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A comparative study of industrial arts students and college course students at Indiana State Teachers College

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A COMPARATIVE STUDY OF INDUSTRIAL ARTS STUDENTS AND COLLEGE COURSE STUDENTS AT INDIANA STATE TEACHERS COLLEGE

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I. INTRODUCTION

A. Reasons for this Study.

The opinion that students who elect Industrial Arts as their major subject are inferior in intelligence and scholastic achievement to students who elect their major subject from the academic field, has long been a popular assumption.

This study was undertaken to determine, as far as may be, the degree of truth in the opinion mentioned above.

B. Review of Previous Studies.

In a search of the literature available only one study was found which made comparisons similar to this study.

Helen E. Stimson found that, upon comparing the general scholarship indexes of students on the regular A. B. curriculum, there were ninety-five chances in one hundred that a true difference in favor of the A. B. group existed.[1]

On comparing the general scholarship index of students on the Bachelor of Science curriculum with those on the Industrial Arts curriculum, she also found that there were seventy-one chances in one hundred that a true difference in favor of the Industrial Arts group existed.[2]

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[1] Helen E. Stimson, An Analysis of the Possible Uses of the Scholarship Index at Indiana State Teachers College. Contributions of the Graduate School, No. 161, Indiana State Teachers College, Terre Haute; Table III, p. 18

[2] Ibid., Table V. p. 20.

She also found that there were sixty-three chances in one hundred that a true difference in favor of the students on the Industrial Arts curriculum over those on the Academic curriculum existed.[3] In her comparison of all curricular groups, she found that the Industrial Arts group ranked below all except Primary, B. S., Academic, and Physical Education groups in mean scholarship index.

Judging from the paucity of investigations in this particular field, some further research in other schools as well as Indiana State Teachers College, should be done.

C. The Scope of this Study.

The personnel of the groups to be compared with the Industrial Arts group was somewhat difficult to determine, since there are so few bases on which to make a comparison. However, a plan was decided upon which required the following groups to be set up:

Group A includes students enrolled on the Special Four-year Industrial Arts curriculum.

Group B includes students enrolled on any of the Regular Four-year College curricula, not taking a major in English.

Group C includes students enrolled on any of the Regular Four-year College curricula, not taking a major in Mathematics.

Group D includes students enrolled on any of the Regular Four-year College curricula, not taking a major in Science.

Since no women are enrolled on the Special Four-year Industrial Arts curriculum, the records of men students only

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[3] Helen E. Stimson, op. cit., Table VII, p. 22.

[4] Ibid., Fig. 2, p. 43.

were included in the other groups, thus eliminating any differences due to sex.

Also, only the undergraduate work of those students who have completed at least one year of work in Indiana State Teachers College, is considered in this study.

D. The Methods Used in Making the Study.

1. Records used. The permanent records of Indiana State Teachers College were searched for a representative list of students in the academic field. Such a list was very difficult to obtain because records of students by major subject are inadequate. The list used, therefore, was taken from the records of license applications and recommendations, and covered the period beginning with the Fall Quarter, 1928, and ending with the Summer Quarter 1932.

The list of students in the Industrial Arts field was obtained from records in the office of the Department of Industrial Arts.

The percentile scores on the Freshman Mental Test were obtained from the office of the Executive Officer of the Graduate School. The complete scholastic record of each student used was obtained from the permanent records in the office of the Registrar.

2. Treatment of the data. After the data were gathered, the groups were paired on the basis of the percentile score on the Freshman Mental Test, thus giving two groups which were approximately equal. Scholarship indexes were then computed for the complete record; all courses in Education except Practice Teaching, which was omitted in order to eliminate the influence

of the major subject; English 111 and 112 or equivalent; Mathematics 110 and 112 or equivalent; and Science 181 and 183 or equivalent.

a. Comparison of Group A with other groups. Group A was compared with all the other groups combined on the basis of scholarship index in all courses, and also on the basis of scholarship index in Education.

b. Group A and Group B compared. From the complete list of College Course students were selected those who were classified in Group B. From the complete list of Industrial Arts students were selected those whose percentile scores were paired with those in Group B. These two groups were then compared on the basis of scholarship index in Freshman English courses 111 and 112 or equivalent, these courses being required of all Freshmen.

c. Group A and Group C compared. Groups A and C were paired out of the whole groups in the manner stated above. They were then compared on the basis of scholarship index in Freshman Mathematics courses 110 and 112 or equivalent, these courses being required of all Industrial Arts students.

d. Group A and Group D compared. Groups A and D were paired from the whole groups in the same manner as the others and compared on the basis of scholarship index in Freshman Science courses 181 and 183 or equivalent, these courses being required of all Industrial Arts students.

e. Correlations. Correlations of scholarship index with percentile score, calculated by the product-moment method, were obtained for Group A and for the combined groups. The

regression equations were also found in both deviation and score form, for both groups.

f. Reliability of the various measures. In all cases, the reliability of the measure used was computed from formulas listed by Garrett.[5] However, as Garrett points out, the reliability formulas make allowance only for errors due to sampling.

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[5] Henry E. Garrett, Statistics in Psychology and Education. New York: Longmans, Green and Co., 1926. Pp. xiv, 318.

II. A COMPARISON OF THE TWO GROUPS IN GENERAL SCHOLARSHIP AND IN EDUCATION.

For purposes of comparison in general scholarship and in Education, the groups were not subdivided.

A. Comparison in General Scholarship.

1. Cases considered. From a list of nearly two hundred fifty names in each group, a final list of one hundred thirty-eight in each was obtained. This reduction was due to the lack of percentile scores for many and to the pairing of the two groups.

2. Analysis of the data. In arriving at the measure of scholarship to be used as a basis for comparison, it seemed best to adopt the scholarship index as used by the Indiana State Teachers College. This index is the quotient of the number of honor points divided by the number of term hours of credit earned. The number of honor points was found by assigning values to each letter grade, as follows: A=4; B=3; C=2; P or D=1; F=0. No consideration was given to withdrawals.

The general scholarship indexes for the Industrial Arts students were found to range from 24 to 88, in a bimodal distribution. The two modes are represented by the midpoint of the class-intervals as 52.5 and 67.5.

The general scholarship indexes of the students in the other groups range from 40 to 91, in a more symmetrical distribution.

The distributions of the two groups are shown in Table I, which shows the frequency in each class-interval for each of the two groups.

TABLE I

SCHOLARSHIP INDEXES IN ALL SUBJECTS EARNED BY INDUSTRIAL ARTS STUDENTS AND COLLEGE COURSE STUDENTS

Class-interval	Industrial Arts Students	College Course Students
95 - 99.9	0	0
90 - 94.9	0	2
85 - 89.9	1	2
80 - 84.9	4	6
75 - 79.9	6	14
70 - 74.9	14	12
65 - 69.9	26	23
60 - 64.9	16	17
55 - 59.9	17	25
50 - 54.9	28	21
45 - 49.9	14	12
40 - 44.9	3	4
35 - 39.9	3	0
30 - 34.9	4	0
25 - 29.9	1	0
20 - 24.9	1	0
	N = 138 Ave = 59.3±1.03 S.D. = 12.1±.73	N = 138 Ave=63.1±.95 S.D.=11.2±.68

From the data in Table I it is found that the mean scholarship index for Group A is 59.31±1.03, and for the other groups 63.08±.95, showing a difference in the obtained means of 3.77 in favor of the college groups. The reliability of the obtained difference was determined by the formula $\sigma_{(diff)} = \sqrt{\sigma^2_{av_1} + \sigma^2_{av_2}}$ [1]. This reliability coefficient was found to be 1.402, giving a significant ratio to the obtained difference of 2.68. A significant ratio of this size indicates that there are 99 chances in 100 that a true difference greater than zero, and in favor of the college course students, exists.[2]

B. Comparison in Education.

In the field of Education the scholarship indexes for Group A range from 25 to 88, and for Groups B, C, and D combined, from 25 to 100.

The frequency distributions are shown in Table II, from which an apparent difference in favor of the college students is seen. The mean scholarship index for Group A is 52.33±1.09, and the standard deviation 12.88±.78. For the other groups combined the mean is 62.1±1.11, and the standard deviation is 12.97±.78.

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[1] Henry E. Garrett, Statistics in Psychology and Education. New York: Longmans, Green and Co., 1926. pp. 128-137.

[2] Ibid., Table XIV, p. 134.

TABLE II

A DISTRIBUTION OF SCHOLARSHIP INDEXES IN EDUCATION, EARNED BY INDUSTRIAL ARTS AND COLLEGE COURSE STUDENTS

Class-interval	Industrial Arts Students	College Course Students
95 - 99.9	0	1 (100)
90 - 94.9	0	2
85 - 89.9	1	1
80 - 84.9	0	4
75 - 79.9	6	22
70 - 74.9	3	10
65 - 69.9	12	13
60 - 64.9	6	24
55 - 59.9	20	11
50 - 54.9	25	30
45 - 49.9	16	9
40 - 44.9	22	6
35 - 39.9	12	3
30 - 34.9	6	1
25 - 29.9	9	1
	N=138	N=138
	Ave.= 52.3±1.09	Ave.=62.1±1.1
	S.D.=12.88±.78	S. D.=12.97±.78

1. Variability. In a comparison of the variability of the two groups, it is seen that they cluster about the means practically the same, as there is a very slight difference in the two sigmas. However, applying the Pearson formula for the coefficient of relative variability ($V=\frac{100\sigma}{Ave.}$), V is 24.61 for Group A and 20.88 for the other groups. Expressing these coefficients in terms of percentage, Groups B, C, and D are $\frac{20.88}{24.61}$ or 84.85% as variable as Group A.

2. Reliability. Referring to Table 11, p.9, the mean scholarship index for Group A is 52.3 1.09, and for the other groups, 62.1 1.11. The obtained difference of the two means is 9.8, and is in favor of the college course group. The reliability of this difference, by the formula ($\sigma_{diff}=\sqrt{\sigma_{av_1}^2+\sigma_{av_2}^2}$), is 1.55. Since the difference of the two means is greater than three times its standard error, it is certain that a true difference greater than zero, and in favor of the college course students, exists between the two groups.

C. Summary.

1. Comparison in all subjects. From a study of the data in Table I, p.7, there is found to be a small, but practically certain, difference in favor of the college course groups in general scholarship index. The significant ratio of the reliability of the difference to the obtained difference reveals that there are 99.7 chances in 100 that the true difference between the true means of the scholarship indexes of the two groups will be greater than zero.

2. Comparison in Education. In a study of achievement in Education, as measured by the scholarship index, it is found that the college course groups are but 84.85% as variable as the industrial arts group.

With an obtained difference of 9.8±1.5, it is evident that a true difference in favor of the college course group exists. Since the obtained difference is more than six times its standard error, and a ratio of 3 to 1 indicates certainty, it is certain that a true difference greater than zero exists between the scholarship indexes of the two groups in Education.

III. A COMPARISON OF THE TWO GROUPS IN ENGLISH, MATHEMATICS, AND SCIENCE.

A. Comparison in English.

In making a comparison of achievement in English as measured by the scholarship index, only the grades in Freshman English courses required of both groups, were used.

1. Personnel of the groups. From the list of students making up the college course group were chosen those who did not elect English as a major subject, which group is designated as Group B. The students from the list of industrial arts students whose percentile scores were paired with those in Group B, are designated as Group A.

Of a total of 138 cases in the entire group, there were 101 in Group B. English apparently was not a popular major subject among the men students, since only 37 out of 138, or approximately 27%, elected English as a major.

2. Analysis of the data. A much wider divergence of the two groups is seen in English than in Education. While a study of Table III, p. 13, shows the same range in scholarship index, it also reveals a marked difference in the means of the two groups, and also in variability.

The means of the two groups, as computed from the data in Table III are, for Group A, 39.9 ± 1.7, and for Group B, 54.1 ± 1.9, with an obtained difference of 14.2.

TABLE III

DISTRIBUTIONS OF SCHOLARSHIP INDEXES IN ENGLISH FOR INDUSTRIAL ARTS STUDENTS AND COLLEGE COURSE STUDENTS

Class-interval	Industrial Arts Students	College Course Students
95 - 99.9	1	2
90 - 94.9	0	1
85 - 89.9	1	8
80 - 84.9	0	0
75 - 79.9	6	8
70 - 74.9	0	0
65 - 69.9	0	0
60 - 64.9	1	17
55 - 59.9	0	5
50 - 54.9	29	28
45 - 49.9	0	0
40 - 44.9	0	2
35 - 39.9	26	17
30 - 34.9	0	3
25 - 29.9	31	6
20 - 24.9	0	0
15 - 19.9	0	2
10 - 14.9	0	1
5 - 9.9	1	0
0 - 4.9	5	1
	N=101 Ave=39.9±1.8 S.D.=17.47	N=101 Ave=54.1±1.9 S.D.=19.28

The reliability of the difference of the two means, in terms of its standard error, is 2.6. The significant ratio, obtained by the formula $\frac{D}{\sigma_{diff}}$, is 5.5. Since a ratio of 3 or more indicates certainty, or 100 chances in 100, that a true difference greater than zero exists between the two groups, a ratio of 5.5 is more than ample for certainty.

This ratio, 5.5, and the ratio for the two groups in Education, 6.1, are indicative of the same degree of difference, while the ratio for the two groups in all subjects, 2.7, shows a reliability about one-half as great.

In measuring the dispersion of the two groups about their respective means we find a somewhat wider spread in the case of Group B.

Group A has a standard deviation of 17.5 ± 1.23, which means that approximately 68.26% of the scholarship indexes lie between 22.4 and 57.4, or a spread of thirty-five points. Group B has a standard deviation of 19.3 ± 1.36, which means that approximately 68.26% of the scholarship indexes lie between 34.8 and 73.4, or a spread of nearly thirty-nine points.

However, since the dispersion of each of the two groups is taken about a different central tendency, a more direct comparison is obtained by the use of Pearson's coefficient of relative variability, found by the formula $V = \frac{100\sigma}{Ave.}$.

For Group A, $V = \frac{1747}{39.925} = 43.76$. For Group B, $V = \frac{1928}{54.085} = 35.65$. Therefore Group B is $\frac{35.65}{43.76}$ or 81.46% as variable as Group A.

B. Comparison in Mathematics.

In comparing the two groups in Mathematics, only the grades in Freshman Mathematics courses required on the Industrial Arts curriculum are used. The reason these courses are chosen is that for the years covered by this study, no Mathematics was required on the college curricula.

1. Personnel of the two groups. Those students in the college course group who did not major in Mathematics and who earned credit in Freshman courses in Mathematics during their Freshman year are designated as Group C. From the list of Industrial Arts students were chosen those who were paired on the basis of percentile score with the individuals in Group C. This group is designated Group A.

From a total of 138 students in each of the two groups, 41 cases were found for Groups C and A. While a group this size is not large enough to yield very reliable data, it may serve to indicate the tendencies of the two large student groups.

2. Analysis of the data. There is quite a difference in the range of scores for Groups A and C; Group C ranging from 12.5 to 97.5, and Group A from 27.5 to 77.5. As can be seen from Table IV, p.16, the scores in Group A are concentrated into three widely separated class-intervals, while those in Group C are more normally distributed.

TABLE IV

DISTRIBUTIONS OF SCHOLARSHIP INDEXES IN MATHEMATICS FOR INDUSTRIAL ARTS AND COLLEGE COURSE STUDENTS

Class-interval	Industrial Arts Students	College Course Students
95 - 99.9	0	2
90 - 94.9	0	0
85 - 89.9	0	1
80 - 84.9	0	0
75 - 79.9	10	8
70 - 74.9	0	0
65 - 69.9	0	0
60 - 64.9	0	11
55 - 59.9	0	0
50 - 54.9	19	14
45 - 49.9	0	0
40 - 44.9	0	1
35 - 39.9	1	3
30 - 34.9	0	0
25 - 29.9	11	0
20 - 24.9	0	0
15 - 19.9	0	0
10 - 14.9	0	1
5 - 9.9	0	0
0 - 4.9	0	0
	N=41 Ave.=51.53±2.84 S.D.=18.18±2.01	N=41 Ave.=60.79±2.55 S.D.=16.33±1.80

A study of Table IV shows Group C to be superior to Group A when compared on the basis of the means. Group A has a mean scholarship index of 51.5±2.8, while Group C has a mean scholarship index of 60.8±2.5, a difference of 9.3 in favor of Group C.

The reliability of this difference, in terms of its standard error, is 3.8. Applying the formula for the significant ratio, $\frac{D}{\sigma_{(diff)}}$, we find a ratio of 2.43, which is interpreted as meaning that there are 99 chances in 100 that a true difference greater than zero exists between the scholarship indexes of the two groups in Mathematics.

In comparing the two groups on the basis of relative variability, by means of Pearson's formula for the coefficient of variation, $V=\frac{100\sigma}{Average}$, we find for Group A a coefficient of 34.97, and for Group C a coefficient of 26.86. In terms of percentage, Group C is $\frac{26.86}{34.97}$, or 76.81% as variable as Group A. According to Garrett[1] a direct comparison of measures of variability cannot be drawn unless they are measured about equal measures of central tendency. A comparison of relative variability of the two groups can be made because such a measure takes into account both the central tendency and the variability about that central tendency.

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[1] Henry E. Garrett, Statistics in Psychology and Education. New York: Longmans, Green and Co., 1926, p. 41.

C. Comparison in Science.

The difference between the two groups in Science is greater than that of any of the other subject matter groups considered in this report.

1. Personnel of the two groups. From the group of college course students those were selected who had not majored in Science. This group comprised 83 students, and is designated as Group D. From the list of industrial arts students were taken those whose records were paired with Group D. This group is designated as Group A.

Of the total group of 138 students, 55 or 40% selected Science as one major.

The grades earned in Freshman courses in Physics were used in computing the scholarship indexes for the two groups.

2. Analysis of the data. A considerable difference is noted in the range of scholarship indexes for the two groups in Science. Group A ranges, in terms of class-intervals, from 2.5 to 87.5; and Group D from 27.5 to 97.5.

A study of Table V, p. 19, shows that for Group A the mean is 44.45 ± 2.03; and for Group D, 64.36 ± 1.79, a difference of 19.91 in favor of the college group. The reliability of this difference in terms of its standard error is 2.71.

The significant ratio of the difference of the two means to its standard error is 7.35, and as a ratio of 3 is considered to denote complete reliability, or assurance that a difference greater than zero exists, the obtained ratio, 7.35, indicates so much added reliability. It may, therefore, be considered that a real difference in achievement in Science in favor of the college course students, exists.

There is quite a difference, too, in the variation within the two groups. As measured by the coefficient of variation, Group A is much more variable than Group D. The coefficient of variation for Group A is 41.64 and for Group D it is 25.44. Group D is, therefore, $\frac{25.44}{41.64}$, or 61.1% as variable as Group A.

TABLE V

DISTRIBUTIONS OF SCHOLARSHIP INDEXES IN SCIENCE FOR INDUSTRIAL ARTS AND COLLEGE COURSE STUDENTS

Class-intervals	Industrial Arts Students	College Course Students
95 - 99.9	0	5
90 - 94.9	0	0
85 - 89.9	1	8
80 - 84.9	0	0
75 - 79.9	8	15
70 - 74.9	0	0
65 - 69.9	0	0
60 - 64.9	9	24
55 - 59.9	0	0
50 - 54.9	21	24
45 - 49.9	0	0
40 - 44.9	0	0
35 - 39.9	15	4
30 - 34.9	0	0
25 - 29.9	25	3
20 - 24.9	0	0
15 - 19.9	0	0

TABLE V (Continued)

10 - 14.9	1	0
5 - 9.9	0	0
0 - 4.9	3	0
	N=83 Ave.=44.45±2.03 S.D.=18.51	N=83 Ave.=64.36±1.79 S.D.=16.37

D. Summary.

1. Comparison in English. A much wider divergence of the two groups is apparent in English than in Education.

Computation of scholarship indexes in English for the two groups give a mean index for Group A of 39.9±1.7, and for Group B, 54.1±1.9. The obtained difference of the two means is 14.2±2.6. The significant ratio of the difference, 14.2, to its standard error, 2.6, is 5.5, indicating that a true difference greater than zero exists between the two groups. The difference between the means show this difference to be in favor of the college course students.

The relative variability of the two groups shows Group B to be 81.46% as variable as Group A. The coefficient of relative variability for Group A is 43.76 and for Group B is 35.65.

2. Comparison in Mathematics. On the basis of the difference between the means, the college course students are shown to be superior to the industrial arts students in Mathematics. The mean scholarship index for Group A is 51.5±2.8, and for Group C, 60.8±2.5, with a difference of 9.3±3.8. The significant ratio is $\frac{9.3}{3.8}$ or 2.43, which indicates that there are 99 chances in 100 that the college course group will be superior in Mathematics to the industrial arts group.

The coefficient of relative variability for Group A is 34.97, and for Group C is 26.86. Group C is therefore, 76.81% as variable within itself as is Group A.

3. Comparison in Science. A greater difference between the groups is noted in Science than in Education, English, or Mathematics. The mean scholarship index for Group A, the industrial arts group, is 44.45±2.03; and for Group D, the college group, is 64.36±1.79, giving a difference of 19.91±.71 in favor of the college group. The reliability of this difference is quite high, being 7.35 or more than twice the necessary amount to insure complete reliability. A true difference in favor of the College group is thus shown to exist.

The coefficient of relative variability for Group A is 41.64, and for Group D is 25.44. Group D is, therefore, 61.1% as variable as Group A.

IV. CORRELATION OF SCHOLARSHIP INDEX WITH PERCENTILE SCORES.

In pairing the individual records for consideration in this study, it was evident that some differences existed in scholarship index in a number of the pairings, which as indicated before, were based on the percentile score on the Freshman Mental Test. It was therefore deemed desirable to determine what correlation exists between scholarship index and percentile score for both of the student groups.

A. Correlation for the Industrial Arts Group.

The method used to obtain the coefficient of correlation was the product-moment or Pearson method, whereby r, the coefficient of correlation is found by the formula[1]

$$r = \frac{\frac{\Sigma x'y'}{N} - c_x \cdot c_y}{\sigma_x \cdot \sigma_y}$$

in which $\Sigma x'y'$ is the sum of all the product deviations; c_x and c_y the corrections, in units of class-interval, used in determining the means of the two distributions; and σ_x and σ_y, the standard deviations, also in units of class-interval, of the two distributions.

By the solution of the formula, r is determined as .379 with a PE of .049, which means that the true r lies between .33 and .428, and that it is certain that, for this group, the true r lies between .183 and .575.

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[1] Henry E. Garrett, Statistics in Psychology and Education. New York: Longmans, Green and Co., 1926, p. 167.

Since r is positive but small, there is evidently a slight relationship between scholarship index and percentile score. Whether or not this relationship is significant may be determined by the regression coefficient.

1. The regression equations. The real significance and use of r lie in its predictive value; that is, the extent to which the relationship between two values may be used to predict one from the other.

The formulae used for the regression equations, in deviation form, are:

$$x = r.\frac{\sigma_x}{\sigma_y}.y \qquad \text{and} \qquad y = r.\frac{\sigma_x}{\sigma_y}.x \qquad [2]$$

in which x represents scholarship index and y represents percentile score. From substituting in the two formulae, x=.19y and y=.75x.

These values mean that for a known deviation from the mean in percentile score the probable deviation in scholarship index will be .19 as great; and for a known deviation from the mean in scholarship index the probable deviation in percentile score will be .75 as great.

The regression equations in score form are more useful than in deviation form. The equations are

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[2] Henry E. Garrett, op. cit., pp. 178-179.

here determined, as the following:

$$X=.19Y+49.82$$

and

$$Y=.75X+5.45$$

where X is the score in scholarship index and Y is the score in percentile rank.

2. Probable error of the estimate. The reliability of the prediction of values of the dependent variable is determined most conveniently by means of the probable error of the estimate, $PE_{(est)}$, the formula for which is

$$PE_{(est\ X)}=.6745\times\sigma_x\sqrt{1-r^2}$$

and

$$PE_{(est\ Y)}=.6745\times\sigma_y\sqrt{1-r^2}$$ [3]

Substituting in these formulae the values $\sigma_x=12.067$; $\sigma_y=23.805$; and $r=.379$; the equations become

$$PE_{(est\ X)}=7.55$$

and

$$PE_{(est\ Y)}=14.89\ .$$

These values of the $PE_{(est)}$ mean that, having obtained a predicted scholarship index, the chances are 50 in 100 that the true scholarship index will be within the limits of ± 7.75 of the obtained score, and, having obtained a predicted percentile score, that the chances are also even that the true percentile score lies within the limits of ± 14.89 of the obtained score.

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[3] Henry E. Garrett, op. cit., p. 184.

B. Correlation for the College Course Group.

The same formulae and methods were used in obtaining the coefficient of correlation, r; the regression equations; and the probable errors of the estimate, as were used in obtaining these values for the Industrial Arts group.

Substituting in the equation

$$r = \frac{\frac{\sum x'y'}{N} - c_x \cdot c_y}{\sigma_x \cdot \sigma_y}$$

the following values: $\sum x'y' = 636$; $c_x = .74$; $c_y = .116$; $\sigma_x = 5.455$; $\sigma_y = 2.243$; r is found to be .3698 with a PE of .049.

The Pearson r for this group is slightly smaller than for the Industrial Arts group.

1. The regression equations. The regression equations for the College group in deviation form, after solution are:

$$x = .152y$$

for the regression of scholarship index on percentile score; and

$$y = .899x$$

for the regression of percentile score on scholarship index. In these two equations x represents deviations in scholarship index and y represents deviations in percentile score.

The equations in score form are

$$X = .152Y + 53.15$$

and

$$Y = .899X + 9.46$$

where X is scholarship index and Y is percentile score.

2. Probable error of the estimate. The probable error of the estimate for the regression of scholarship index on percentile score is ±7.014, which means that the chances are even that the true scholarship index will lie between the limits of the obtained index ±7.014.

The probable error of the estimate for the regression of percentile score on scholarship index is ±17.06. The chances, therefore, are even that the true percentile score lies between the limits of the obtained percentile score ±17.06.

C. The Difference Between the two Coefficients of Correlation.

The coefficients of correlation for the two groups are nearly the same, being, .379±.049 for the industrial arts group, and .3698±.049 for the college course group. The probable errors are the same, showing that the true r's will both lie somewhere within the same approximate range.

The r for the industrial arts group is larger, the difference being .0092. The significance of this apparent difference is determined by finding the PE of the difference, the formula for which is

$$PE_{(diff.\ r_1-r_2)} = \sqrt{PE_{r_1}^2+PE_{r_2}^2}\ .$$

The solution of the above formula gives a value of .0047 for the PE of the difference. The ratio of the difference to the PE(diff,) is approximately 2, which indicates that there are 91 chances in 100 that a true difference greater than zero

will exist between the true r's of the two groups. Since any measure which is less than 4 times as great as its PE is considered unreliable, the obtained difference between the two r's is not reliable.

D. Summary.

1. Correlation data for the Industrial Arts Group.

The value of r is found to be .379±.049, showing a slight relationship existing between scholarship index and percentile score on the Freshman Mental Test.

The regression equations in score form, based on this value of r, are: X=.19Y+49.82, and Y=.75 X+5.45, where X = score in scholarship index, and Y= the score in percentile rank.

The probable error of the estimate indicates the limits between which the true score will probably lie.

The $P.E._{(est.X)}$ = ±7.55, and the $P.E._{(est.\ Y)}$ = ±14.89. These values mean that the chances are even that the true score will lie between the limits of the predicted score plus or minus the $P.E._{(est.)}$.

The values of the regression equations in this case, however, are very small, because as Garrett[4] points out, with a low correlation or a high variability the predictions are little better than a guess. Both of these conditions are present in this case, so the predictions are practically valueless.

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[4] Henry E. Garrett, op. cit., p. 185.

2. Correlation data for the College Group. The value of r for the College Group is found to be .3698±.049. The regression equations, in deviation form, based on this value of r, are: $x = .152y$ and $y = .899x$. In score form they are: $X = .152Y + 53.15$; and $Y = .899X + 9.46$, where X is scholarship index and Y is percentile score.

The $P.E._{(est.\ X)} = \pm 7.014$ and the $P.E._{(est.\ Y)} = \pm 17.06$, indicating the limits above and below the estimated score, within which the true score will probably lie. On the basis of the P.E. the chances are 50 in 100 that the true score will lie within these limits.

However, when r is small, the $P.E._{(est.)}$ approaches the P.E. of the distribution of scores, which means that the estimate based on one group of data alone is as reliable as when both groups of data are available.[5] This indicates that the low degree of correlation in this case between scholarship index and percentile score is but little better than a guess.

A value of r ganging from .15 or .20 to .35 or .40 is interpreted by Rugg, however, as indicating a marked relationship.[6] He says further, "Except in the case in which the variability is the same, r does not enable us to foretell, for example, knowing the value of one

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[5] Henry E. Garrett, op. cit., pp. 288-289.

[6] H. O. Rugg, Statistical Methods Applied to Education. Boston: Houghton Mifflin Co., 1917. pp.256-257.

trait, what, on the average, the value of the other will be."

In this case, while there is evidence of at least a slight relationship between percentile rank and scholarship index, the use of r as a predictive device is practically valueless.

V. SUMMARY.

A. Comparison in General Scholarship.

A comparison of the two groups on the basis of mean scholarship index reveals a difference between the means of 3.77 in favor of the College course groups. A reliability coefficient of 1.402 and a significant ratio of $\frac{3.77}{1.402}$ or 2.68 indicates that there is practical certainty that a true difference, greater than zero, exists between the two groups.

B. Comparison in Education.

The mean scholarship index in Education for the Industrial Arts group is 52.33 ± 1.09; and for the College group, 62.1 ± 1.11, showing a difference in favor of the College group. This difference, with its reliability coefficient, is 9.8 ± 1.55, giving a significant ratio of 6.3. Since a significant ratio of 3 is considered to denote complete reliability, a ratio of 6.3 shows that there is a true difference greater than zero in favor of the College group in achievement in Education.

While the standard deviations of the two groups are nearly the same - 12.88 ± .78 for the Industrial Arts group, and 12.97 ± .78 for the College group - a comparison of relative variability shows the College groups to be only 84.85% as variable as the Industrial Arts group.

C. Comparison in English.

The data used in comparing the two groups in English are based on a smaller number of cases, 101. There is a large difference in the mean scholarship index for the two groups. The mean for the Industrial Arts group is 39.9 ± 1.7, and for the College group it is 54.1 ± 1.9, showing a difference in favor of the College group of 14.2 ± 2.6. The significant ratio of this difference to its standard error is 5.5, which is more than ample to indicate that there is a true difference greater than zero between the mean scholarship indexes in English, of the two groups.

Group B, the College group, also seems to be more consistent or stable within itself. While it shows a larger standard deviation than the Industrial Arts group, it also has a much higher mean. When these two measures are considered by means of Pearson's coefficient of variation, the College group is found to be 81.46% as variable as the Industrial Arts group. This fact indicates that the College group ranks consistently higher in English than does the Industrial Arts group.

D. Comparison in Mathematics.

The mean scholarship indexes of the two groups, 51.5 ± 2.8 for the Industrial Arts group and 60.8 ± 2.5 for the College group, show a difference of 9.3 in favor of the College group. The standard error of this difference is 3.8, giving a signifi-

cant ratio of $\frac{9.3}{3.8}$ or 2.43, which means that there are 99 chances in 100 that there will be a true difference greater than zero between the means of the scholarship indexes of the two groups. This true difference, as indicated by the means, is in favor of the College group.

In terms of the coefficient of relative variability, the College group again is more consistent in achievement, being 76.81% as variable as the Industrial Arts group.

E. Comparison in Science.

There is a large difference in the ranges of the two groups in Science, with a correspondingly large difference in the means, since the skewness of the two distributions is in opposite directions.

The mean of the Industrial Arts group is $44.45 \pm .03$; and of the College group, 64.36 ± 1.79, showing a difference in favor of the College group of 19.91 ± 2.71.

The significant ratio of this difference to its standard error is 7.35, which is more than twice as large as is necessary to insure complete reliability. There is, therefore, a true difference greater than zero between the two groups, and in favor of the College group.

The coefficient of relative variability for the two groups; 41.64 for Group A, and 25.44 for Group D; shows Group D to be only 61.1% as variable as Group A.

F. Correlation of Scholarship Indexes with Percentile Scores.

1. The Industrial Arts group. By the product-moment method, the coefficient of correlation between scholarship index and percentile score for Group A is .379 ± .049, showing evidence of some relationship between the two values.

The regression equations, in deviation form, are $x = .19y$ and $y = .75x$; where x represents scholarship index and y percentile score. In score form these equations become $X = .19Y + 49.82$, and $Y = .75X + 5.45$; where X is the score in scholarship index and Y is the score in percentile rank.

The $P.E._{(est.X)}$ is determined as ± 7.55; and the $P.E._{(est.Y)}$ as ± 14.89. Since these reliability values are large in relation to the quartile deviations of the two distributions, they reveal the relative unreliability of the regression equations.

2. The College group. The coefficient of correlation for this group is .3698 ± .049, being .0092 smaller than the coefficient of correlation for Group A.

The regression equations, in deviation form, are $x = .152y$, and $y = .899x$, where x represents scholarship index and y percentile score. In score form these equations become $X = .152Y + 53.15$, and $Y = .899X + 9.46$.

The P. E.$_{(est.X)}$ is ±7.014, and the P. E.$_{(est.Y)}$ is ±17.06. As in the case of the Industrial Arts group, these values show the regression equations to be unreliable as tools of prediction, since the P. E.$_{(est.)}$ so closely approaches the quartile deviation of the distribution of the original data.

3. The Difference Between the two r's. The difference between the two r's is .0092, with a P. E. of .0047. The significant ratio of the difference to its P. E. is approximately 2, which is too small to be reliable. A significant ratio of 2 indicates that there are only 91 chances in 100 that a true difference really exists. The small difference between the two r's is therefore an unreliable one.

G. Conclusions as a Result of this Study.

1. The Question Answered. As was stated in the reason for making this study, an attempt was to be made to determine the amount of truth in the assumption that Industrial Arts students are inferior, scholastically, to Academic students.

The analysis of the several pertinent data show that there is a slight difference, in favor of the Academic students, in scholastic achievement between the two student groups in Indiana State Teachers College. This difference is found both in general scholastic achievement and in the separate subject-matter fields of Mathematics, English, and Science.

The series of tests, known as the Freshman Mental Test, revealed little as to the students' future academic achievement. The value of the coefficient of correlation is low, and the value of its Probable Error is large, thereby rendering r of little value as an accurate tool of prediction in this case. The value of r does, however, indicate a small, positive relationship between scholarship index and percentile score on the Freshman Mental Test.

2. Further Studies. Some topics for further study which have suggested themselves are; In-service Training of Industrial Arts Teachers; The Relation Between Scholarship Index and Success or Failure of Industrial Arts Teachers; and Graduate Work in Industrial Arts.

VI. APPENDIX.

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B. Form Used to Tabulate Data.

Case No_____ Name_____ Percentile rank_____

Grade	No	Point Score	Total Point Score	Pro Sub	Total Point Score	Math	Total Point Score	Eng	Total Point Score	Sci	Total Point Score
A		4									
B		3									
C		2									
P		1									
F		0									
Average Point Score				Av Pt Sc		Av Pt Sc		Av Pt Sc		Av Pt Sc	