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# Achievement in Physical Science in Relation To The Type of High School Attended

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# ACHIEVEMENT IN PHYSICAL SCIENCE IN RELATION TO THE TYPE OF HIGH SCHOOL ATTENDED

being

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by

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TABLE OF CONTENTS

# LIST OF TABLES

# CHAPTER I

## INTRODUCTION

Today there are indications of an increasing interest in and a demand for better teaching. The Kansas State Department of Public Instruction gives evidence of this in its statement of general policies on school classifications.

> The rating of schools is based on teacher preparation, qualification of administrator, administration, science and laboratory equipment, library facilities, building and grounds, attractiveness, neatness and sanitary condition of the building, both interior and exterior, orderliness and neatness of students, professional attitude of faculty, teacher tenure, attitude of school board and community toward the school and student attitude.[1]

Undoubtedly, the reader can readily understand why the Kansas State Department of Public Instruction ordinarily classifies secondary schools of the state into three divisions, namely, class "A" schools, class "B" schools and class "C" schools. A duly appointed and qualified high school supervisor, however, first makes a recommendation concerning the accrediting and the classifying of the school to the state superintendent. The recommendation is based upon the data presented by the respective high school administrator and by the state supervisor's personal visitation of the school where possible.[2]

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1. Kansas State Department of Public Instruction, The Kansas High School Handbook (Topeka: State Printer, 1947), p. 27.

2. Ibid., p. 28.

Certain standards set up by the State Board of Education upon the recommendation of the State Superintendent of Public Instruction must be met by a class "A", "B" or "C" school. Administrators in class "A" and "B" high schools are required to hold a Kansas administrator's certificate, and this requirement must also be met by all administrators in class "C" schools by September 1, 1952.[3] At the present time, teachers in class "A" schools must have at least fifteen semester hours of preparation in a teaching field, in class "B" schools at least twelve hours, and in class "C" schools at least eight hours.[4]

The general public and many educators seemingly are of the opinion that student achievement is scholastically better in a class "A" high school than in a class "B" high school, and in a class "B" high school better than in a class "C" high school. A knowledge of the standards for classifying high schools by the State of Kansas leads the reader to a like conclusion.

Actually, does any real difference of achievement exist among these three classes of high schools in Kansas? In particular, is there a significant difference of achievement in physical science among our Kansas secondary school graduates according to the type of school attended? In order to answer this second question the writer undertook to find the differences, if any, in achievement of students in class "A", "B" and "C" high schools in the state

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3. Kansas State Department of Public Instruction, Monthly Bulletin (Topeka: State Printer, May, 1948), p. 1.

4. Kansas State Department of Public Instruction, Certificate Handbook (Topeka: State Printer, January 1, 1948), pp. 16-22.

of Kansas, as measured by the attainment of students who took a physical science entrance examination at the Fort Hays Kansas State College at Hays, Kansas. As a corollary to the main problem just stated, attention was also given relative to physical science courses taken in high school by the students included in this study.

It should be understood that this thesis does not include all of the high schools of the state but only 178 of them from which students enrolled in regular work at the Fort Hays Kansas State College during the scholastic years 1946-1947 and 1947-1948. Students from class "A" schools represented 125 different high schools; class "B", 33; class "C", 20. The total number of students included in this survey was 812; of this number, 404 boys and 174 girls were from class "A" schools, 90 boys and 37 girls from class "B" schools and 88 boys and 19 girls from class "C" schools.

The physical science test which concerns this study and which consists of 100 questions was prepared by Doyle K. Brooks, assistant professor of physics at the Fort Hays Kansas State College where the test was used for the purpose of exempting students ranking in the upper ten percent from taking the fundamental college physical science course. The test was administered to college freshmen, boys and girls, in September, 1946 and 1947. The author upon examination of the test pointed out that 9% of the test questions pertained to geology, 15% to chemistry, 29%

to astronomy and 47% to physics. (Four per cent of the physics questions dealt with sound, 5% with light, 12% with mechanics, 13% with electricity and 13% with heat). The subject matter of the test was not limited to general science but also included the fields of physics and chemistry.[5]

By checking all of the questions of Brooks' physical Science test, Rev. L. Wuenschel,[6] physical science professor at St. Joseph's College, Hays, Kansas, found that 95% of the questions can be answered with the aid of three physical science high school texts which are currently approved by the Kansas State Department of Public Instruction: general science text written by Caldwell and Curtis,[7] physics text written by Dull[8] and the chemistry text which is also written by Dull.[9]

To establish the validity of the physical science test the writer used an indirect method by relying upon the concensus of opinion of teachers as to the adequacy, suitability and validity of the material included. Ross placed his sanction of approval up-

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5. Personal Interview with Doyle K. Brooks, Fort Hays Kansas State College, June 14, 1948.

6. Rev. L. Wuenschel, Letter, July 25, 1948.

7. Otis W. Caldwell and Francis D. Curtis, Everyday Science, (Chicago; Ginn and Company, 1946), 664.

8. Charles E. Dull, Modern Physics, (New York; Henry Holt and Company, Inc., 1939), 587.

9. Charles E. Dull, Modern Chemistry, (New York; Henry Holt and Company, Inc., 1942), 604.

on this method of test validation.

> Curricular validity is determined by examining the content of the test itself and judging the degree to which it is a true measure of the important objectives of the course, or a truly representative sampling of the essential materials of instruction.[10]

Harold C. Elder, science instructor in the Hays High School, Hays, Kansas, thoroughly checked the test and well expressed the opinion of high school physical science instructors,

> I consider the physical science test as written by Mr. Doyle Brooks to be a valid test. The questions cover many of the fundamentals of physical science. I, myself would recommend it as a test to be used to determine achievement in physical science.[11]

Roy Rankin, professor of chemistry at the Fort Hays Kansas State College, speaks for the college physical science professors,

> I am acquainted with the physical science test prepared by assistant professor D. K. Brooks and used in the classes for screening purposes in the case of freshmen entering Fort Hays Kansas State College. I consider it a valid test.[12]

Other favorable opinions confirming the validity of Brooks' physical science test were expressed by the following: Harold S. Choguill,[13] chairman of the department of chemistry, Fort Hays Kansas State College, Hays, Kansas, Father Ludger Wuenschel,[14]

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10. C. C. Ross, Measurement in Today's Schools ( New York; Prentice Hall, Inc., 1941), p. 253.

11. Harold C. Elder, Letter, June 16, 1948.

12. Roy Rankin, Letter, June 15, 1948.

13. Harold S. Choguill, Letter, June 15, 1948.

14. Father Ludger Wuenschel, Letter, July 20, 1948.

physical science professor, St. Joseph's College, Hays, Kansas; Manly C. Huber,[15] physical science instructor, Ellinwood High School, Ellinwood, Kansas; Lambert Brookman, [16] physical science instructor, Elsie, Nebraska.

This thesis is limited to achievement in physical science. The word "achievement" connotes mastery of subject matter. The term "physical science" includes chemistry, physics, general science, astronomy and geology. By the phrase "type of school" is meant its scholastic classification as "A", "B" or "C" by the State Department of Public Instruction. "Significant difference" is a term which insures that the true difference in performance is greater than zero between two groups.[17] If this prevails, there is virtual certainty that one group will always be superior to the other group in the particular field that has been tested. The "mean" is found by dividing the sum of the relevant values by the total number of cases.

In his review of similar research, the writer selected two studies that present different but interesting opinions relative to types of secondary schools. Thornberg in 1921 and 1922 studied the classes entering the State College of Washington. He used total honor points as a measure of achievement and found that,

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15. Manly C. Huber, Letter, July 17, 1948.

16. Lambert Brookman, Letter, June 29, 1948.

17. Henry E. Garret, Statistics in Psychology and Education (New York: Longmans, Green and Company, 1941) p. 210.

> . . . Students from large schools are superior in scholarship in college to those coming from small high schools. In general scholarship increases with the size of high school. The most marked differences in quality of college work is found between students coming from high schools with an enrollment of more than 100 students. This does not seem due so much to difference in native ability as difference in preparatory training.[18]

Gowan and Gooch, at the University of Maine in 1926, used the "freshman average" as indicative of academic success, but applied it only to students who had graduated from college. They concluded that,

> The general trend of these results clearly points to the conclusion that the quality of high school does not play more than an insignificant part in subsequent college work which the student does.[19]

After having obtained the answer sheet with the score indicated thereon made by each student who took the physical science test, the writer listed 812 Kansas students alphabetically and classified them in relation to the type of school attended according to their transcripts in the office of the registrar and the "Kansas Educational Directory." The availability of scholastic records made it possible to note high school courses in physical science, if any, taken by each student.

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18. L. H. Thornberg, "College Scholarship and Size of High Schools" School and Society, XX (August 9, 1924), pp. 191-192.

19. J. W. Gowan and M. Gooch, "The Mental Attainment of College Students in Relation to Preparatory School and Heredity," Journal of Educational Psychology, XVII (September, 1926), 417.

# CHAPTER II

## PRESENTATION OF STATISTICAL SIGNIFICANT DIFFERENCES

It is important to have some way of estimating the reliability of an obtained difference. It is imperative that a method be employed to determine whether one group is sufficiently superior to another so that it can confidently be stated that no matter how often similar groups are compared, the first group will nearly always excel the second. The writer, in his Introduction, mentioned that an obtained difference is significant when the odds are great that the true difference is greater than zero. Furthermore, if the obtained difference is not significant, it should be known how nearly it approaches to significance. In this thesis, 95 or more chances out of 100 that one group is superior in achievement to another group will be regarded as significant.

The writer computed the grades made on the physical test by the students from the three classes of schools and then treated the test results statistically. Proper emphasis was given, for the purpose of obtaining significant differences, to the mean, standard deviations, standard error of the mean, standard error of difference, the difference of the means and their quotient to determine the reliability or chances in 100 that one group is superior to another group.

Cognizance should be given to the fact that, in general, a difference due to chance could possibly be present in the cases included in this study. To show that the difference obtained was larger than

could reasonably be accounted for by chance, the standard deviation of the difference between two means, known also as the standard error of that difference, was calculated. The degree of reliability was obtained by dividing the obtained differences by the sigma differences. Garret's table was consulted for its significance.[1]

In Table I are given the results obtained by comparing the achievement of the students from the three classes of schools.

TABLE I. ACHIEVEMENT OF ALL STUDENTS IN PHYSICAL SCIENCE IN CLASS "A", "B", AND "C" HIGH SCHOOLS

| Group | Cases | Mean | S.D. | Diff. | $\sigma$ Diff. | Diff. / $\sigma$ Diff. | Reliability |
|---|---|---|---|---|---|---|---|
| "A" Boys & Girls | 578 | 39.68 | 11.47 | .70 | 1.09 | .64 | 73 |
| "B" Boys & Girls | 127 | 40.38 | 11.05 | | | | |
| "A" Boys & Girls | 578 | 39.68 | 11.47 | .75 | 1.03 | .72 | 76 |
| "C" Boys & Girls | 107 | 38.93 | 8.50 | | | | |
| "B" Boys & Girls | 127 | 40.38 | 11.05 | 1.45 | 1.34 | 1.08 | 85 |
| "C" Boys & Girls | 107 | 38.93 | 9.50 | | | | |

The results in Table I show that students from class "B" schools will, on the average, score 73 times out of 100 above class "A" students in physical science; class "A" students, 76 times

1. Henry E. Garret, Statistics in Psychology and Education (New York: Longmans, Green and Company, 1941), p. 213.

out of 100 above class "C" students; class "B" students, 85 times out of 100 above class "C" students. These margins do not indicate complete reliability because for a difference to be significant there have to be 95 or more chances out of 100 showing that one group is superior to another group.

TABLE II. COMPARISON OF ACHIEVEMENT ACCORDING TO SCHOOL CLASSIFICATION

| Group | Cases | Mean | S.D. | Diff. | $\sigma$ Diff. | $\frac{\text{Diff.}}{\sigma \text{ Diff.}}$ | Reliability |
|---|---|---|---|---|---|---|---|
| | | | Boys | | | | |
| "A" Boys | 404 | 42.06 | 11.23 | 1.34 | 1.16 | 1.07 | 85 |
| "B" Boys | 90 | 43.40 | 12.40 | | | | |
| "A" Boys | 404 | 42.06 | 11.23 | 2.30 | 1.28 | 1.01 | 84 |
| "C" Boys | 88 | 39.76 | 10.76 | | | | |
| "B" Boys | 90 | 43.40 | 12.40 | 3.64 | 1.55 | 2.35 | 99.3 |
| "C" Boys | 88 | 39.76 | 10.76 | | | | |
| | | | Girls | | | | |
| "A" Girls | 174 | 34.68 | 12.42 | 2. | 1.56 | 1.28 | 90 |
| "B" Girls | 37 | 32.68 | 6.89 | | | | |
| "A" Girls | 174 | 34.68 | 12.42 | .43 | 2.34 | .18 | 57 |
| "C" Girls | 19 | 35.11 | 9.08 | | | | |
| "B" Girls | 37 | 32.68 | 6.89 | 2.43 | 2.42 | 1. | 84 |
| "C" Girls | 19 | 35.11 | 9.08 | | | | |

The results of Table II show that class "B" boys are favored with a significant difference of achievement in physical science when compared to the class "C" boys. No other significant differences were obtained by making the comparisons of all the boys from one class of school with all of the boys from the other classes of schools. This was true also in the case of the girls since the chances in 100 were not high enough to be significant. A trend toward significance, however, was indicated in favor of the class "A" girls over the class "B" girls.

TABLE III. COMPARISON OF ACHIEVEMENT ACCORDING TO HIGH SCHOOL PREPARATION AND TYPE OF SCHOOL

| Group | Cases | Mean | S.D. | Diff. | $\sigma$ Diff. | Diff. / $\sigma$ Diff. | Reliability. |
|---|---|---|---|---|---|---|---|
| **Boys with No Courses** | | | | | | | |
| "A" Boys | 26 | 35.11 | 8.06 | .39 | 2.95 | .10 | 54 |
| "B" Boys | 4 | 35.50 | 4.28 | | | | |
| "A" Boys | 26 | 35.11 | 8.06 | 1.47 | 2.66 | .55 | 71 |
| "C" Boys | 14 | 33.64 | 7.65 | | | | |
| "B" Boys | 4 | 35.50 | 4.28 | 1.86 | 3.25 | .59 | 73 |
| "C" Boys | 14 | 33.64 | 7.65 | | | | |
| **Boys with One Course** | | | | | | | |
| "A" Boys | 152 | 38.55 | 9.73 | 2.10 | 1.47 | 1.43 | 92 |
| "B" Boys | 40 | 40.65 | 7.836 | | | | |
| "A" Boys | 152 | 38.55 | 9.73 | .38 | 1.42 | .42 | 60 |
| "C" Boys | 44 | 38.93 | 7.834 | | | | |
| "B" Boys | 40 | 40.65 | 7.836 | 1.72 | 1.70 | 1.06 | 85 |
| "C" Boys | 44 | 38.93 | 7.834 | | | | |
| **Boys with Two Courses** | | | | | | | |
| "A" Boys | 183 | 43.98 | 10.44 | 2.23 | 1.51 | 1.47 | 93 |
| "B" Boys | 41 | 46.21 | 8.38 | | | | |
| "A" Boys | 183 | 43.98 | 10.44 | .48 | 2.27 | .21 | 58 |
| "C" Boys | 30 | 43.50 | 11.83 | | | | |
| "B" Boys | 41 | 46.21 | 8.38 | 2.23 | 2.51 | .88 | 81 |
| "C" Boys | 30 | 43.50 | 11.83 | | | | |
| **Boys with Three Courses** | | | | | | | |
| "A" Boys | 43 | 51.37 | 11.48 | .43 | 6.32 | .07 | 53 |
| "B" Boys | 5 | 51.80 | 12.16 | | | | |

(No "C" Boys had three courses).

TABLE III (CONTINUED) COMPARISON OF ACHIEVEMENT ACCORDING TO HIGH SCHOOL PREPARATION

| Group | Cases | Mean | S.D. | Diff. | $\sigma$ Diff. | Diff. / $\sigma$ Diff. | Reliability |
|---|---|---|---|---|---|---|---|
| | | | Girls with No Courses | | | | |
| "A" Girls | 37 | 30.27 | 7.18 | 3.93 | 1.63 | 2.41 | 99 |
| "B" Girls | 5 | 34.20 | 3.31 | | | | |
| "A" Girls | 37 | 30.27 | 7.18 | | | | |
| "C" Girls | 1 | ( 23 - No comparison possible). | | | | | |
| | | | Girls with One Course | | | | |
| "A" Girls | 90 | 35.12 | 8.80 | 5.08 | 1.47 | 3.46 | 99 |
| "B" Girls | 23 | 30.04 | 5.32 | | | | |
| "A" Girls | 90 | 35.12 | 8.80 | 2.67 | 1.79 | 1.44 | 93 |
| "C" Girls | 11 | 32.45 | 4.80 | | | | |
| "B" Girls | 23 | 30.04 | 5.32 | 2.41 | 2.43 | .99 | 84 |
| "C" Girls | 11 | 32.45 | 4.80 | | | | |
| | | | Girls with Two Courses | | | | |
| "A" Girls | 46 | 39.45 | 11.61 | .89 | 3.49 | .25 | 60 |
| "B" Girls | 9 | 38.56 | 8.54 | | | | |
| "A" Girls | 46 | 39.45 | 11.61 | .22 | 4.94 | .04 | 52 |
| "C" Girls | 7 | 39.67 | 11.31 | | | | |
| "B" Girls | 9 | 38.56 | 8.54 | 1.11 | 5.52 | .20 | 58 |
| "C" Girls | 7 | 29.67 | 11.31 | | | | |

(Only one girl took three courses.

TABLE III. COMPARISON OF ACHIEVEMENT ACCORDING TO SEX AND TO SCHOOL CLASSIFICATION (CONTINUED)

| Group | Cases | Mean | S.D. | Diff. | $\sigma$ Diff. | Diff. / $\sigma$ Diff. | Reliability |
|---|---|---|---|---|---|---|---|
| | | | No Courses | | | | |
| "A" Boys & Girls | 63 | 32.69 | 7.90 | 2.16 | 1.732 | 1.25 | 89 |
| "B" Boys & Girls | 9 | 34.85 | 4.01 | | | | |
| "A" Boys & Girls | 63 | 32.69 | 7.90 | .24 | 2.17 | .11 | 55 |
| "C" Boys & Girls | 15 | 32.93 | 7.17 | | | | |
| "B" Boys & Girls | 9 | 34.85 | 4.01 | 1.92 | 2.39 | .80 | 79 |
| "C" Boys & Girls | 15 | 32.93 | 7.17 | | | | |
| | | | One Course | | | | |
| "A" Boys & Girls | 242 | 37.27 | 10.04 | 2.02 | 1.47 | 1.35 | 91 |
| "B" Boys & Girls | 63 | 35.25 | 10.46 | | | | |
| "A" Boys & Girls | 242 | 37.27 | 10.04 | 1.58 | 1.23 | 1.28 | 90 |
| "C" Boys & Girls | 55 | 35.69 | 7.79 | | | | |
| "B" Boys & Girls | 63 | 35.25 | 10.46 | .44 | 1.68 | .26 | 60 |
| "C" Boys & Girls | 55 | 35.69 | 7.79 | | | | |
| | | | Two Courses | | | | |
| "A" Boys & Girls | 229 | 41.71 | 3.51 | .67 | 1.30 | .52 | 70 |
| "B" Boys & Girls | 50 | 42.38 | 9.02 | | | | |
| "A" Boys & Girls | 229 | 41.71 | 3.51 | .13 | 1.83 | .07 | 53 |
| "C" Boys & Girls | 37 | 41.58 | 11.02 | | | | |
| "B" Boys & Girls | 50 | 42.38 | 9.01 | .80 | 2.22 | .36 | 64 |
| "C" Boys & Girls | 37 | 41.58 | 11.02 | | | | |
| | | | Three Courses | | | | |
| "A" Boys & Girls | 44 | 51.57 | 11.62 | .23 | 6.32 | .04 | 51 |
| "B" Boys & Girls | 5 | 51.80 | 12.02 | | | | |

(No class "C" student took 3 courses).

The results of Table III show no significant differences of achievement in physical science when boys from class "A", "B" and "C" schools are compared with one another. A trend toward significance resulted in comparing class "B" boys with one and two courses to class "A" boys with one and two courses, respectively. Chances in 100 were 92 in favor of the class "B" boys with one course and 93 in 100 in favor of class "B" boys when comparing achievement of the two groups when they had had two high school courses in physical science.

There was a significant difference in favor of class "B" girls when compared to class "A" girls when both groups had had no physical science in high school. This was also true when both groups had had one high school physical science course. In comparing class "A" girls with class "C" girls, 93 chances in 100 were present in favor of the "A" girls when both groups had had one course in physical science. This may be regarded as a trend toward significance.

No. significant differences of achievement were obtained by comparing class "A", "B" and "C" students in relation to physical science courses taken in high school. There are, however, 89 chances in 100 that class "B" students, boys and girls, with no physical science courses in high school, will always score above class "A" students who also had no physical science in high school. There are 55 chances in 100 that class "A" students with no physical science will score above class "C" students who had no physical science courses in high school. Also, there are 79 chances in 100 that class "B" students will score above class "C" students provided that both

groups had no physical science courses in high school.

The following facts concern students who had only one physical science course in high school. There are 91 chanced in 100 that class "A" students excel class "B" students; 90, that class "A" students score above class "C" students; 60, that class "C" students excel class "B" students in physical science.

In comparing students from different school classifications with two courses, the writer found that class "B" students will, 70 times out of 100, score above Class "C" students; class "B" students will, 64 times out of 100, excel class "C" students in physical science.

No class "C" student took three courses in physical science in high school. Students from class "B" schools will, 51 times out of 100, score above class "A" students provided both groups had three physical science courses in high school.

TABLE IV. COMPARISON OF ACHIEVEMENT ACCORDING TO HIGH SCHOOL PREPARATION

| Group | Cases | Mean | S.D. | Diff. | $\sigma$Diff. | Diff. / $\sigma$Diff. | Reliability |
|---|---|---|---|---|---|---|---|
| | | Class "A" Boys | | | | | |
| No Courses | 26 | 35.11 | 8.06 | 3.44 | 1.79 | 1.92 | 97 |
| 1 Course | 152 | 38.55 | 9.73 | | | | |
| 1 Course | 152 | 38.55 | 9.73 | 5.43 | 1.09 | 4.0 | 99 |
| 2 Courses | 183 | 43.98 | 10.44 | | | | |
| 2 Courses | 183 | 43.98 | 10.44 | 7.39 | 2.08 | 3.5 | 99 |
| 3 Courses | 43 | 51.37 | 11.48 | | | | |
| | | Class "B" Boys | | | | | |
| No Courses | 4 | 35.50 | 4.28 | 5.12 | 2.76 | 1.87 | 97 |
| 1 Course | 40 | 40.65 | 7.84 | | | | |
| 1 Course | 40 | 40.65 | 7.84 | 5.56 | 1.80 | 3.08 | 99 |
| 2 Courses | 41 | 46.21 | 8.39 | | | | |
| 2 Courses | 41 | 46.21 | 8.39 | 5.59 | 6.21 | .90 | 82 |
| 3 Courses | 5 | 51.80 | 12.17 | | | | |
| | | Class "C" Boys | | | | | |
| No Courses | 14 | 33.64 | 7.65 | 5.59 | 2.43 | 2.17 | 99 |
| 1 Course | 44 | 38.93 | 7.83 | | | | |
| 1 Course | 44 | 38.93 | 7.83 | 4.57 | 2.45 | 1.87 | 97 |
| 2 Courses | 30 | 43.50 | 11.83 | | | | |
| (No class "C" Boys had three courses). | | | | | | | |
| | | ALL "A", "B" and "C" Boys | | | | | |
| No Courses | 44 | 34.03 | 8.31 | 5.35 | 1.39 | 3.80 | 99 |
| 1 Course | 236 | 39.38 | 9.40 | | | | |
| 1 Course | 236 | 39.38 | 9.40 | 5.18 | .87 | 5.90 | 99 |
| 2 Courses | 254 | 44.56 | 10.17 | | | | |
| 2 Courses | 254 | 44.56 | 10.17 | 7.02 | 1.88 | 3.90 | 99 |
| 3 Courses | 48 | 51.58 | 11.42 | | | | |

TABLE IV.(CONTINUED) COMPARISON OF ACHIEVEMENT ACCORDING TO HIGH SCHOOL PREPARATION

| Group | Cases | Mean | S.D. | Diff. | $\sigma$Diff. | Diff. / $\sigma$ Diff. | Reliability |
|---|---|---|---|---|---|---|---|
| **Class "A" Girls** | | | | | | | |
| No. Courses | 37 | 30.27 | 7.18 | 4.85 | 1.48 | 3.27 | 99 |
| 1 Course | 90 | 35.12 | 8.80 | | | | |
| 1 Course | 90 | 35.12 | 8.80 | 4.33 | 1.96 | 2.21 | 98.6 |
| 2 Courses | 46 | 39.45 | 11.62 | | | | |
| **Class "B" Girls** | | | | | | | |
| No Courses | 5 | 34.20 | 3.32 | 4.16 | 1.62 | 2.57 | 99.5 |
| 1 Course | 23 | 30.04 | 5.33 | | | | |
| 1 Course | 23 | 30.04 | 5.33 | 8.52 | 3.23 | 2.64 | 99.6 |
| 2 Courses | 9 | 38.56 | 8.54 | | | | |
| **Class "C" Girls** | | | | | | | |
| (Only one girl had no course). | | | | | | | |
| 1 Course | 11 | 32.45 | 4.81 | 7.27 | 4.85 | 1.49 | 93 |
| 2 Courses | 7 | 39.67 | 11.31 | | | | |
| **All Girls** | | | | | | | |
| No Courses | 43 | 32.23 | 6.83 | .31 | 1.30 | .238 | 59 |
| 1 Course | 124 | 32.54 | 8.22 | | | | |
| 1 Course | 124 | 32.54 | 8.22 | 6.69 | 1.68 | 3.97 | 99 |
| 2 Courses | 62 | 39.23 | 11.96 | | | | |
| **ALL Boys and ALL Girls from "A", "B" and "C" Schools** | | | | | | | |
| No Courses | 87 | 32.64 | 7.47 | 4.50 | .95 | 4.74 | 99 |
| 1 Course | 360 | 37.14 | 9.45 | | | | |
| 1 Course | 360 | 37.14 | 9.45 | 4.75 | .75 | 6.9 | 99 |
| 2 Courses | 316 | 41.89 | 10.04 | | | | |
| 2 Courses | 316 | 41.89 | 10.04 | 9.88 | 1.65 | 5.9 | 99 |
| 3 Courses | 49 | 51.77 | 10.88 | | | | |

The results in Table IV show a significant difference of achievement, in all cases except 1, in favor of those who had had one course when compared to those who had had none; those who had two courses when compared to those who had one; those who had three courses when compared to those who had two. The exception was in regard to the "B" boys with two courses when compared to the "B" boys who had three since there were only 82 chances in 100. There was five students who had three courses in class "B" schools as compared to 41 who had two courses.

A trend toward significance was found with 93 chances in 100, in favor of the group with 2 courses when comparing class "C" girls who had two courses in physical science with those who had only one course. In all other cases, excepting class "B" girls, significant differences of achievement were found in favor of those who had one course in comparison with those who had none; those who had two courses in comparison with those who had one. In comparing all of the girls from the three classes of schools, a significant difference was found in favor of those who had two courses when compared to those who had only one course; but there were only 59 chances in 100 that all the girls with one course were superior in achievement to those who had no course.

A significant difference of achievement was found when comparing all the boys and all the girls included in this study who had no physical science courses in high school with those who had one course, the difference favoring those who had one course. A significant difference was found in comparing those who had two courses with those who had one course, and those who had three courses with those who had two courses.

TABLE V (Continued) COMPARISON OF ACHIEVEMENT ACCORDING TO SEX AND PHYSICAL SCIENCE COURSES TAKEN IN HIGH SCHOOL

| Group | Cases | Mean | S.D. | Diff. | $\sigma$ Diff. | Diff. / $\sigma$ Diff. | Reliability |
|---|---|---|---|---|---|---|---|
| | | | Two Courses | | | | |
| "B" Boys | 41 | 46.21 | 8.39 | 7.65 | 3.29 | 2.32 | 98.9 |
| "B" Girls | 9 | 38.56 | 8.54 | | | | |
| "C" Boys | 30 | 43.50 | 11.83 | 3.83 | 5.09 | .75 | 77 |
| "C" Girls | 7 | 39.67 | 11.31 | | | | |
| | | | Three Courses | | | | |
| "A" Boys | 43 | 51.37 | 11.48 | | | | |
| "A" Girls | 1 (Score: 69) | | | | | | |
| "B" Boys | 5 | 51.80 | 12.16 | | | | |
| "B" Girls | 0 | | | | | | |
| (No class "C" students took three courses). | | | | | | | |
| | | | No Courses | | | | |
| All Boys From A, B, C Schools | 44 | 34.03 | 8.31 | 1.80 | 1.65 | 1.08 | 86 |
| All Girls From A, B, C Schools | 43 | 32.23 | 6.83 | | | | |
| | | | One Course | | | | |
| All Boys From A, B, C Schools | 236 | 39.38 | 9.40 | 6.84 | .95 | 7.2 | 99 |
| All Girls From A, B, C Schools | 124 | 32.54 | 8.22 | | | | |
| | | | Two Courses | | | | |
| All Boys From A, B, C Schools | 254 | 44.56 | 10.17 | 5.33 | 1.65 | 3.24 | 99 |
| All Girls From A, B, C Schools | 62 | 39.23 | 11.96 | | | | |
| | | | Three Courses | | | | |
| All Boys From A, B, C Schools | 48 | 51.58 | 11.42 | | | | |
| All Girls From A,B, C Schools | 1 (Score: 69) | | | | | | |

The results of Table IV show that significant differences of achievement in physical science exist in favor of the boys when class "A" boys are compared to class "A" girls when both groups had no physical science courses in high school, one physical science course, or two courses in physical science. No comparison could be made in regard to three courses since only one girl representing class "A" schools has three courses in physical science.

The writer found significant differences in favor of class "B" boys when compared to class "B" girls when both groups had one physical science course and when both groups had two courses. When both groups had no high school physical science, there were 68 chances in 100 that class "B" boys would excel class "B" girls.

A significant difference was found in favor of class "C" boys with one course when compared to class "C" girls with one course but there were only 68 chances in 100 that the boys will score higher than the girls when both groups had no physical science and only 77 chances in 100 that class "C" boys will score above class "C" girls when both groups had two physical science courses in high school. No class "C" students took three courses in high school physical science.

In comparing all the boys from the three classes of schools with all of the girls from class "A", "B" and "C" schools who had no physical science courses in high school, the writer found only 86 chances in 100 that the boys will score above the girls. A significant difference exists in favor of the boys when these

two groups had only one course and also when the two groups had only two courses. Since only one girl had three courses, no comparison could be made with all the boys and all the girls having had three courses in high school physical science.

# CHAPTER III

## CONCLUSION

This sixth and final chapter states summarily the findings of the thesis problem which was stated in the Introduction. The problem was to determine whether or not there exists a significant difference of achievement in physical science among our Kansas secondary school graduates in relation to the type of school attended.

Before undertaking to state his conclusions, the writer feels that he should point out certain limitations relative to this thesis. Only 812 college freshmen were included in this study. The sampling, however, was considered adequate because it did not concern a select group but included students from 178 different cities and towns in Kansas. A second limitation of the study concerns the relatively small number of students from class "B" and class "C" schools when compared to the larger number from class "A" schools. Nevertheless, the approved statistical procedure employed helped to reduce the possible probable error and, in fact, served as a correction for the small number of cases from class "B" and "C" schools.

After comparing meticuously and accurately the achievement by the students in the three classes of high schools in the physical science entrance test given at the Fort Hays Kansas State College, the writer is, first of all, prepared to say that no significant difference of achievement was found when all the students, boys-and

girls, from class "A" schools were respectively compared to class "B" and class "C" school students and this same conclusion stands regarding the comparison of class "B" students with class "C" students.

Second, no significant difference was found when comparing the "A" boys with the "B" boys and the "A" boys with the "C" boys. No significant difference of achievement was found when comparing "A" girls with "B" girls, "A" girls with "C" girls, and when "B" girls were compared with the "C" girls.

Third, in comparing the achievement of class "A", "B" and "C" boys with no physical science course, with one course, with two courses, and with three courses, the writer found no significant difference in favor of "A" boys, the "B" boys or the "C" boys. (No "C" boys had three courses). The comparison of achievement of 37 class "A" girls, with no physical science courses, with 5 class "B" girls with no courses showed a significant difference in favor of the class "A" girls and this was also found true when 90 class "A" girls were compared with 23 class "B" girls when both groups had had only one course.

Fourth, excepting the comparison of 41 class "B" boys with two courses with 5 class "B" boys with three courses, the writer found a significant difference regarding the achievement of boys in favor of those who had one course when compared to those who had none; those who had two courses when compared to those who had one; those who had three courses when compared to those who had two. The achievement comparison of "A" girls, according to high

school preparation, showed a significant difference in favor of the girls with one course when compared to those with no courses, and also in favor of those with two courses when compared with those who had had only one course. Also, a significant difference was found when the girls who had two courses were compared to those who had only one course from class "A", "B" and "C" schools with the resulting significant difference in favor of those who had two courses. The comparison of achievement according to high school physical science preparation of all boys and all girls from class "A", "B" and "C" schools showed a significant difference in favor of those who had one course when compared to those who had no courses; in favor of those who had two courses when compared to those who had one course; in favor of those who had three courses when compared to those who had two courses.

Fifth, achievement comparisons according to sex and physical science courses taken, or not taken, in high school showed significant differences in favor of the boys when comparisons were made between "A" boys and "A" girls with no courses, with one course, with two courses; between "B" boys and "B" girls with no courses, one course, two courses; between "C" boys and "C" girls with one course. When all the boys from "A", "B" and "C" schools were compared with all the girls from the three school classifications, no significant difference was found between the boys and girls who had no courses, but there definitely was a significant difference in favor of the boys when the girls and boys with one course were

compared, and also when the girls and boys with two courses were compared.

The three final conclusions of this thesis are: 1) there are no significant difference of achievement in the physical science test according to "A", "B" and "C" school classifications; 2) there was a significant sex difference in favor of the boys when the achievement of the boys and girls from the three classes of schools was compared; 3) there were significant differences in achievement in physical science according to the number of courses taken in the field.

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