Summer 1949

A Study in Achievement of College Freshmen Using The American Council of Education Cooperative Biology Test

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A STUDY IN ACHIEVEMENT OF COLLEGE FRESHMEN USING THE AMERICAN COUNCIL OF EDUCATION COOPERATIVE BIOLOGY TEST

being

A thesis presented to the Graduate Faculty
of the Fort Hays Kansas State College in
partial fulfillment of the requirements for
the Degree of Master of Science

by

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ACKNOWLEDGMENTS

The writer wishes to express his appreciation to Dr. Robert T. McGrath, Professor of Education and Head of the Department of Education for his criticism and guidance in the preparation of this manuscript. In addition the author wishes to thank Dr. H. B. Reed, Dr. L. W. Thompson, and Dr. F. B. Streeter for their suggestions and final approval of this thesis.

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CHAPTER I

INTRODUCTION

Many educators, the public, and the writer as well, believe that scholastic achievement is better in class "A" high schools than in class "B", and is better in class "B" than in class "C". The logical reason for this belief is that we know the state requirements in regard to class room equipment and teacher preparation are higher for class "A" than for class "B", and higher for class "B" than for class "C".

Is there any real difference in achievement among students in these three classes of high schools? Has their course in high school biology had any effect upon their college entrance examination score? Do boys make better scores than girls? These are interesting questions which the writer had in mind while completing this thesis.

When students from the various high schools of the state go to college they are immediately given a battery of entrance tests. When these students take the tests no distinction is made as to whether or not they have had that particular subject in high school; whether they are boys or girls; or whether they are from class "A", "B", or "C" high schools.[1]

Teacher preparation for teachers in class "A" schools must

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1. L. W. Brooks, State Superintendent of Public Instruction, Topeka, Kansas. Kansas Secondary School Handbook, 1948, p. 28.

include at least 15 college hours in the field and 5 college hours in the subject taught. For class "B" teaching the teacher must have 12 college hours in the field and 5 college hours in the subject taught. Requirements for class "C" schools are at least 8 college hours in the field and 3 college hours in the course taught. Administrators in class "A" and "B" schools must hold a masters degree. There are also requirements as to school building and class room equipment.

STATEMENT OF PROBLEM

The purpose of this study was to discover significant differences in achievement, if any, of boys and girls from the three classes of high schools in Kansas. This brings one to the statement of the problem which may be stated as follows: "A Study in Achievement of College Freshmen using the American Council of Education Cooperative Biology Test. Form P." The problem was to discover: (1) significant differences, if any, between boys who had biology in high school and those who did not; (2) significant differences, if any, between girls who had biology in high school and those who did not; (3) significant differences, if any, between the above mentioned groups from class "A", "B", and "C" schools; (4) significant difference, if any, between boys and girls used in this study.

LIMITATIONS AND DEFINITIONS

This study is limited to the freshmen students who entered Fort Hays Kansas State College during the school years of 1946-1947 and 1947-1948. Only students from class "A", "B", and "C" high schools were used in the study. Students from out of the state and from "M" schools were not considered because they were so few that it was not considered a fair sampling. The study included 759 graduates from 287 Kansas high schools. A division of these students showed that there were 584 from class "A" high schools of whom 417 were boys and 167 were girls. There were 121 students from class "B" high schools of whom 91 were boys and 30 were girls. The class "C" group of 54 was made up of 36 boys and 18 girls.

METHOD USED

The correlation method of research was used. It is one of the most widely used methods of research in the field of education.[2] The biology test given these entering freshmen for the school years of 1946-1947 and 1947-1948 was The American Council of Education Cooperative Biology Test. Form P. It is a standardized general biology test of 120 points. When the college gave this test no recognition was given to the former preparation of the student or the classification of his

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2. Carter V. Good, A. S. Barr, and Douglas E. Scates, The Methodology of Educational Research (New York and London: D. Appleton-Century Co., Inc., 1935) p. 548.

high school. If a student made a score of 80 or above he was not required to take the general biology course in college. This score was an arbitrary division point. It was thought that this score would exempt approximately ten per cent of the entering freshmen and that a student with a score of 80 or more would have a fair knowledge of general biology.[3]

The writer has taken the scores made by these entering freshmen and grouped them according to the class of high school and also as to whether the student was a boy or girl. This information was obtained from the Registrar's office at Fort Hays Kansas State College. The fact that a student had had, or had not had, biology in high school was taken from the student's transcript, the classification of his high school was obtained from the Kansas Educational Directory.[4] These scores were assembled into frequency tables and statistical data compiled for each group of students used in the investigation.

The arithmetic mean or "average" score was found for each group. The mean reduces all scores to an average or score that each student would have made if all students in the group had shared equally.[5] The standard deviation or "sigma" was then computed. It is the distance above and be-

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3. Harley F. Garrett, Interview, June 6, 1949.

4. Kansas Educational Directory, 1946-1947 and 1947-1948.

5. C. C. Ross, Measurement in Today's School (New York: Prentice Hall, Inc., 1941), p. 239.

low the mean that includes 68.26 per cent or approximately two thirds of the scores in a normal distribution.[6] The reliability of the obtained mean for each group was determined by obtaining the standard error of the mean.[7]

To determine the reliability of the difference between two means the standard error of the difference between the two uncorrelated means was calculated.[8] This is to determine if the difference between the two means is significant. To test the hypothesis that a significant difference exists the critical ratio was determined by dividing the obtained difference by its standard error. The reliability of an obtained difference was determined by computing the critical ratio and applying the quotient thus obtained to Garrett's table of chances in 100.[9] This table gives the chances in 100 that a superior group will nearly always excel the other group when two such similar groups are compared. In this study the writer has taken 95 of 100 chances as showing significance.

RELATED RESEARCH

Reed, in 1947, made a study of freshmen at Fort Hays Kansas State College. He stated:

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6. Ibid., p. 244.

7. Henry E. Garrett, Statistics in Psychology and Education (New York, London and Toronto: Longmans, Green and Co., 1947), p. 189.

8. Ibid., p. 198.

9. Henry E. Garrett, Statistics in Psychology and Education (New York, London and Toronto: Longmans, Green and Co., 1941), p. 213.

> . . . The two important conclusions reached as a result of this study were: First, that the classification of high schools had little effect upon the mastery of subject matter; second, that military service did not have a detrimental effect upon achievement. The study demonstrates that it is the individual and not the school that plays the major role in the determination of results.[10]

Barnes and Mouser made a study of high school and college students in Illinois. The test used was developed at the University of Illinois and consists of 125 items. Each item is in the form of a statement dealing with a biological belief. The items include such beliefs as health, disease, nutrition, behavior of animals, and some miscellaneous items. They said:

> . . . The question of sex differences was investigated. In the university group the mean score for girls was 81.3, whereas the mean score for boys was 73.1. The difference of 8.2 is barely statistically significant. In the high school group the difference between mean scores of boys and girls was smaller.[11]

Smith, in 1942, compared the intelligence scores of Kansas University freshmen. His study dealt with the size of the community from which the students came. He concluded: " . . . There is some tendency in the direction of a regular progression in average intelligence of subjects from smallest to largest communities, but regularity if not disclosed."[12]

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10. Floyd L. Reed. "The Comparative Achievement of Entering College Freshmen Based on Standardized Tests and Semester Grade Point," Master's Thesis, Fort Hays Kansas State College, 1947. 84 pp.

11. Melvin W. Barnes, University of Illinois; and Gilbert W. Mouser, Greenville High School, Greenville, Illinois. "A Comparative Performance of High School and University Freshmen of A Test of Biological Misconceptions", School Science and Mathematics, XLIII (May, 1943), 447-450.

12. Mapheus Smith, "Intelligence of University Students by Size of Community of Residence", School and Society, LV (May 16, 1942), 567.

Reverend Joseph A. Stremel made a study of achievement among entering freshmen at Fort Hays Kansas State College in 1948. He made a comparison as to sex, class of high school, and number of preparatory physical science courses taken in high school. He found:

> . . . There are no significant differences 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.[13]

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13. Reverend Joseph A. Stremel. "Achievement in Physical Science in Relation to the Type of High School Attended." Master's Thesis, Fort Hays Kansas State College, 1948. 31 pp.

CHAPTER II

THE PERFORMANCE OF STUDENTS IN CLASS "A", "B", AND "C" SCHOOLS

In this division of the thesis test scores of students in class "A", "B", and "C" high schools are grouped into tables of four sections each, as follows: boys, girls, boys and girls, and boys versus girls. Each of the four sections is of importance in the study because through these close attention is called to pupil performance in each class of high school. The first part of the chapter is devoted to students in class "A" schools. Then follows similar treatment of each of the other classes of schools.

In order that findings may be reliably evaluated and appraised the difference in the means between groups in making comparisons was used. The difference in the means were calculated and if found to be significant, used in making comparisons between schools and group sections within a given class of schools. Thus the significant difference between means became the method for reliable appraisal of group performance.

In Table I are portrayed four groupings of boys and girls in class "A" high schools. The first of these groupings pertain to boys only, who did or did not take biology in high school. This section of the table yields the following comparison in performance: One hundred eighty six boys took biology and 231 did not take the subject; and of those who did take biology there seems to be a distinct superiority in performance because there is a mean difference of 6.00 over the group

TABLE I

ACHIEVEMENT OF STUDENTS IN CLASS "A" HIGH SCHOOLS

Group	Cases	Mean	S. D.	Std. E. of Mean	Obt. Diff	S. D.D.	Diff. / S.D.D.	Chances in 100
Boys								
H. S. Biology	186	53.30	14.80	1.08	6.00	1.36	4.40	99.9
No Biology	231	47.30	13.10	.86				
Girls								
H. S. Biology	115	60.30	16.40	1.53	13.60	2.63	5.21	99.9
No Biology	52	46.70	15.50	2.14				
Boys and Girls								
H. S. Biology	301	56.00	17.70	1.02	8.80	1.96	4.48	99.9
No Biology	283	47.20	12.70	1.68				
Boys vs. Girls								
Boys No Biology	231	47.30	13.10	.86	.60	2.29	.25	60
Girls No Biology	52	46.70	15.50	2.14				
Boys Biology	186	53.30	14.80	1.08	7.00	1.87	3.74	99.9
Girls Biology	115	60.30	16.40	1.53				
All Boys "A"	417	50.01	14.10	.54	7.01	1.39	4.32	99.9
All Girls "A"	167	56.02	17.20	1.29				

of boys that did not take biology. Statistical findings indicate that the chances are 99.9 in 100 that the same extent of superiority would show up if an equally superior group were used in a second similar comparison.

The second grouping in Table I covers the performance of girls in class "A" schools only. In this group there were 167 girls from class "A" high schools. One hundred fifteen of these girls took biology and 52 did not take the course when they were in high school. The girls who had high school biology had a 13.60 higher mean than the girls who did not have biology in high school. This indicates that if the performance of similar groups were compared in the future; the girls who have taken biology in class "A" high schools would show superiority 99.9 times in 100 over the girls in class "A" high schools who did not take biology in high school.

The third section of Table I covers the combined performance of boys and girls in class "A" high schools. It shows the combined performance of the 301 students who had biology in class "A" high schools in comparison with the performance of the 283 students who did not have high school biology while attending class "A" high schools. The results show that the students who took biology in high school had a mean 8.80 higher than those students who did not have the high school course. This comparison shows that if similar groups were compared again the students in class "A" schools who had biology in high school would rank above those students who did not have biology while attending class "A" high schools 99.9 times out of 100.

The last section of Table I consists of 3 comparisons. This section of the table shows the performance of all boys in class "A" high schools with that of all girls in class "A" high schools. The first of these comparisons tells that 231 boys and 52 girls in class "A" high schools did not take high school biology. The performance of these two groups indicates that the boys had an advantage of only .60 difference in their means. This reveals that the boys in class "A" schools who did not have biology had only a slight advantage over the girls from class "A" schools who did not have biology in high school. Statistically speaking the meaning to be derived in this .60 in means indicates that the boys would be superior only 60 times in 100 if other similar comparisons were made. The 115 girls who had high school biology had a 7.00 advantage in their mean over the 186 boys who had biology. This was a significant difference. The last comparison made among the students in class "A" schools was the comparison of the performance of the 417 boys in class "A" schools with the performance of the 167 girls in class "A" high schools. The girls in class "A" schools had a 7.01 advantage of their mean over the boys. This is a significant difference in favor of the girls.

Table II contains the groupings made among the students in class "B" high schools. The first of these reveals that of the 91 boys in class "B" high schools; 48 took the biology course and 43 did not take it in high school. Those boys who took biology in class "B" high schools gave a better performance than the boys in class "B" high schools who did not take the high school course. Their mean was 8.90

TABLE II

ACHIEVEMENT OF STUDENTS IN CLASS "B" HIGH SCHOOLS

Group	Cases	Mean	S.D.	Std. E. Mean	Obt. Diff.	S.D.D.	Diff / S.D.D.	Chances in 100
Boys								
H. S. Biology	48	60.55	13.40	1.95	8.90	2.97	2.99	99
No Biology	43	51.65	14.35	2.24				
Girls								
H. S. Biology	21	56.35	11.95	2.67	5.50	2.66	2.07	98
No Biology	9	42.50	6.65	2.35				
Boys and Girls								
H. S. Biology	69	58.90	13.10	1.53	8.80	2.43	3.62	99.9
No Biology	52	50.10	13.75	1.90				
Boys vs. Girls								
Boys No Biology	43	51.65	14.35	2.24	9.15	3.24	2.82	99
Girls No Biology	9	42.50	6.65	2.35				
Boys H. S. Biology	48	60.55	13.40	1.95	4.20	3.30	1.27	89
Girls H.S.Biology	21	56.35	11.95	2.67				
All Boys	91	55.35	14.15	1.48	5.15	2.86	1.10	84
All Girls	30	52.20	12.35	2.45				

above that of the group who did not take the high school biology course. This significant difference shows that if similar comparisons were made again the boys who took biology in class "B" high schools would be superior to the boys who did not take biology in class "B" schools 99 times in 100.

The second section of Table II shows that 21 girls in class "B" high schools took biology and 9 did not. The difference in performance showed a significant difference in favor of the girls who had biology in class "B" high schools over those girls who did not have biology in glass "B" schools. The difference of their means was 5.50 which reveals that 98 times in 100 the girls who had biology in class "B" high schools would make better scores than those girls who did not have biology in class "B" high schools if more such comparisons were made.

When groups of students were combined, Table II shows that 69 boys and girls took biology in class "B" high schools and 52 students did not take biology in class "B" high schools. The students who took biology in high school had an 8.80 advantage in their mean over the group who did not have biology in high school. This was a significant difference and made the chances 99.9 in 100 that a similar group of students who had biology in class "B" high schools would again be superior in performance to a group of students who did not take biology in class "B" high schools.

The last section of Table II deals with the comparisons made between boys and girls in class "B" high schools. Forty-three boys and 9 girls did not take biology while attending class "B" high schools. Of

the boys and girls who did not take biology in class "B" high schools the boys had a mean 9.15 above that of the girls. This difference is significant and shows that if similar groups were compared again the boys who did not have biology in class "B" high schools would be superior to the girls who did not have biology in high school 99 times in 100. Forty-eight boys and 21 girls had biology in class "B" high schools. Although the boys who had biology in class "B" high schools had a slightly higher mean than the girls who had biology in high school, the difference shows a trend toward domination but it is not significant. When the performance of the 91 boys in class "B" high schools was compared with that of the 30 girls in class "B" schools; the boys showed a trend toward superiority but it is insignificant. The boys had a 5.15 advantage in their mean but their chances to repeat the performance were 84 in 100 which is not significant.

The comparisons made among students in class "C" high schools are shown in Table III. These groups were small, 36 boys and 18 girls in all; however, the same scientific procedure was followed and as careful calculations as possible were made when dealing with them as with large numbers of students. It is believed that the results are as valid as could be obtained under the circumstances. In several instances the difference of the means was rather large but because of the small number of students the chances in 100 were low, showing no significant advantage.

The 23 boys with the preparatory course in biology had a 7.95 higher mean than those 13 boys who had no high school biology course

TABLE III

ACHIEVEMENT OF STUDENTS IN CLASS "C" HIGH SCHOOLS

Group	Cases	Mean	S. D.	Std. E. of Mean	Obt. Diff.	S.D.D.	Diff. / S.D.D.	Chances in 100
Boys								
H. S. Biology	23	56.20	13.45	2.87	7.95	6.39	1.40	92
No Biology	13	48.25	19.80	5.72				
Girls								
H. S. Biology	13	60.55	17.25	4.79	18.05	8.97	2.01	98
No Biology	5	42.50	15.15	7.57				
Boys and Girls								
H. S. Biology	36	57.80	15.05	2.54	11.15	5.19	2.13	98
No Biology	18	46.65	18.70	4.53				
Boys vs. Girls								
Boys No Biology	13	48.25	19.80	5.72	5.75	9.47	.60	73
Girls No Biology	5	42.50	15.15	7.57				
Boys Biology	23	56.20	13.45	2.87	4.35	5.58	.78	77
Girls Biology	13	60.55	17.25	4.79				
All Boys "C"	36	53.30	17.85	3.54	2.25	5.54	.40	65
All Girls "C"	18	55.55	18.65	4.27				

in class "C" schools. This advantage made their chances for success 92 in 100 and it can not be construed as significant.

The girls with the high school course in biology showed unquestioned superiority over the girls who had not taken high school biology. These 13 girls who had biology in class "C" high schools had an advantage of 18.05 in their mean over the 5 girls who did not have biology in class "C" high schools. This made their chances for success in similar future comparisons 98 in 100 and was a significant difference.

The 36 boys and girls who had biology in class "C" high schools had a 11.15 higher mean than the 18 boys and girls who did not have the high school biology course in class "C" high schools. Their chances were 98 in 100 which is significant.

The last section of Table III puts the performance of boys versus that of girls. In the first of these comparisons the 13 boys who had biology in class "C" high schools had a slight 5.75 advantage in their mean over the 5 girls who did not have high school biology in class "C" high schools. This showed an indication of superiority but it made their chances 73 in 100 which is not significant.

Girls who had biology in class "C" high schools had a small advantage when compared with boys who had biology in class "C" high schools. However, the difference in their means was only 4.35 which was insignificant since it made their chances for superiority only 77 in 100.

When a comparison of all the boys in class "C" schools with all girls in class "C" schools was made; it was found, that the girls had

only a 2.25 advantage in their mean. This made their chances for superiority in similar comparisons only 65 in 100. This advantage is so small that it can not be considered significant.

CHAPTER III

THE INTER-GROUP COMPARISON OF ACHIEVEMENT AMONG THE BOYS AND GIRLS IN CLASS "A", "B", AND "C" HIGH SCHOOLS

In Chapter III inter-group achievement of students in class "A", "B", and "C" high schools is presented. The performance of boys and girls in one class of schools was compared with that of the students in the other two classes; and combined performance of all students within each class was compared with that of each of the other classes. The achievement of all boys and all girls who have taken high school biology and those who have not had high school biology was compared. As a final analysis, the performance of all boys used in the study was compared with that of all the girls.

The same procedure was used in compiling the statistics used in this chapter was used in Chapter Two with one exception. In comparisons between groups larger than single groups within a class of high schools, the frequency tables from which the information was compiled were combined. This combination of data yielded desirable information when the larger groups were studied. This presented a composite picture of the inter-group achievement of the students in the three classes of high schools; and also between the boys and girls of each class with those of each of the other two classes.

It should be clear that Table IV - - Comparison of Achievement Among Boys in Class "A", "B", and "C" High Schools -- shows the results of the study involving all boys -- 544 -- in all the schools

TABLE IV

COMPARISON OF ACHIEVEMENT AMONG BOYS IN CLASS "A", "B" and "C" HIGH SCHOOLS

Group	Cases	Mean	S.D.	Std. E. of Mean	Obt. Diff.	S.D.D.	Diff / S.D.D.	Chances in 100
Boys Who Had High School Biology								
Boys "A"	186	53.30	14.80	1.08	7.25	2.22	3.71	99.9
Boys "B"	48	60.55	13.40	1.95				
Boys "A"	186	53.30	14.80	1.08	2.90	3.06	.94	82
Boys "C"	23	56.20	13.45	2.87				
Boys "B"	48	60.55	13.40	1.95	4.35	3.61	1.20	88
Boys "C"	23	56.20	13.45	2.87				
Boys Who Did Not Have High School Biology								
Boys "A"	231	47.30	13.10	.86	4.35	2.39	1.82	96
Boys "B"	43	51.65	14.35	2.24				
Boys "A"	231	47.50	13.10	.86	.95	5.78	.16	56
Boys "C"	13	48.25	19.80	5.72				
Boys "B"	43	51.65	14.35	2.24	3.40	6.14	.55	71
Boys "C"	13	48.25	19.80	5.72				

used in the thesis.

The 48 boys who had biology in class "B" high schools had a 7.25 greater mean than the 186 boys who had biology in class "A" high schools. This was a significant difference in favor of the boys in class "B" schools.

The 23 boys who had biology in class "C" high schools also had an advantage in the difference of their mean over that of the boys who had biology in class "A" high schools. The boys in class "C" high schools had a mean 2.90 above those in class "A" schools; however, this difference was not significant.

Class "B" high school boys who had biology in high school had a slight advantage over a corresponding group in class "C" schools. The boys in class "B" high schools had a 4.35 greater mean which was not a significant difference.

A difference of 4.35 in their mean gave the 43 boys who did not have high school biology in class "B" high schools a significant difference over the 231 boys who did not have biology in class "A" high schools.

Boys who did not have high school biology in class "C" high schools had a slight advantage over the corresponding group in class "A" high schools, but the difference of their means was only .95 which is not significant.

Boys who did not have biology in class "B" high schools had a 3.40 greater mean than the boys in class "C" high schools who did

have high school biology. This made their chances for domination 71 in 100, which is not significant.

Table V -- Comparison of Achievement Among Girls From Class "A", "B", and "C" High Schools -- shows the results of the comparisons made among female students who had biology in high school, and also among girls who did not have biology in high school. The scores of 215 girls were included in the study.

The girls who had biology in class "C" high schools made a slightly better showing than the girls who had biology in class "A" high schools; and those who had biology in class "A" high schools ranked above those who had biology in class "B" high schools; but the difference was insignificant in each case.

Among girls who did not have high school biology; the girls in class "A" schools had a slightly better mean than those in the class "B" and "C" schools. The latter two groups had the same mean. There was not enough difference in their means to show any significance.

The study of Table V discloses that there was no significant difference in the achievement among the groups who took high school biology, nor was there any important difference in achievement between the groups of girls who did not take high school biology.

TABLE V

COMPARISON OF ACHIEVEMENT AMONG GIRLS IN CLASS "A", "B", and "C" HIGH SCHOOLS

Group	Cases	Mean	S.D.	Std. E. of Mean	Obt. Diff.	S.D.D.	Diff. / S.D.D.	Chances in 100
			Girls Who Had High School Biology					
Girls "A"	115	60.30	16.40	1.53	3.95	3.07	1.25	89
Girls "B"	21	56.35	11.95	2.67				
Girls "A"	115	60.30	16.40	1.53	.25	5.02	.04	50
Girls "C"	13	60.55	17.25	4.79				
Girls "B"	21	56.35	11.95	2.67	5.80	5.20	1.12	86
Girls "C"	13	60.55	17.25	4.79				
			Girls Who Did Not Have High School Biology					
Girls "A"	52	46.70	15.50	2.14	4.20	3.17	1.32	90
Girls "B"	9	42.50	6.65	2.35				
Girls "A"	52	46.70	15.50	2.14	4.20	7.53	.57	71
Girls "C"	5	42.50	15.15	7.57				
Girls "B"	9	42.50	6.65	2.35	0.00	7.98	00	50
Girls "C"	5	42.50	15.15	7.57				

TABLE VI

INTER-GROUP COMPARISON OF ACHIEVEMENT AMONG GIRLS WHO HAD TAKEN HIGH SCHOOL BIOLOGY AND THOSE WHO HAD NOT TAKEN IT

Group	Cases	Mean	S.D.	Std. E of Mean	Obt. Diff.	S.D.D.	Diff / S.D.D.	Chances in 100
				High School Biology vs. No High School Biology				
"A" H.S.Biology	115	60.30	16.40	1.53	13.60	2.63	5.21	99.9
"A" No Biology	52	46.70	15.50	2.14				
"A" H.S.Biology	115	60.30	16.40	1.53	17.80	2.97	5.99	99.9
"B" No Biology	9	42.50	6.65	2.35				
"A" H.S.Biology	115	60.30	16.40	1.53	17.80	7.03	2.53	99
"C" No Biology	5	42.50	15.15	7.57				
"B" H.S.Biology	21	56.35	11.95	2.67	5.50	2.66	2.07	98
"B" No Biology	9	42.50	6.65	2.35				
"B" H.S.Biology	21	56.35	11.95	2.67	13.85	8.01	1.72	96
"C" No Biology	5	42.50	15.15	7.57				
"B" H.S.Biology	21	56.35	11.95	2.67	9.85	3.42	2.87	99
"A" No Biology	52	46.70	15.15	2.14				
"C" H.S.Biology	13	60.55	17.25	4.79	18.05	8.97	2.01	98
"C" No Biology	5	42.50	15.15	7.57				
"C" H.S.Biology	13	60.55	17.25	4.79	18.05	5.43	3.32	99.9
"B" No Biology	9	42.50	6.65	2.35				
"C" H.S.Biology	13	60.55	17.25	4.79	13.85	5.24	2.64	99
"A" No Biology	52	46.70	15.15	2.14				

Table VI -- Inter-Group Comparison of Achievement Among Girls Who Had Taken High School Biology and Those Who Had Not Taken It -- portrays the 9 group studies made among the girls in class "A", "B", and "C" high schools. In each of these comparisons, which were made between groups who had taken biology in high school and groups who had not taken biology in high school, there was a significant difference in favor of the group who had taken the high school biology course.

The 13 girls who had biology in class "C" high schools had a better mean than any other group of girls. Their mean was 60.55. The lowest mean among the groups of girls was 42.50 which was made by girls who did not have biology in class "B" high schools and also by the girls who did not have biology in class "C" high schools. Thus it may be noted that the girls in class "C" high schools had the highest mean and also shared the lowest.

Table VII -- Inter-group Comparison of Achievement Among Boys Who Had Taken High School Biology and Those Who Had Not Taken It -- show the results of the comparisons made among the boys used in this study. The results show that the boys who took biology had a higher mean than those boys who had not taken the high school biology course. However, the difference was not significant in all cases. The following comparisons showed a significant difference in favor of the boys with the high school biology course: Boys in class "A" schools who had high school biology over those in class "A" schools who did not have the high school course. Boys in class "B" schools who had high school biology over those in class "B" who did not have it. Boys in

TABLE VII

INTER-GROUP COMPARISON OF ACHIEVEMENT AMONG BOYS WHO HAD TAKEN HIGH SCHOOL BIOLOGY AND THOSE WHO HAD NOT TAKEN IT

Group	Cases	Mean	S.D.	Std. E. of Mean	Obt. Diff.	S.D.D.	Diff. S.D.D.	Chances in 100
	High School Biology vs. No High School Biology							
"A" H.S.Biology	186	53.30	14.80	1.08	6.00	1.36	4.40	99.9
"A" No Biology	231	47.30	13.10	.86				
"A" H.S.Biology	186	53.30	14.80	1.08	1.65	2.48	.66	74
"B" No Biology	43	51.65	14.35	2.24				
"A" H.S.Biology	186	53.30	14.80	1.08	5.05	5.81	.87	80
"C" No Biology	13	48.25	19.80	5.72				
"B" H.S.Biology	48	60.55	13.40	1.95	8.90	2.97	2.99	99
"B" No Biology	43	51.65	14.35	2.24				
"B" H.S.Biology	48	60.55	13.40	1.95	12.30	6.03	2.04	98
"C" No Biology	13	48.25	19.80	5.72				
"B" H.S.Biology	48	60.55	13.40	1.95	13.25	2.12	6.25	99.9
"A" No Biology	231	47.30	13.10	.86				
"C" H.S.Biology	23	56.20	13.45	2.87	7.95	6.39	1.40	92
"C" No Biology	13	48.25	19.80	5.72				
"C" H.S.Biology	23	56.20	13.45	2.87	4.55	3.64	1.25	89
"B" No Biology	43	51.65	14.35	2.24				
"C" H.S.Biology	23	56.20	13.45	2.87	8.90	2.91	3.05	99.9
"A" No Biology	231	47.30	13.10	.86				

class "B" high schools who had high school biology over those in class "C" schools who did not have the high school course. Class "B" high school boys who had high school biology over those in class "A" schools who did not have high school biology. Boys in class "C" high schools who had high school biology over the boys in class "A" schools who did not have high school biology.

The following comparisons showed a difference in favor of the groups with the high school biology course but it was not significant in either case: Boys who had taken biology in class "A" high schools over the boys from class "C" high schools who had no high school biology. Boys in class "A" high schools who had biology over the boys in class "C" high schools who did not have high school biology. Boys in class "C" high schools who had biology over their school mates in class "C" high schools who did not have it. Boys in class "C" high schools who had high school biology over the boys in class "B" high schools who did not have it. When means were compared the boys who had biology in class "B" high schools had a mean of 60.55 which was the best mean among the groups of boys. The lowest mean made among the groups of boys was 47.30 made by the boys who did not have biology in class "A" high schools.

Table VIII reveals the results of the comparisons made when groups of boys and girls who had high school biology were combined and their performance was compared with the combined achievement of groups of boys and girls who did not have biology in the different classes of high schools.

TABLE VIII

INTER-GROUP COMPARISON OF ACHIEVEMENT AMONG GROUPS OF BOYS AND GIRLS WHO HAVE HAD HIGH SCHOOL BIOLOGY WITH SIMILAR GROUPS WHO HAVE NOT

Group	Cases	Mean	S.D.	Std. E. of Mean	Obt. Diff.	S.D.D.	Diff. / S.D.D.	Chances in 100
Boys and Girls With High School Course vs. Those With None								
"A" H.S.Biology	301	56.00	15.80	.91	8.80	1.21	6.44	99.9
"A" No Biology	283	47.20	13.60	.81				
"A" H.S.Biology	301	56.00	15.80	.91	5.90	2.11	2.75	99
"B" No Biology	52	50.10	13.75	1.90				
"A" H.S.Biology	301	56.00	15.80	.91	9.35	4.62	2.02	98
"C" No Biology	18	46.65	18.70	4.53				
"B" H.S.Biology	69	58.90	13.10	1.53	8.80	2.43	3.62	99.9
"B" No Biology	52	50.10	13.75	1.90				
"B" H.S.Biology	69	58.90	13.10	1.53	12.25	4.78	2.56	99
"C" No Biology	18	46.65	18.70	4.53				
"B" H.S.Biology	69	58.90	13.10	1.53	11.70	1.73	6.76	99.9
"A" No Biology	283	47.20	13.60	.81				
"C" H.S.Biology	36	57.80	15.05	2.54	11.15	5.19	2.13	98
"C" No Biology	18	46.65	18.70	4.53				
"C" H.S.Biology	36	57.80	15.05	2.54	7.70	3.16	2.43	99
"B" No Biology	52	50.10	13.75	1.90				
"C" H.S.Biology	36	57.80	15.05	2.54	10.60	2.66	3.98	99.9
"A" No Biology	283	47.20	13.60	.81				

An examination of Table VIII reveals that in the various comparisons made between groups of boys and girls who had biology in high school and those students who did not have the high school course; the students who had the course showed superiority over those who did not have high school biology.

In the 9 comparisons made among these groups the difference in the means varied from 5.90 in the case of the students who had biology in class "A" high schools above the students who did not have the course in class "B" high schools; to a difference of 12.65 which the students who had biology in class "B" high schools had above the students who did not have biology in class "C" high schools.

All these comparisons showed a significant difference in favor of the students who had high school biology regardless of the class of high schools.

The Achievement of all students in each class of high school is revealed in Table IX. Contrary to expectations, there was no definite pattern of superiority shown. One might have expected students in class "A" high schools to have the highest combined achievement and them to be followed by the students in class "B" and "C" high schools. Instead students in class "B" schools showed the best performance, and in the only comparison that showed a significant difference, the students in class "B" schools ranked above those in class "A" schools in performance. Students in class "C" schools had a mean slightly above those in class "A" schools and those in class "B" schools were slightly above those in class "C" schools but the difference was insignificant

TABLE IX

COMPARISON OF ACHIEVEMENT AMONG ENTIRE GROUPS OF STUDENTS IN CLASS "A", "B", AND "C" HIGH SCHOOLS

Group	Cases	Mean	S.D.	Std. E of Mean	Obt. Diff	S.D.D.	Diff. / S.D.D.	Chances in 100
All Students in Class "A", "B", and "C" Schools								
Class "A"	584	51.70	15.40	.63	3.45	1.42	2.43	99
Class "B"	121	55.15	14.15	1.28				
Class "A"	584	51.70	15.40	.63	2.10	2.42	.86	80
Class "C"	54	53.80	17.20	2.34				
Class "B"	121	55.15	14.15	1.28	1.35	2.66	.50	67
Class "C"	54	53.80	17.20	2.34				

in both cases.

Table X, the last used in this thesis, reveals the results of comparisons between boys who had biology and boys who did not have high school biology; between girls who had biology and girls who did not; between all students who had biology and all students who had no high school biology; and finally a comparison between the 544 boys and 215 girls used in the study.

Each comparison between students who had biology in high school and those who did not have the course showed a significant difference in favor of the group who had the high school course.

No significant difference was noted between the groups of boys who did not have high school biology and the girls who did not have the course.

In the comparison of all the girls used in the study versus all the boys, the girls' mean was 3.90 above that of the boys and this was a significant difference in favor of the girls.

TABLE X

COMPARISON OF ACHIEVEMENT AMONG ENTIRE GROUPS OF BOYS AND GIRLS

Group	Cases	Mean	S.D.	Std. E. of Mean	Obt. Diff.	S.D.D.	Diff. / S.D.D.	Chances in 100
All Boys and All Girls								
Boys Biology	257	54.90	14.60	.91	7.00	1.21	5.78	99.9
Boys No Biology	287	47.90	13.60	.81				
Girls Biology	149	59.80	16.00	1.31	13.90	2.17	6.40	99.9
Girls No Biology	66	45.90	14.00	1.72				
Boys Biology	257	54.90	14.60	.91	4.90	1.59	3.08	99.9
Girls Biology	149	59.80	16.00	1.31				
Boys No Biology	287	47.90	13.60	.81	2.00	1.90	1.05	85
Girls No Biology	66	45.90	14.00	1.72				
All Students Biology	544	58.40	14.20	.70	10.80	.98	11.02	99.9
All Students No Biology	353	47.60	13.50	.71				
All Boys used	544	51.20	14.20	.61	3.90	1.28	3.04	99.9
All Girls used	215	55.10	16.80	1.13				

CHAPTER IV

CONCLUSIONS

In this part of the study is presented a summary which gives the answer to the thesis problem which is restated for clarity. The problem was to discover: (1) significant differences, if any, between boys who had biology in high school and those who did not; (2) significant differences, if any, between girls who had biology in high school and those who did not; (3) significant differences, if any, between the above mentioned groups in class "A", "B", and "C" high schools; (4) the significant difference, if any, between all the boys and all the girls used in this study.

It is conceded that the study is somewhat limited, including 759 graduates of 287 Kansas high schools. However, the sampling was from a good cross section of Kansas high schools. The statistics were carefully compiled from scores made on a standardized biology test and were handled through the use of approved scientific procedure which has reduced the probability of error.

Tables I, II, and III disclose that there was in all comparisons made among boys within each class of high schools a significant difference in performance in favor of the boys who had biology in high school. The tables also reveal that girls, within each class of high schools, who had high school biology made better scores than those girls who did not have the high school course.

Inter-group comparisons are shown in Tables IV, V, VII, and VII. When the inter-group comparisons were made among the boys, there was in each comparison, either a significant difference or one approaching significance in favor of the boys who had biology in high school. The inter-group comparisons among the girls disclosed that in every comparison thus made, the girls who had the course in high school had a greater mean than the girls who did not have the high school biology course. This difference was significant in each comparison.

The achievement of boys and girls who had biology in each class of high schools was combined in Table VIII and compared with the preformance of the students in each class of high school who did not have biology in high school. There was a significant difference in each of these cases in favor of the group who had the high school biology course.

The 406 students who had high school biology had a 10.80 advantage in their mean, which is a significant difference in their favor, over the 353 pupils who did not have high school biology.

Comparisons between the entire groups in each class of high schools showed that students in class "B" high schools had a higher mean than those in class "A" schools, and this difference was significant. In the other two comparisons, students in class "C" schools had a slight advantage over those in class "A" schools, and pupils in class "B" schools had a better mean than students in class "C" schools;

but the difference was not significant in each of the two latter comparisons.

As a final comparison, the mean of the 544 boys used in this thesis was compared with that of the 215 girls. The girls had a mean 3.90 above that of the boys and this difference was significant, showing that in similar comparisons, the girls would make better scores in 99 of 100 such comparisons.

This study has lead the writer to these conclusions: (1) the achievement of students who took biology in high school was above that of those students who had no high school biology; (2) the classification of a student's high school had little or no bearing on his test score; (3) there was a significant difference in the achievement of girls above that of the boys.

High school students who plan to enter college should take high school biology in order that they might increase their chances for exemption from the basic college biology course. Exemptions gained through good entrance examination scores give entering college freshmen a better chance to make a personal selection of courses without having to take basic courses.

High school biology is often considered a "fill-in" course which students take in order to get an additional credit. They do not take the course seriously and as a result get little out of it. High school biology teachers should stress the importance of this subject to the students and insist that they master the subject matter

offered in the course. They should know that many colleges require a basic knowledge of biology and that if they get this in their high school course it will be to their advantage when they reach the college level.

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