1	0	-1	-2						
fdx	44		-35	-10	-1					
fdx^2	44		35	20	99					
Edyfx	2	-13	-18	- 3	-32					
Edxdy	2		18	6	26					

	Edxf	Edyf	Edx^2	Edy^2	Edxdy
Sums	-1	-32	99	78	26
Means	-.007	- .244			
Correction		.007	7.808	.244	
Corrected Value		98.99	70.19	25.76	

$$r = \frac{Exy}{\sqrt{Ex^2 \cdot Ey^2}} = \frac{25.76}{\sqrt{98.99 \times 70.19}} = .309$$

$$Sy = \sigma y \sqrt{1 - r^2}$$

$$\sigma y = i \sqrt{\frac{Ey^2}{N}} = 8 \sqrt{\frac{70.192}{131}} = 5.84$$

$$Sy = 5.84 \sqrt{1 - (.309)^2} = 5.55$$

$$\sigma r = \frac{1 - r^2}{\sqrt{N}} = \frac{1 - (.309)^2}{\sqrt{131}} = .079$$

$$Y = a + bX$$

$$b = \frac{Exy}{Ex^2} = \frac{25.76}{98.99} = .26$$

$$a = \bar{Y} - b\bar{X}$$

$$\bar{Y} = A + \frac{Efy}{N} \cdot i$$

$$= 89 + \frac{-32}{131} \cdot 8 = 87.05$$

$$\bar{X} = A + \frac{Efx}{N} \cdot i$$

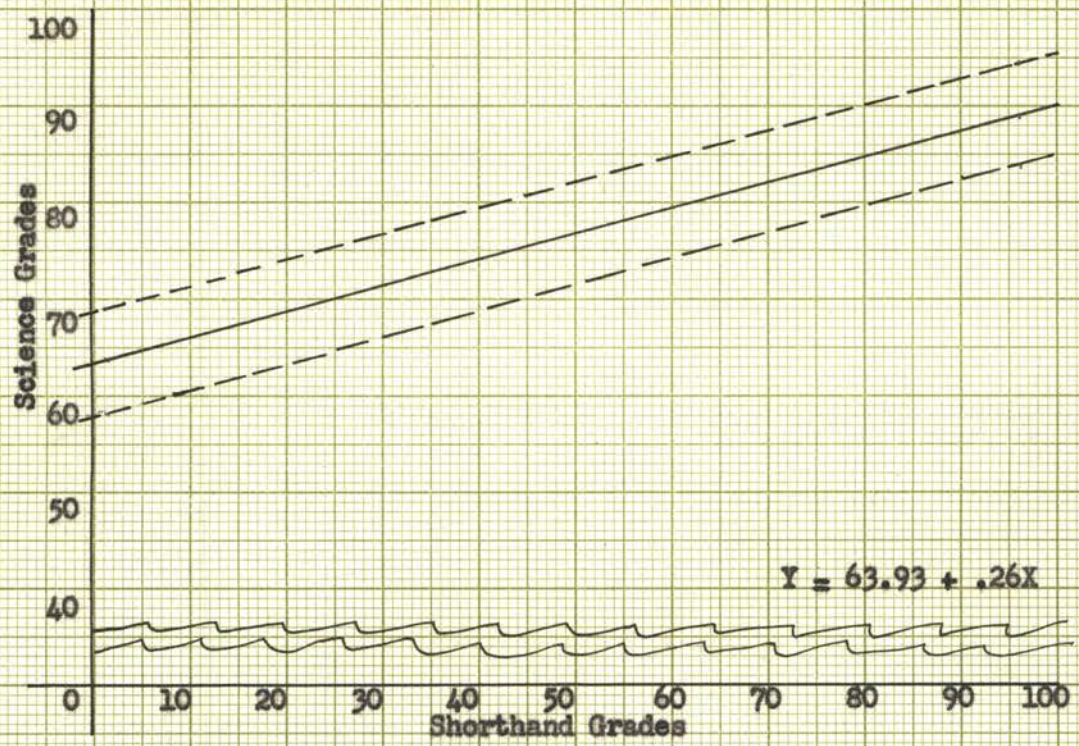
$$= 89 + \frac{-1}{131} \cdot 8 = 88.94$$

$$a = 87.05 - .26 \times 88.94$$

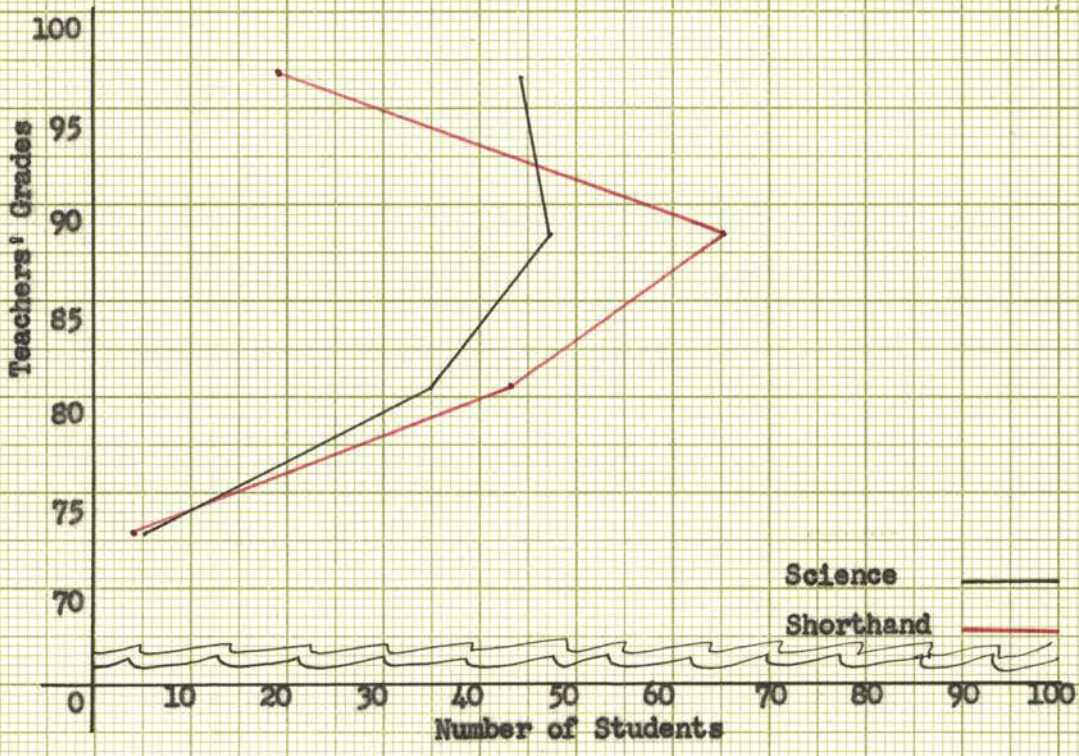
$$= 63.93$$

$$Y = 63.93 + .26X$$

(a) REGRESSION LINE RELATIONSHIP BETWEEN SCIENCE GRADES AND SHORTHAND GRADES



(b) LINE GRAPH OF SCIENCE GRADES, SHORTHAND GRADES, AND NUMBER OF STUDENTS



The regression line as shown in Graph V (a), page 34, shows that the grades in shorthand change, on the average, .26 per unit of change in the science grades. The line crosses the y-axis at 63.93 and reaches 89.93 at one hundred on the x-axis. The standard error of estimate is ±5.55. Sixty-eight per cent, or 89, of the items fall within ±5.55 on either side of the regression line.

Graph V (b), page 34, is a graphic representation of the grades in science and in shorthand, and the number of students in each class interval.

History, as shown by Table VI on page 36, falls sixth in this correlation series with a coefficient of correlation of .257. This table includes 186 items which is 93 per cent of the total number used in the study. This is a sufficient number for authenticity. The standard error of correlation is ±.068, thus making a possible correlation of .257 ± .068, or from .189 to .325. There is a greater number of A's in history and an F which tend to skew the correlation considerably. Almost half the items fall along the central line, but because of the great scatter of the items the correlation is low--yet it is 6.6 per cent better than a mere guess.

The arithmetic means of 86.81 and 87.11, in shorthand and history respectively, indicate that the mean averages are about the same, but the low correlation coefficient indicates that the causal factors must be dissimilar.

Graph VI (a), page 37, shows the regression line crossing the y-axis at 67.04 with an increase of .227 per unit on the x-axis. The line reaches 89.74 at one hundred on the x-axis. The standard error of estimate, ±5.75, shows the lines within which 68 per cent, or 126, of the items fall

TABLE VI

SHORTHAND

Y \ X HISTORY	93-100	85-92	77-84	69-76	61-68	fy	dy	fdy	fdy^2	Edxfy	Edxdy
93-100	10	15	2			27	1	27	27	8	8
85-92	13	46	21	7		87	0			-22	
77-84	14	16	33	2	1	66	-1	-66	66	-26	26
69-76		2	4			6	-2	-12	24	- 4	8
fx	37	79	60	9	1	186		-51	117	-44	42
dx	1	0	-1	-2	-3						
fdx	37		-60	-18	-3	-44					
fdx^2	37		60	36	9	142					
Edyfx	-4	-5	-39	-2	-1	-51					
Edxdy	-4		39	4	3	42					

	Efdx	Efdy	Edx^2	Edy^2	Edxdy
Sums	-44	-51	142	117	42
Means -	.24 -	.27			
Correction			10.43	13.97	12.07
Corrected Value			131.57	103.03	29.93

$$r = \frac{Exy}{\sqrt{Ex^2 \cdot Ey^2}} = \frac{29.93}{\sqrt{131.57 \times 103.03}} = .257$$

$$Sy = \sigma y\sqrt{1 - r^2}$$

$$\sigma y = i\sqrt{\frac{Ey^2}{N}} = 8\sqrt{\frac{103.03}{186}} = 5.952$$

$$Sy = 5.952\sqrt{1 - (.257)^2} = 5.75$$

$$\sigma r = \frac{1 - r^2}{\sqrt{N}} = \frac{1 - (.257)^2}{\sqrt{186}} = .068$$

$$Y = a + bX$$

$$b = \frac{Exy}{Ex^2} = \frac{29.93}{131.57} = .227$$

$$a = \bar{Y} - b\bar{X}$$

$$\bar{Y} = A + \frac{Efy}{N} \cdot i$$

$$= 89 + \frac{-51}{186} \cdot 8 = 86.81$$

$$\bar{X} = A + \frac{Efx}{N} \cdot i$$

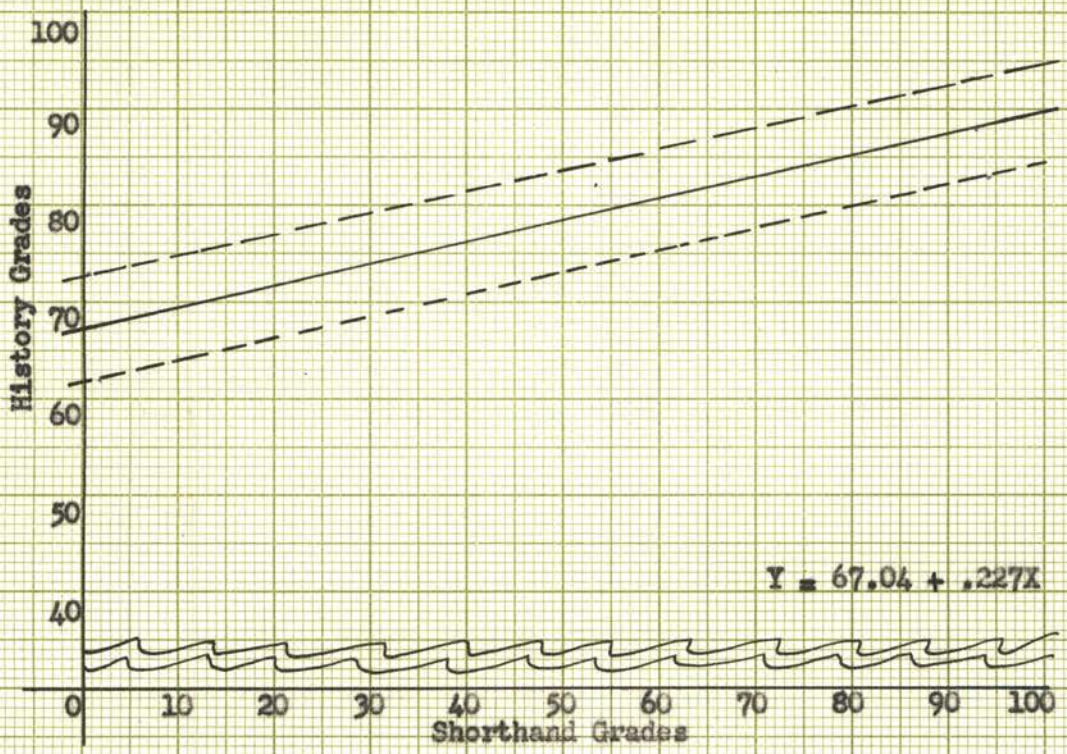
$$= 89 + \frac{-44}{186} \cdot 8 = 87.11$$

$$a = 86.81 - .227 \times 87.11$$

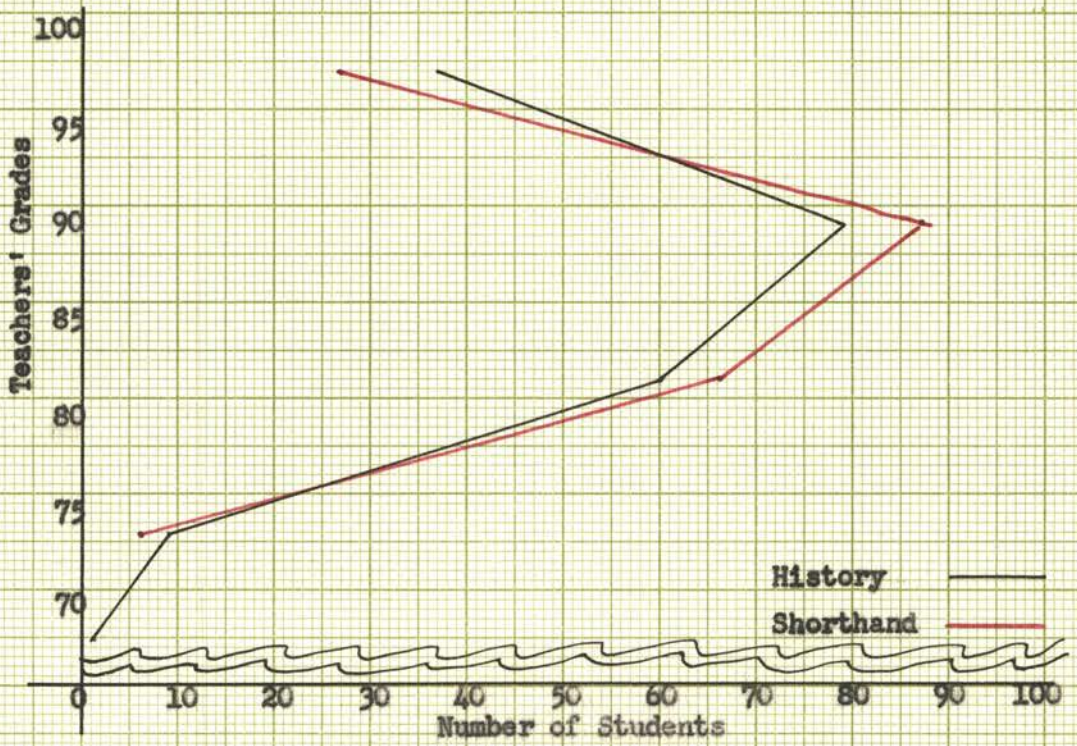
$$= 67.04$$

$$Y = 67.04 + .227X$$

(a) REGRESSION LINE RELATIONSHIP BETWEEN HISTORY GRADES AND SHORTHAND GRADES



(b) LINE GRAPH OF HISTORY GRADES, SHORTHAND GRADES, AND NUMBER OF STUDENTS



on either side of the regression line. This leaves only 60 items that would fall outside the two dotted lines.

Graph VI (b), page 37, is a graphic representation of the grades in history and in shorthand, and the number of students in each class interval.

The coefficient of correlation of .25 on Table VII, page 39, between mathematics and shorthand is slightly lower than that found between history and shorthand. The range in this instance is .25 ± .071. Mathematics grades have, therefore, in this study, a slightly lower predictive value for shorthand than history. The relationship is not enough to justify using teachers' grades in mathematics alone to predict teachers' grades in shorthand. This table includes 174 items which is 87 per cent of the total data. The grades in this table are greatly skewed toward mathematics in the A's, then swing over to shorthand in the B's. The C and D grades run about the same.

The arithmetic means of 87.28 and 87.4, in shorthand and mathematics respectively, vary by only .12 of a point indicating that students probably have about the same degree of difficulty in mastering the two subjects, judging from the stand-point of teachers' grades. Yet, as shown by the low correlation, the same students did not make high grades in both subjects—only 40 per cent made the same grades in mathematics as they made in shorthand.

In Graph VII (a), page 40, the regression line for the data crosses the y-axis at 69.01 and rises very slowly at the rate of .209 per unit on the x-axis. At the point one hundred on the x-axis the regression line has reached 89.91 on the y-axis. Sixty-eight per cent, or 118, of the items lie within a ±5.99 on either side of the regression line.

TABLE VII

SHORTHAND Y	X MATHEMATICS 93-100	85-92	77-84	69-76	fy	dy	fdy	fdy^2	Edxfy	Edxdy
93-100	12	10	7		29	1	29	29	5	5
85-92	16	35	24	5	80	0			-18	
77-84	11	19	23	5	58	-1	-58	58	-22	22
69-76		2	5		7	-2	-14	14	- 5	10
fx	39	66	59	10	174		-43	101	-40	37
dx	1	0	-1	-2						
fdx	39		-59	-20	-40					
fdx^2	39		59	40	138					
Edyfx	1	-13	-26	-5	-43					
Edxdy	1		26	10	37					

	Efdx	Efdy	Edx^2	Edy^2	Edxdy
Sums	-40	-43	138	101	37
Means	- .23	- .25			
Corrections			9.2	10.75	10
Corrected Value			128.8	90.25	27

$$r = \frac{Exy}{\sqrt{Ex^2 . Ey^2}} = \frac{27}{\sqrt{128.8 \times 90.25}} = .25$$

$$Sy = \sigma y \sqrt{1 - r^2}$$

$$\sigma y = i \sqrt{\frac{Ey^2}{N}} = 8 \sqrt{\frac{101}{174}} = 6.0944$$

$$Sy = 6.09 \sqrt{1 - (.25)^2} = 5.90$$

$$\sigma r = \frac{1 - r^2}{\sqrt{N}} = \frac{1 - (.25)^2}{\sqrt{174}} = .071$$

$$Y = a + bX$$

$$b = \frac{Exy}{Ex^2} = \frac{27}{128.8} = .209$$

$$a = \bar{Y} - b\bar{X}$$

$$\bar{Y} = A + \frac{Efy}{N} . i =$$

$$= 89 + \frac{-43}{174} . 8 = 87.28$$

$$\bar{X} = A + \frac{Efx}{N} . i$$

$$= 89 + \frac{-40}{174} . 8 = 87.4$$

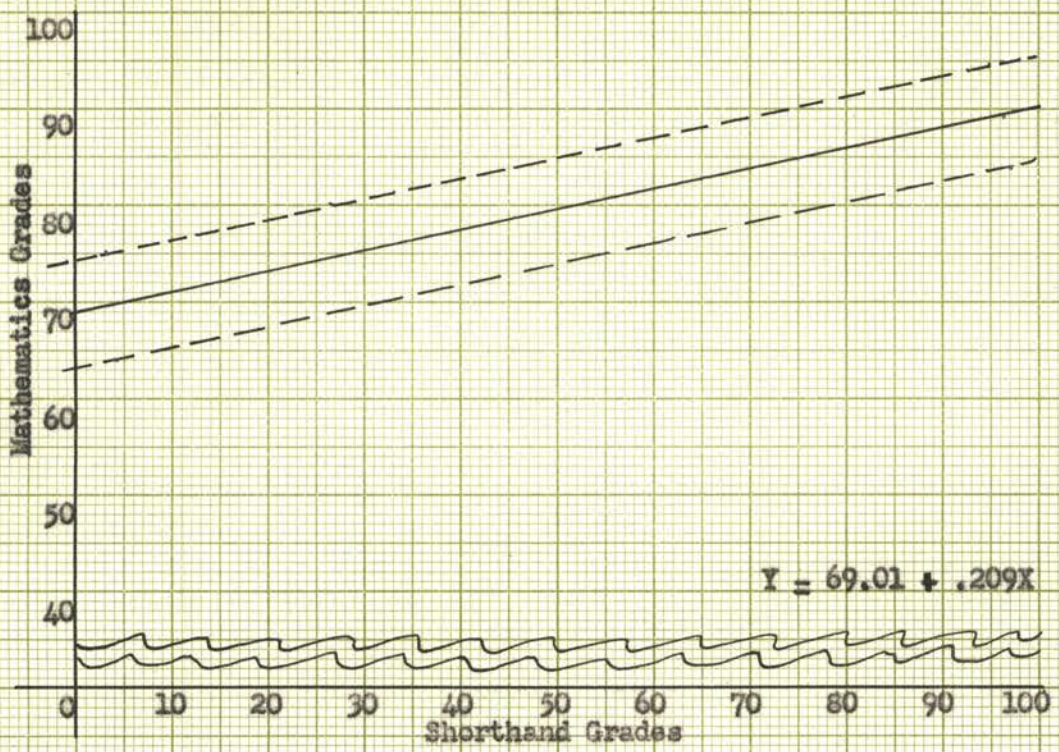
$$a = 87.28 - .209 \times 87.4$$

$$= 69.01$$

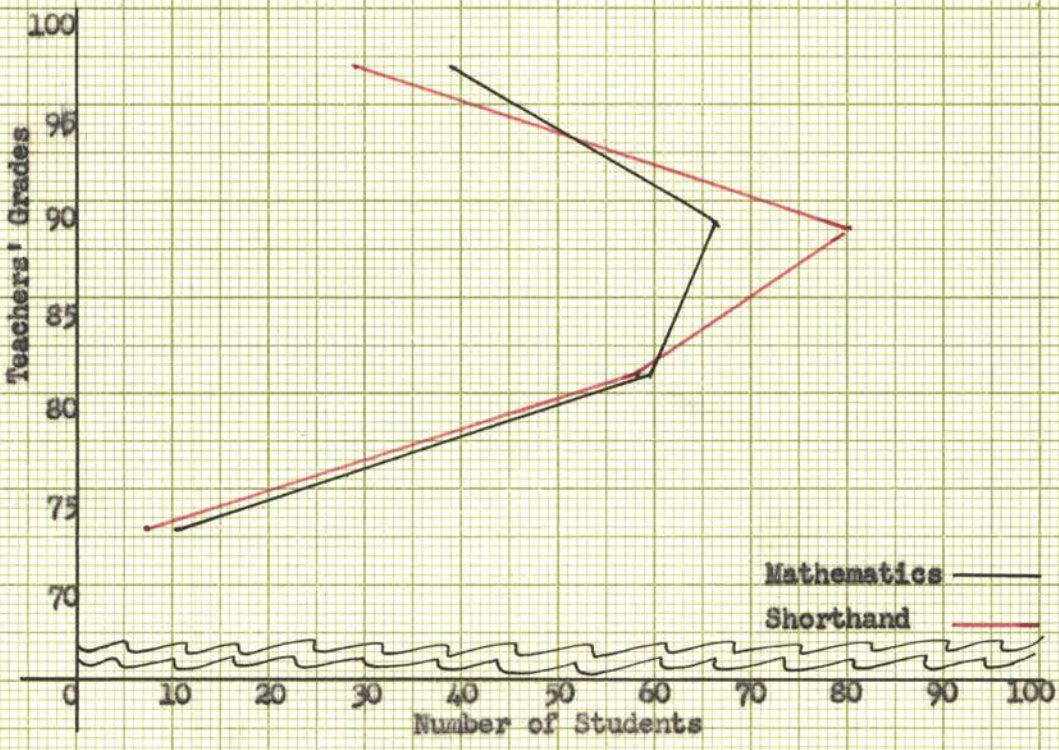
$$Y = 69.01 + .209X$$

GRAPH VII

(a) REGRESSION LINE RELATIONSHIP BETWEEN MATHEMATICS GRADES AND SHORTHAND GRADES



(b) LINE GRAPH OF MATHEMATICS GRADES, SHORTHAND GRADES, AND NUMBER OF STUDENTS



Graph VII, page 40, is a graphic representation of the grades in mathematics and in shorthand, and the number of students in each class interval.

On page 42, Table VIII shows economics to have a very low correlation of .180 with a standard error of correlation of ±.068. This correlation gives little indication of what the student might do in shorthand, for it shows a likeness in predictive factors of only 3.5 per cent. It is interesting to note that in the table the items are scattered more or less evenly over the entire field with only 29.5 per cent receiving the same grade in both shorthand and economics. Since economics is a required subject for all commerce majors, there are 200 items in this table.

The arithmetic means of 86.76 and 86.4, in shorthand and economics respectively, indicate that students have about the same degree of learning ability in the two subjects, as judged by teachers' grades. The coefficient of correlation, however, indicates that the students receiving high grades in economics do not necessarily receive high grades in shorthand. In fact, 25 per cent of those receiving A in shorthand received D in economics and about 24 per cent of those receiving A in economics received D in shorthand.

The regression line as shown by Graph VIII (a), page 43, crosses the y-axis at 70.95 and rises a little more slowly than that in history—.183 per unit on the x-axis. As the line approaches one hundred on the x-axis, it approaches 89.25 on the y-axis. The standard error of estimate of ±6.28 includes 68 per cent, or 136, of the items of data on either side of the regression line. As the correlation becomes smaller, the distance between the dotted lines becomes greater.

TABLE VIII

SHORTHAND

Y	X ECONOMICS 93-100	85-92	77-84	69-76	fy	dy	fdy	fdy^2	Edxfy	Edxdy
93-100	5	16	8		29	1	29	29	-3	-3
85-92	12	45	35	1	93	0			-25	
77-84	8	28	29	6	71	-1	-71	71	-33	33
69-76		3	4		7	-2	-14	28	- 4	8
fx	25	92	76	7	200		-56	128	-65	38
dx	1	0	-1	-2						
fdx	-25		76	14	-65					
fdx^2	25		76	28	129					
Edyfx	3	18	29	6	-56					
Edxdy	-3		29	12	38					

	Efdx	Efdy	Edx^2	Edy^2	Edxdy
Sums	-65	-56	129	128	38
Means	- .325	- .28			
Correction			21.12	15.68	18.2
Corrected Value			107.88	112.32	19.8

$$r = \frac{Exy}{\sqrt{Ex^2 \cdot Ey^2}} = \frac{19.80}{\sqrt{107.88 \times 112.32}} = .180$$

$$Sy = \sigma y \sqrt{1 - r^2}$$

$$\sigma y = i \sqrt{\frac{Ey^2}{N}} = 8 \sqrt{\frac{128}{200}} = 6.4$$

$$Sy = 6.4 \sqrt{1 - (.18)^2} = 6.28$$

$$\sigma r = \frac{1 - r^2}{\sqrt{N}} = \frac{1 - (.18)^2}{\sqrt{200}} = .068$$

$$Y = a + bX$$

$$b = \frac{Exy}{Ex^2} = \frac{19.80}{107.88} = .183$$

$$a = \bar{Y} - b\bar{X}$$

$$\bar{Y} = A + \frac{Efy}{N} \cdot i$$

$$= 89 + \frac{-56}{200} \cdot 8 = 86.76$$

$$\bar{X} = A + \frac{Efx}{N} \cdot i$$

$$= 89 + \frac{-65}{200} \cdot 8 = 86.4$$

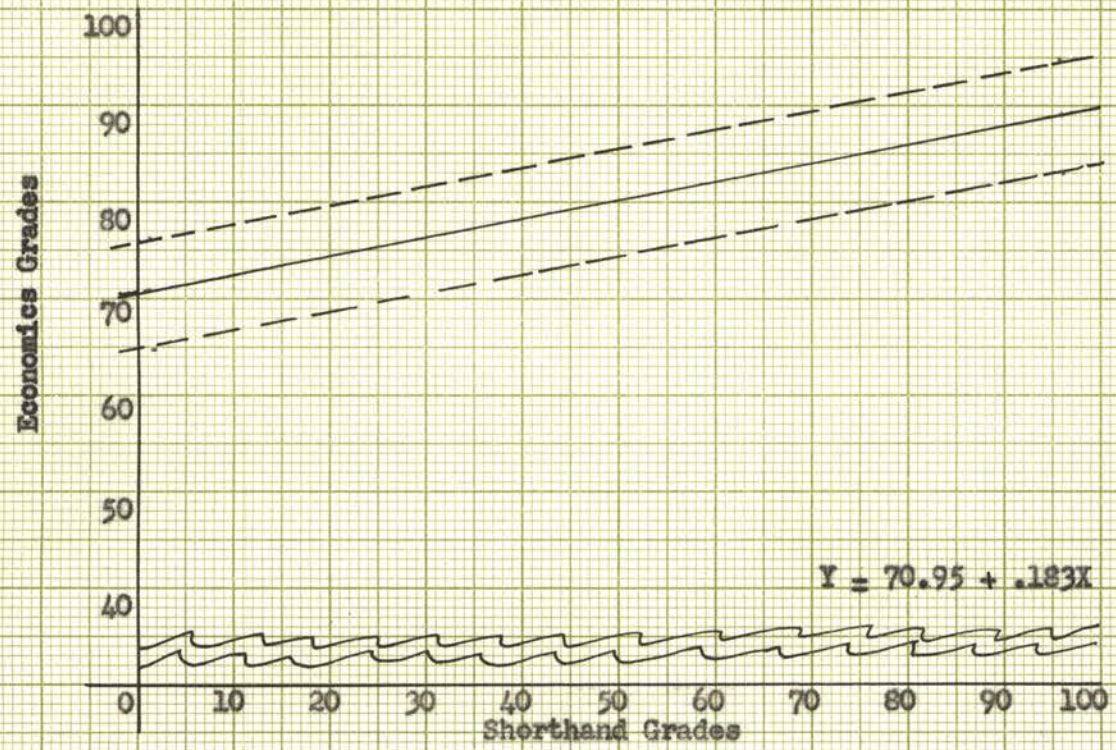
$$a = 86.76 - .183 \times 86.4$$

$$= 70.95$$

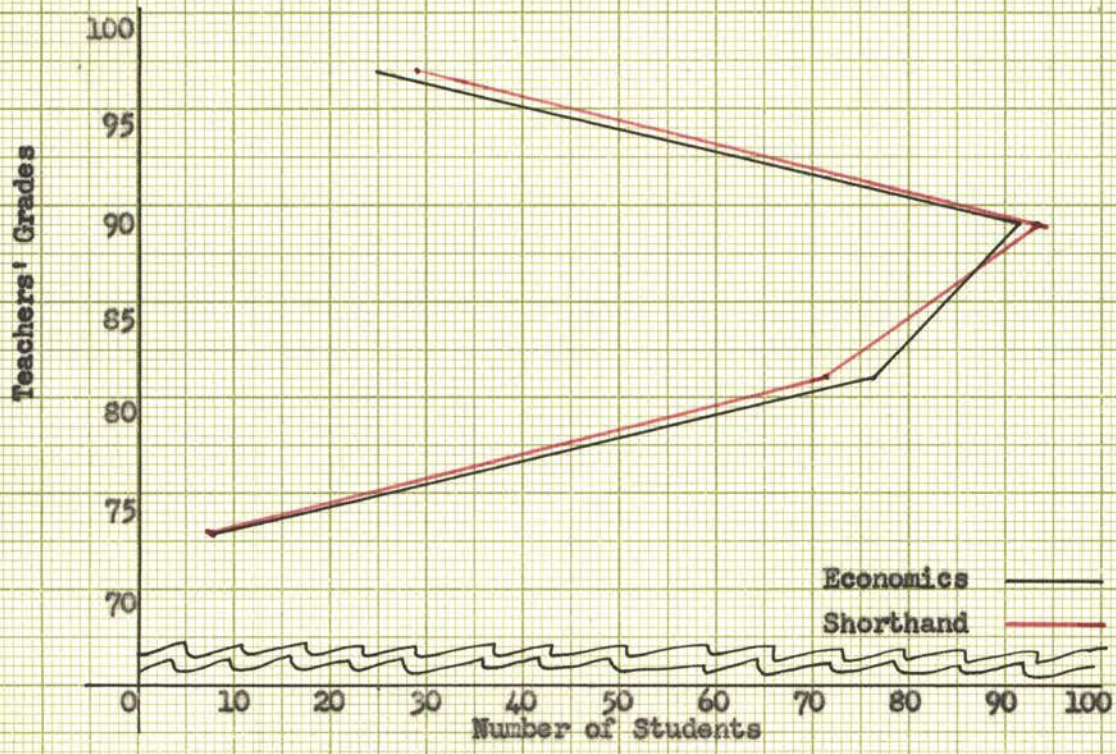
$$Y = 70.95 + .183X$$

GRAPH VIII

(a) REGRESSION LINE RELATIONSHIP BETWEEN ECONOMICS GRADES AND SHORTHAND GRADES



(b) LINE GRAPH OF ECONOMICS GRADES, SHORTHAND GRADES, AND NUMBER OF STUDENTS



Graph VIII (b), page 43, is a graphic representation of the grades in economics and in shorthand, and the number of students in each class interval.

The lowest correlation in the grades of academic subjects was found between geography and shorthand. As shown in Table IX, page 45, the coefficient of correlation is .146 with an estimated error of correlation of ±.071. Geography, as taught on the Oklahoma Agricultural and Mechanical College campus is more or less a memory subject. It would seem that that might be the only factor of similarity between the two. As noted from the table, grades in geography run much lower than in the other academic subjects. There are 24 per cent more A's and 81.8 per cent more D's in geography than in shorthand. This great difference along with the three F's in geography tend to throw the correlation very low. No estimate could be based on grades in geography for predicting grades in shorthand.

Again, as in the other subjects, the arithmetic means of 86.78 and 85.48, in shorthand and geography respectively, are close together. This might seem to indicate that similar work would be done by students in both subjects, but the coefficient of correlation indicates that this is quite untrue so far as can be judged from teachers' grades. As was seen in the fore-going paragraph, a great divergence is shown in grades in the two subjects.

The regression line as shown by Graph IX, part (a) on page 46, crosses the y-axis at 77.21 and rises only .112 with each unit on the x-axis. This gives a line which more nearly approaches a horizontal line than that of any of the other subjects used in the study. The line reaches 88.41 at one hundred on the x-axis. The standard error of estimate, ±6.01, shows

TABLE IX

SHORTHAND Y	X GEOGRAPHY 93-100	85-92	77-84	69-76	61-68	fy	dy	fdy	fdy^2	Edxfy	Edxdy
93-100	7	15	4	2	1	29	1	29	29	-4	-4
85-92	19	18	38	8		83	0			-35	
77-84	12	22	23	10	2	69	-1	-69	69	-37	37
69-76		3	1	2		6	-2	-12	24	- 5	10
fx	38	58	66	22	3	187		-52	122	-81	43
dx	1	0	-1	-2	-3						
fdx	38		-66	-44	-9	-81					
fdx^2	38		66	88	27	219					
Edyfx	-5	-13	-21	-12	-1	-52					
Edxdy	-5		21	24	3	43					

	Efdx	Efdy	Edx^2	Edy^2	Edxdy
Sums	-81	-52	219	122	43
Means	- .43	- .28			
Correction			35.07	14.46	22.42
Corrected Value			183.93	107.54	20.58

$$r = \frac{Exy}{\sqrt{Ex^2 \cdot Ey^2}} = \frac{20.58}{\sqrt{183.93 \times 107.54}} = .146$$

$$Sy = \sigma y \sqrt{1 - r^2}$$

$$\sigma y = i \sqrt{\frac{Ey^2}{N}} = 8 \sqrt{\frac{107.54}{187}} = 6.08$$

$$Sy = 6.08 \sqrt{1 - (.146)^2} = 6.01$$

$$\sigma r = \frac{1 - r^2}{\sqrt{N}} = \frac{1 - (.146)^2}{\sqrt{187}} = .071$$

$$Y = a + bX$$

$$b = \frac{Exy}{} = \frac{20.58}{183.93} = .112$$

$$a = \bar{Y} - b\bar{X}$$

$$\bar{Y} = A + \frac{Efy}{N} \cdot i$$

$$= 89 + \frac{-52}{187} \cdot 8 = 86.78$$

$$\bar{X} = A + \frac{Efx}{N} \cdot i$$

$$= 89 + \frac{-81}{187} \cdot 8 = 85.48$$

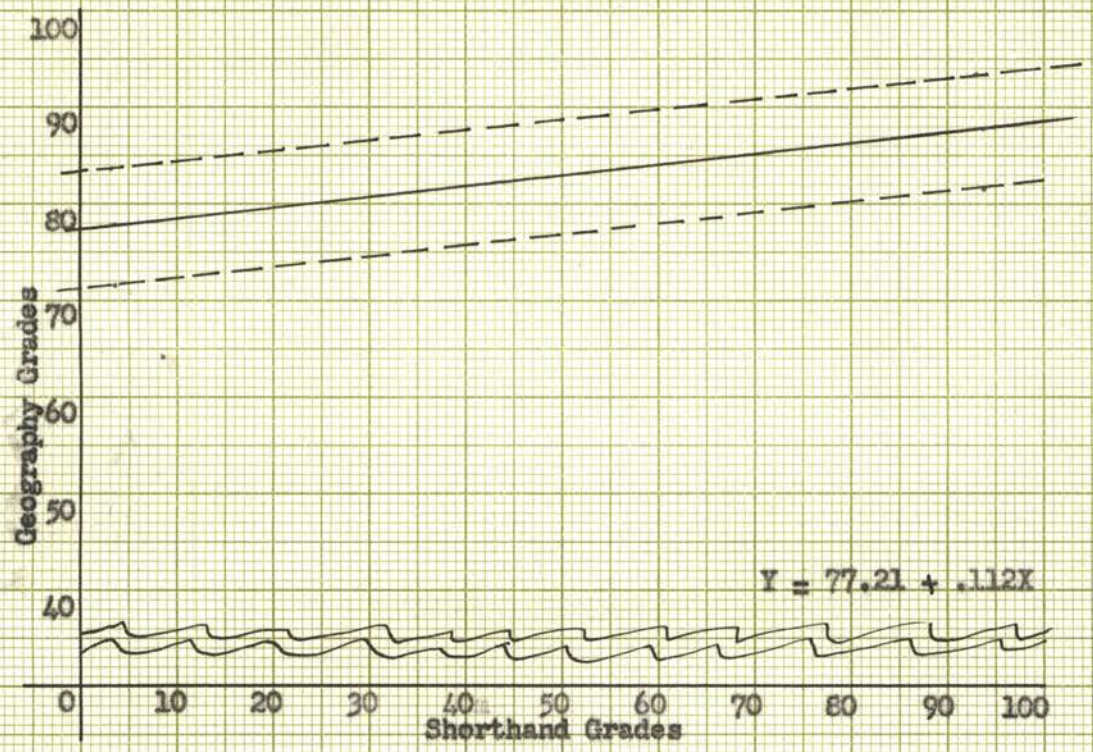
$$a = 86.78 - .112 \times 85.48$$

$$= 77.21$$

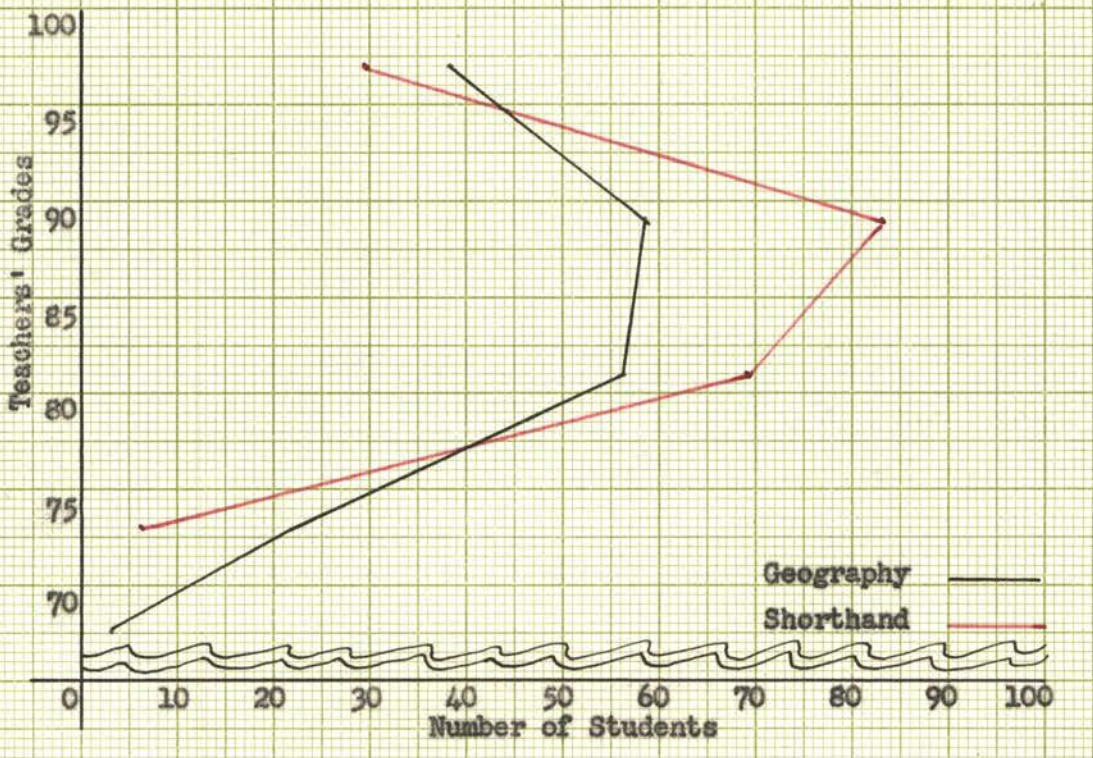
$$Y = 77.21 + .112X$$

GRAPH IX

(a) REGRESSION LINE RELATIONSHIP BETWEEN GEOGRAPHY GRADES AND SHORTHAND GRADES



(b) LINE GRAPH OF GEOGRAPHY GRADES, SHORTHAND GRADES, AND NUMBER OF STUDENTS



that the data are spread over a wider area than in the more highly correlated subjects. Sixty-eight per cent, or 127, of the items fall within ±6.01 units on either side of the regression line.

Graph IX (b), page 46, is a graphic representation of the grades in geography and in shorthand, and the number of students in each class interval.

The grade point average does not have the lowest correlation as it might seem by its placement at the end of this study, but it seemed more fitting to place it here since it is a summation of the grades in all subjects. The record sheets of the 200 students used in the study were pulled from the permanent record files of the registrar and the grade point average computed from all grades made by the student during the complete college course of study. Table X, page 48, shows the grade point average correlation with shorthand to be .375. This gives a correlation of only .01 less than that of typewriting which was second high in this study. The standard error of correlation, ±.061, is .04 less than that of typewriting, indicating that prediction may be made more accurately from the average of all grades. Noting the table, all grade point averages are C or above. This is accounted for by the fact that the college requires an average of C for graduation. The total grade point average shows only half as many A's as does shorthand. However, the number of B's in grade point average is 1.42 times that of the B's in shorthand. The seven D's in shorthand throw the correlation off still more.

The arithmetic means of 86.76 and 87.4, in shorthand and in total grade point average respectively, show a difference of only .64 of a point. This, however, does not mean a great deal in so far as

TABLE X

SHORTHAND

Y	X GRADE PT. AVERAGE 93–100	85–92	77–84	69–76	fy	dy	fdy	fdy^2	Edxfy	Edxdy
93–100	7	20	2		29	1	29	29	5	5
85–92	6	69	18		93	0			-12	
77–84	1	40	30		71	-1	-71	71	-29	29
69–76		3	4		7	-2	-14	28	- 4	8
fx	14	132	54		200		-56	128	-40	42
dx	1	0	-1							
fdx	14		-54		-40					
fdx^2	14		54		68					
Edyfx	6	-26	-36		-56					
Edxdy	6		36		42					

	Efdx	Efdy	Edx^2	Edy^2	Edxdy
Sums	-40	-56	68	128	42
Means	- .2	- .28			
Correction			8	15.68	11.2
Corrected Value			60	112.32	30.8

$$r = \frac{Exy}{\sqrt{Ex^2 \cdot Ey^2}} = \frac{30.8}{\sqrt{60 \times 112.32}} = .375$$

$$Sy = \sigma y\sqrt{1 - r^2}$$

$$\sigma y = i\sqrt{\frac{Ey^2}{N}} = 8\sqrt{\frac{30.8}{200}} = 3.128$$

$$Sy = 3.128\sqrt{1 - (.375)^2} = 2.90$$

$$\sigma r = \frac{1 - r^2}{\sqrt{N}} = \frac{1 - (.375)^2}{\sqrt{200}} = .061$$

$$Y = a + bX$$

$$b = \frac{Exy}{Ex^2} = \frac{30.8}{60} = .515$$

$$a = \bar{Y} - b\bar{X}$$

$$\bar{Y} = A + \frac{Efy}{N} \cdot i$$

$$= 89 + \frac{-56}{200} \cdot 8 = 86.76$$

$$\bar{X} = A + \frac{Efx}{N} \cdot i$$

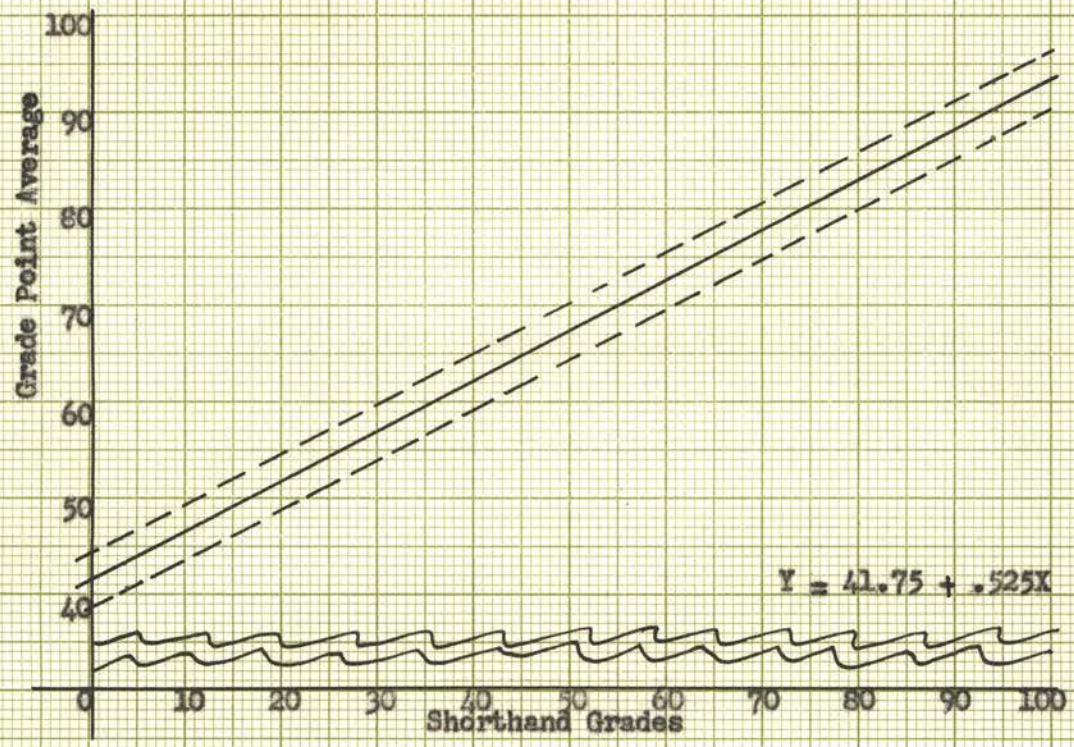
$$= 89 + \frac{-40}{200} \cdot 8 = 87.4$$

$$a = 86.76 - .515 \times 87.4$$

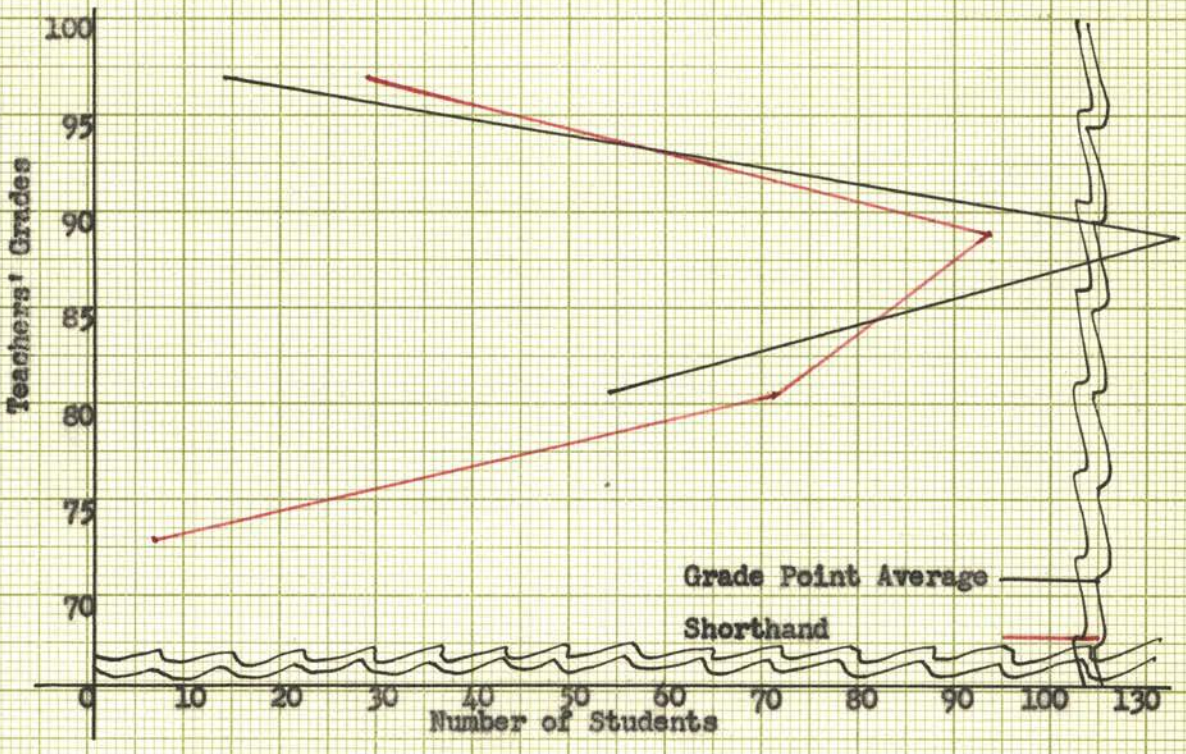
$$= 41.75$$

$$Y = 41.75 + .515X$$

(a) REGRESSION LINE RELATIONSHIP BETWEEN GRADE POINT AVERAGES AND SHORTHAND GRADES



(b) LINE GRAPH OF GRADE POINT AVERAGES, SHORTHAND GRADES, AND NUMBER OF STUDENTS



prognostic work is concerned when the correlation is noted. The coefficient of correlation does indicate that a likeness of determining factors does exist, however, and these should not be neglected.

The regression line, as shown in Graph X (a), page 49, shows up somewhat differently from those of the nine academic subjects studied. It crosses the y-axis at a much lower point, 41.75, and rises much more rapidly—.515 to each unit on the x-axis. It attains a height of 93.25 at one hundred on the x-axis. The standard error of estimate, ±2.90, is much less than in any of the other tables, showing a greater concentration of the data on either side of the regression line.

Graph X (b), page 49, is a graphic representation of the grades in the total point averages and in shorthand, and the number of students in each class interval.

Table XI, page 51, gives the average relationships found between given academic grades and estimated shorthand grades. The mid-points of A, B, C, and D were taken as 97, 89, 81, and 73 respectively. Using these grades as the base for the academic subject and the regression equations as found in each of the ten tables, the estimated grades were computed for shorthand.

The table is read across as follows: with a basic grade of 73 in foreign language, the estimated grade in shorthand is 80.85; with 81 as a base, the estimated grade becomes 84.7; with 89 as a base, the estimated grade becomes 87.5; and with a base of 97, the estimated grade becomes 89.6.

The standard error of estimate was not used in working out the table. To determine the amount of variation in each estimated grade the plus and minus standard error of estimate from the respective tables must be added.

TABLE XI

AVERAGE RELATIONSHIPS BETWEEN GIVEN ACADEMIC GRADES AND ESTIMATED SHORTHAND GRADES

SUBJECT	Letter Grade in Academic Subjects							
	D		C		B		A	
	Academic Grade X	Shorthand Grade Y	Academic Grade X	Shorthand Grade Y	Academic Grade X	Shorthand Grade Y	Academic Grade X	Shorthand Grade Y
Foreign Language	73	80.85	81	84.7	89	87.5	97	89.6
Typewriting	73	81.35	81	84.14	89	86.93	97	89.72
Accounting	73	82.78	81	85.28	89	87.79	97	90.29
English	73	81.68	81	84.58	89	87.49	97	90.39
Science	73	82.91	81	84.99	89	87.07	97	89.15
History	73	83.61	81	85.42	89	86.79	97	89.06
Mathematics	73	84.27	81	85.94	89	87.61	97	89.28
Economics	73	84.31	81	85.77	89	87.24	97	88.70
Geography	73	85.39	81	86.28	89	87.18	97	88.07
Grade Point Average	73	79.35	81	83.47	89	87.39	97	91.71

Summary

A Summary of Statistical Data as given in Table XII, page 53, seems to be the clearest way of summarizing what has been found by computation in the first ten tables of this chapter.

An examination of the summary table reveals some interesting facts with regard to the various computations made. The arithmetic means of the academic subjects are higher than that of shorthand in seven out of ten instances. The regression lines are more or less similar in their upward trend with the exception of the one in grade point average. The standard error of estimate runs well over four in all cases except in the grade point average. The coefficients of correlation are all positive. There is a variance of only .312 between the foreign language correlation of .458 and the geography correlation of .146--the highest and lowest in the study. The coefficient of determination (r^2) indicates that prediction is possible but small. The estimated error of correlation for foreign language runs a little high because of the small number of data.

General conclusions will be made in Chapter IV from what has been revealed by the tables in Chapter III.

TABLE XII

SUMMARY OF STATISTICAL CALCULATIONS

SUBJECT	$\bar{X}$	$\bar{Y}$	$Y = a + bX$	Sy	r	r^2 %	r
Foreign Language	89.0	87.5	$Y = 56.35 + .350X$	4.91	.458	21.0	.114
Typewriting	88.4	86.69	$Y = 55.87 + .349X$	4.32	.385	14.8	.065
Accounting	85.87	86.81	$Y = 59.93 + .313X$	5.99	.348	12.1	.063
English	87.0	86.76	$Y = 55.18 + .363X$	5.62	.346	11.3	.062
Science	88.9	87.05	$Y = 63.93 + .260X$	5.55	.309	9.5	.079
History	87.11	86.81	$Y = 67.04 + .227X$	5.75	.257	6.6	.068
Mathematics	87.4	87.28	$Y = 69.01 + .209X$	5.90	.250	6.3	.071
Economics	86.4	86.76	$Y = 70.95 + .183X$	6.28	.180	3.2	.068
Geography	85.48	86.78	$Y = 77.21 + .112X$	6.01	.146	2.1	.071
Grade Point Average	87.46	86.76	$Y = 71.75 + .515X$	2.90	.375	14.1	.061

CHAPTER IV

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

The purposes of this study, as given in Chapter I, are:

1. To ascertain if there is any significant correlation between shorthand grades and grades in the listed academic subjects of college students.

2. To find if the correlation between shorthand grades of college students and the composite average, or grade point average, is greater or less than that of individual subjects.

3. To determine to what extent and with what degree of accuracy shorthand grades of college students can be predicted from grades in these academic subjects.

4. To discover if there are any appreciable differences in the correlations found in grades of Oklahoma Agricultural and Mechanical College students of commerce and those found in previous studies of high school students.

Analyzing the data from the standpoint of the purposes, certain definite conclusions are reached. The coefficients of correlation found in this study have two points in their favor, that is: (1) they are positive, and (2) their ability to predict ranges all the way from 2.1 per cent to 21 per cent. The correlations range from .146 $\pm$ .071 to .458 $\pm$ .114. Therefore, it must be concluded that there is some correlation between grades in shorthand and grades in academic subjects, but it is low.

Because the subject matter of the courses included in this study is very different from the content of shorthand (or stenography) courses, it is not surprising that the correlations are low. The best correlation found was in foreign language. It may seem strange that this relationship is much higher than any of the others. There must be present in both many

factors that are similar in the learning process. The most reasonable explanation for this higher correlation seems to lie in the fact that foreign language and shorthand are very largely language subjects--both requiring the mastery of new symbols and word forms. Since both subjects are taken by the students by choice, a relatively high correlation might be expected in the factor of likability. Typewriting and accounting are subjects that require a great amount of coordination and manual dexterity. Since shorthand requires this same coordination and alertness, this might account for a part of their higher correlation. English, being a background subject, is one in which the student has probably had more training than in any other subject. He knows that it is to be a part of his curriculum no matter what field he goes into, so he accepts it as such and applies himself more diligently than in some others. Science is a popular subject of the times, and has a great deal of interest for most students. The student usually does well the things he likes to do most. History, mathematics, economics, and geography are studies that do not appeal to all students alike. They are either required or highly recommended courses for students in commerce. Since these subjects are often thought of as "necessary evils" by some students, the lack of interest causes some to do little with the study of the subject. A statement made by Marson A. Sherman with regard to the learning of shorthand might well apply to all courses in the curriculum.

> The failing student of high native ability undoubtedly tends toward failure in shorthand through sheer boredom, lack of interest, or lack of reason for taking shorthand, while the extremely low-ability student gives up because the goal seems too difficult.[1]

---

[1] Marson A. Sherman, "A Study of Prognosis in Shorthand," Business Education World, 22 (April, 1942), 691.

A conclusion that must be reached with regard to the correlations of these academic subjects is that there must be a multiplicity of factors tending to affect the student in his educational career of learning. Some of these factors must be present in the learning of shorthand and in the learning of each of the academic subjects, but the ability to predict from some of these academic grades is so low as to be almost negligible.

As found in this study, the grade point average was as good or better for prediction of shorthand grades as any academic subject except foreign language. Since the grade point average is a composite of the high and low grades of all subjects it, perhaps, gives a better picture of the work of the student as a whole upon which to base prognostic work.

The correlations, on the whole, of the grades of these two hundred college students, ran a little lower than the correlations on the high school level. Perhaps other factors enter into the work of the college student, and factors that affected the work of high school students may have had little influence on the college student. From this study, however, made on the college level, it must be concluded that grades of college students and grades of high school students in shorthand and in academic subjects show about the same general relationship or correlation.

It would seem, in view of this study on the college level, and studies made on the high school level, that other factors of prognosis need to be determined and studies made on their correlation with shorthand.

Recommendations

After making an analysis of the coefficients of correlation and other statistical computations made in this study, and comparing these findings with those of others doing research in this field, it is recommended that:

(1) Further study be made on the college level to ascertain if all such studies on the college level correlate with the facts as brought out in this study.

(2) Since academic subjects have such low correlations, that studies be made using other factors, such as: age, sex, work experience, nationality, personality, type of examination, interest, ambition, physical coordination, and any others that might affect the student in any way.

(3) Some device be used for a more accurate and more standardized system of testing and grading, in order that more efficient prognostic and guidance work may be done on both the high school level and the college level.

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