Proceedings of the Iowa Academy of Science

Volume 73 | Annual Issue Article 52

1966

A Study of the Laboratory Method Versus the Lecture Method of Teaching Biology

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6. Graduates have indicated gratitude for study habits developed from this teaching approach that has been part of their education from their sophomore to senior year.

As a biology team, and part of an entire faculty, we hope we have and are helping in the total development of each student we teach. We hope, too, that working as team-members our own learning and teaching are improved.

A Study of the Laboratory Method Versus the Lecture Method of Teaching Biology

CURTIS E. MCCALLUM

Abstract: Two sections of biology students at the eighth grade level were taught a unit concerned with the cell with two different methods. One group experienced only lectures and discussions. The other group experienced only laboratory sessions. Although there were certain limitations to the study, the general results tended to favor the laboratory approach. This was particularly apparent in the case of the upper one-third of the classes.

The purpose of this study was to determine whether the lecture method of teaching is superior to the laboratory method. The study was extended to see which group was better able to retain material presented to them. This study was conducted on two classes at the University High School in Iowa City, Iowa. The lecture group with 20 students was taught by Mr. Robert E. Cook, and the laboratory group with 21 students by Mr. Donald J. Schmidt. Both teachers were on the staff of University High School at Iowa City.

PROCEDURE

The study was begun on December 7, 1964, when the same pre-test of 50 questions covering chapters 10, 11, and 12 of *Biological Science—Molecules to Man; BSCS Blue Version,* was given to both lecture and laboratory groups. The test was styled to test for biological concepts rather than recall of facts. The students were unaware of the purpose of the pre-test.

Chapters 10, 11, and 12 were outlined for Mr. Cook to follow. Mr. Schmidt followed the text's laboratory suggestions that correlated with the chapters studied. A brief resume of the material covered the following:

Chapter 10—The Evolved Cell—Material about cells, their structural features, and cell division.

Chapter 11—The Cell Theory—The historical background and the contributions to the making of this theory by a few major scientists.

Chapter 12—The Multicellular Organism— Material about the advantages and the disadvantages of unicellular and multicellular states.

Laboratory exercises—

Tuesday, December 8—cell duplication

Wednesday, December 9—the "smear" technique of onion root tips.

Thursday, December 10—the use of biological slides of mitosis

Friday, December 11—discussion

Monday, December 14—the beginnings of multicellular organization

Tuesday, December 15—continuation of the above

Wednesday, December 16—discussion

Thursday, December 17—test

A brief quiz was given at the beginning of the class period on December 8, December 9, and December 15.

Each group was observed twice during the two weeks of study. Both groups were taught in the usual manner. Mr. Cook used a lecture and discussion method, and Mr. Schmidt used the laboratory method entirely, in which the students were told or shown the proper procedure, and then allowed to do the experiment. In Mr. Schmidt's class the students seemed to be more responsive and eager to learn.

The students were forewarned that a post test (Test 11) would be given on December 17. This test contained 50 questions and was similar in content to the pre-test, but the questions were reworded. The observer scored the tests and recorded the number of correct answers for each student. The results of the pre-test and the post test were averaged to obtain the mean score.

An attempt was made to match all of the I.Q.'s that could be matched between the two groups. There were 12 students in the lecture group whose I. Q.'s corresponded exactly, or within one or two points to 12 student in the laboratory group. The reason for doing this was to determine if there was any difference in the mean score of the two groups with nearly identical I.Q.'s. This comparison would show that both groups were basically the same although there was a 10 point difference between average I.Q.'s of the two groups.

The range of the post test was divided into thirds, *i.e.* upper third, middle third, lower third, to determine which section of each class benefitted most from the teaching method used. An attempt was made to select the most discriminating questions from the post test, to see how much of the material taught during this study was retained by the students. Ten questions were selected verbatim from the post test and then typed (Test III).

FINDINGS

The mean score of the pre-test in the laboratory group was 19.55, while the mean score for the lecture group was 15.94. On the post test, the mean score for the laboratory group was 27.05, and for the lecture group, 21.50. For the laboratory group there

TABLE I
LAB SECTION TEST RESULTS
(number correct)

Student	pre-test	post test
1. lab A	22	30
2. lab B	14	18
3. lab C	15	absent
4. lab D	23	17
5. lab E	21	18
6. lab F	17	17
7. lab G	24	40
8. lab H	20	25
9. lab I	16	18
10. lab J	19	21
11. lab K	20	12
12. lab L	25	26
13. lab M	19	32
14. lab N	16	12
15. lab O	24	22
16. lab P	24	29
17. lab Q	21	34
18. lab R	16	13
19. lab S	15	14
20. lab T	20	24
21. lab U	absent	20
Average	19.55	27.05
		(net gain 7.50)

TABLE II
LECTURE SECTION TEST RESULTS
(number correct)

Student	pre-test	post test
1. lec A	17	15
2. lec B	10	23
3. lec C	17	28
4. lec D	13	13
5. lec E	18	34
6. lec F	20	17
7. lec G	16	24
8. lec H	18	23
9. lec I	14	20
10. lec J	12	19
11. lec K	18	31
12. lec L	18	22
13. lec M	24	23
14. lec N	11	13
15. lec O	16	27
16. lec P	15	16
17. lec Q	18	24
18. lec R	13	24
19. lec S	15	14
Average	15.94	21.50
		(net gain 5.56)

was a net gain of 7.50; for the lecture group, a net gain of 5.56 (Tables I and II.)

Twelve students from each group were matched as to I.Q. The mean of this select group for the laboratory group was 22.17, and for the lecture group, 22.25. The difference between means of these two select groups was insignificant. (Table V).

On Test III the mean for the 12 matched students of the laboratory group was 3.44; and for the 12 matched students of the lecture group, 3.88. The mean for each entire group for Test III was also found with the following results; laboratory group—3.42; lecture group—3.59. (Tables III and IV).

TABLE III

TEST THREE

LAB GROUP	SCORE	LECTURE GROUP	SCORE
1. lab G	8	1. lec E	5
2. lab M	5	2. lec C	5
3. lab I	5	3. lec G	5
4. lab E	5	4. lec O	5
5. lab T	4	5. lec R	5
6. lab S	4	6. lec D	5
7. lab L	4	7. lec I	4
8. lab U	4	8. lec H	4
9. lab B	3	9. lec N	4
10. lab F	3	10. lec L	4
11. lab J	3	11. lec F	4
12. lab P	3	12. lec Q	3
13. lab A	3	13. lec P	3
14. lab C	2	14. lec M	3
15. lab D	2	15. lec J	3
16. lab N	2	16. lec K	3
17. lab O	2	17. lec. B	2
18. lab Q	2	18. lec S	1
19. lab K	1	19. lec A	0
20. lab R	0	Average	3.69
Average	3.42		

TABLE IV

(Matched group of test three)

LAB GROUP	IQ	SCORE	LECTURE GROUP	IQ	SCORE
1. lab B	109	3	1. lec O	108	5
2. lab I	110	5	2. lec D	111	5
3. lab O	113	2	3. lec C	112	5
4. lab L	117	4	4. lec K	117	3
5. lab D	118	2	5. lec M	119	3
6. lab T	120	4	6. lec N	119	4
7. lab A	123	3	7. lec B	123	2
8. lab M	125	5	8. lec G	126	5
9. lab P	130	3	9. lec Q	131	3
	Average	3.44		Average	3.88

When the groups were divided into upper, middle, and lower thirds, the upper third of the laboratory group had a mean of 29.42 compared to 22.42 for the corresponding third of the lecture group. The mean for the middle section of the laboratory

TABLE V
(Matched group of post test)

LAB GROUP	IQ	SCORE	LECTURE GROUP	IQ	SCORE
1. lab U	107	19	1. lec P	107	16
2. lab B	109	18	2. lec O	108	27
3. lab I	110	18	3. lec D	111	13
4. lab K	112	11	4. lec R	112	24
5. lab O	113	22	5. lec C	112	28
6. lab H	114	25	6. lec L	115	22
7. lab L	117	25	7. lec K	117	30
8. lab D	118	16	8. lec M	119	23
9. lab T	120	23	9. lec N	119	13
10. lab A	123	30	10. lec B	123	23
11. lab M	125	31	11. lec G	126	24
12. lab P	130	28	12. lec Q	131	24
	Average	22.17		Average	22.25

group was 19.10 compared to 24.66 for the middle section of the lecture group. The mean for the lower third of the laboratory group was 14.57 compared to 17.50 for the lecture group. (Table V).

Summary and Conclusion

Two groups of students were used in this study to determine which method of teaching was more successful: the laboratory method or the lecture method as measured by special testing instruments. When considering the overall performance of each group the laboratory method seems to be superior to the lecture method. This is confirmed by the greater gain between the pre and the post tests achieved by the laboratory group as shown on Tables I and II.

Tables IV and V indicate that when students are selected with matching I.Q.'s from each group, the difference in achievement is insignificant. When the groups are divided into upper, middle, and lower thirds as shown on Table VI, the achievement of the upper third seems to indicate that the laboratory approach is more appropriate for superior students as it presents a challenge to them. The achievement of the middle and lower groups indicates that they profit more from the lecture approach.

Between the 1930's and 1950's, the trend in biology has moved away from individual laboratory work. The only emphasis on laboratory work was achieved through teacher demonstration. Since the revival of biology after the 1950's, the new programs require extensive individual laboratory work by students. This is shown in the new Biological Science Curriculum Study. Findings tend to agree with the new science approach where the lecture and individual laboratory work are correlated. Since it is almost impossible to group students with very little variation in their abilities, a combination approach will be most satisfactory.

Limitations

The validity of the study might be questioned since it was continued for only seven school days. In addition, the two groups were not evenly matched as to I.Q.'s. There was a 10 point

difference between average I.Q.'s of the two groups. Another limiting factor would be that each group had a different teacher.

Recommendations

In order for the study to be more valid, it should be continued for a longer period of time on students with matching I.Q.'s or with very litttle difference in I.Q.'s. Also, one teacher should teach groups being used in the study to be certain that instruction of both groups is equal.

An Analysis of the Outcomes of Special Summer Programs for Secondary Students of High Ability

Robert E. Yager and Gerald Krockover[1]

Abstract: The National Science Foundation has supported special training programs for secondary students of high ability since 1959. This is the report of a study of the outcome of such programs upon the participants. Specific values of the programs were reported to be: 1) renewed interest in the remaining year of high school, 2) development of better study habits, 3) better oriented for college, 4) development of confidence, 5) verification and depending of vocational plans, and 6) general stimulation from a superior academic experience.

In 1959 the National Science Foundation sponsored and supported the first Summer Science Training Program for High-Ability Secondary School Students. The number of these programs has grown to about one hundred fifty each summer and they have been held in nearly all of the fifty states and the District of Columbia and Puerto Rico. The purpose of the programs is "to provide the superior high school student with educational experience in science tand mathematics beyond that normally available in high school courses." The scope of the programs is great as is the diversification in approach. The programs are largely operated by colleges and universities when they are selected following submission of a proposed program to the National Science Foundation. The students receive more intensive training in science content, laboratory experiences, and research participation than is available in high school. This training presumably intensifies interest in science and provides a better background for career choices in science.

The programs generally are believed to be worthwhile. How-

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