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A Comparison of the Contractual Approach and the Traditional Method for Teaching High School Biology

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A COMPARISON OF THE CONTRACTUAL APPROACH AND THE TRADITIONAL METHOD FOR TEACHING HIGH SCHOOL BIOLOGY

by

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CHAPTER I

TEACHING HIGH SCHOOL BIOLOGY BY THE CONTRACTUAL SYSTEM

Introduction

Biology is offered as an elective course which fulfills the science credits required for high school graduation in the Portage Public Schools. Approximately 90 percent of the students select biology rather than another science and most enroll in the class during their sophomore year. The students are grouped into "regular" biology sections for average achievers or into BSCS[1] sections for above average achievers. This study concerns the BSCS program which is outlined in the curriculum guide as recommended for students who are considering advancement to other science courses. The BSCS program is designed to orient students in techniques for the analysis of data and in problem solving procedures.

The Biological Sciences Curriculum Study material, which developed in the early 1960's, was part of an effort to take a new approach in the field of science education. It was recognized that the growth of information in biology made it impossible to cover all the areas of biological science in a beginning course. In biology as well as in other areas, the new approach is placed on teaching the ability to "inquire" or to think critically rather than on simple

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[1]The Biological Sciences Curriculum Study.

memorization of facts. The "inquiry" or problem solving approach can be applied not only to science, but to any situation a student may encounter while functioning as an adult in our society. With the body of knowledge held by the scientific community increasing and changing as rapidly as it is in our time, the understanding of biological principles, rather than simple memorization of facts, has been incorporated into the design of the course.

The very principle of inquiring requires that the student depart from being a mere receptor of knowledge and to step into a more active role in his own education. The ability to think out a problem and approach it logically becomes a very difficult concept to grasp when stalked in the traditional fashion. The student now must be the originator of the thought process rather than a mere parrot of knowledge delivered to him by his instructor. In teaching inquiry, it is apparent that an individualized method of instruction might be a more effective way to teach these relatively abstract principles.

The contract method of instruction is one way to allow each individual to pursue his own interests, yet focus on a specific subject area. The attempt to individualize instruction has been a task pursued by educators for many years. The "open classroom" and "non-graded primary" are a couple of concepts that have become well known in the area of elementary education. The few recent research studies dealing with individualized instruction by the contracting method have been inconclusive.

Nelson and Brian's (1970) study indicated that students who used the contractual approach had more positive attitudes than those who

used the traditional approach, although significant differences in achievement were not found. In this study involving high school mathematics, it was concluded that "there were clear-cut data trends and significant F ratios which favored the combination of contingency management and individualized instruction over conventional instruction." The fact that Nelson and Brian failed to find significant improvement in achievement was contradictory to the findings of Deall (1969), in a four year study involving high school physics. Deall's finding revealed that students who used the contractual approach had significantly greater achievement than those who used the traditional approach. Poppen (1971) in an experiment involving college psychology students, found that although not significant at the .05 level, the results favored the contractual method over the traditional methods for improving student performance. In general, the research comparing the contractual method of instruction with traditional methods seems to be inconclusive and conducted mainly at the college level.

Statement of the Problem

The purpose of this study was to compare the advancement of the students who used the contract method in learning biology with that of students who used the traditional method. The areas for evaluation include the student's achievement, a measurement of his ability to think critically and his attitude toward the method of instruction. The aim is to determine if the contract method of instruction is a favorable alternative to the traditional method, in developing the above mentioned areas.

Course Design

The students electing biology were required to attend five fifty minutes periods a week. The classroom and laboratory were two separate units. Two days a week were spent in the laboratory while the three days in the classroom involved testing and lecturing or viewing movies. The text used was the BSCS yellow version text, Biological Science - An Inquiry Into Life by Harcourt, Brace and World Inc. In the type of instruction referred to as "traditional" in this paper, the students were not given a chance to participate in the course design. Laboratory experiments, movies, lectures and their sequence of presentation were selected by the instructor at his discretion.

Grading was based on a point system with approximately thirty percent of the grade derived from laboratory work while the remainder was determined from test scores and homework assignments. The letter grade was based on class average with the average of the highest three scores serving as the top of the range and sixty percent of this as the failing point. The course itself ran a year in duration and covered a wide range of concepts in an attempt to deliver a well rounded background in biology. The subject matter was divided into 15 major subunits which were presented in a sequence developed by the school system's science department. The sequence of the units was as follows:

1. Introduction to Laboratory Skills
2. The Metric System

3. Ecology
4. Population Dynamics
5. The Community
6. Succession
7. Basic Biochemistry
8. The Cell
9. Cell Reproduction
10. Genetics
11. Embryology
12. Growth and Development
13. Evolution
14. Comparative Anatomy and Physiology
15. Plant Physiology

Instruction by Contracting

In the contract method of instruction the student is directly involved in determining the types and amount of work he does. Contracts were drawn up for each chapter by the instructor. These contracts listed several possible assignments that could be selected by the student and also the work that was required for each chapter. (See Appendix A.) Each assignment was given a point value and the necessary number of points needed to earn a specific letter grade was also listed. Behavioral objectives on the contract directed the student toward the critical material in each chapter and a test at the end of each chapter was given covering these behavioral objectives. The student not only was given the option of selecting which assignments

he wanted to participate in, but also selected the letter grade he wanted to earn. This system provided for the individual differences and interests among the students of the class. Students who were particularly interested in laboratory work were allowed to pursue this interest while those who weren't interested had other assignments available to help them understand the selected concepts. On each unit every individual student had his own assignments directed toward the same objectives and was tested over these objectives with a passing mark mandatory before moving to the next chapter and contract.

Lectures were optional and were available on tapes which the student could listen to during class time. This allowed him to stop the recorder and go back to areas that seemed confusing and generally to progress at his own rate. Programmed materials were frequently incorporated into the contracts, which also allowed students to pace and check themselves on an individual basis. An attempt was made to make as many laboratory projects as possible available for students who favored this type of work. Selected readings from Scientific American were frequently listed as options along with articles from a wide variety of other sources. Building models, preparing reports, answering questions from films were some of the other types of options incorporated into the contracts.

The students who wanted to do additional assignments not listed in the original contract were allowed to do so with the consent of the instructor. The point value of these alternate assignments was determined by mutual agreement between the instructor and student prior to the project. The instructor also offered advice and help

in any area the students seemed to be confused. There were also optional review sessions prior to each test and an attempt was made to bring together the concepts presented in the individual projects.

CHAPTER II

RESEARCH DESIGN

The population selected for this study consisted of three biology classes made up mostly of tenth grade students. The students were placed into these classes by their counselor in a manner that would accommodate their schedule and hence, this was not considered a purely random grouping. One of the classes was selected as a test group and received the contract method of instruction while the students to serve as the control group were selected from the other two classes. The individual students in the contract group were match-paired with control group students of the same age, sex and grade point average.

The same units were covered in both the traditional and contract method of instruction. The instructor, classroom and textbook were the same with the only variable knowingly introduced being the method of instruction. Testing involved three different tests, the Watson - Glazer Critical Thinking Test, the Cooperative Science Biology Test, and the "Finch Test on Attitudes Toward The Method of Instruction." The two tests were administered at the beginning and the end of the semester to both the test and control groups and the pre- and post-test scores were compared. Since the only variable between the test and control group was the method of instruction it was assumed that any difference in pre- and post-test scores for the two groups would be the result of the experimental treatment.

Critical thinking ability, achievement on a standardized

biology test, and the attitude toward the method of instruction were considered important in this course. Also important in the classroom were the many factors such as discipline and ease of management which are more difficult to measure with standardized tests. It was the intent of this investigation to incorporate observations comparing these two methods of instruction in some of the more abstract areas which were not covered by the testing.

CHAPTER III

RESULTS AND INTERPRETATIONS

Biology is usually selected during the sophomore year of high school, although a few freshmen and juniors also enroll in the class. (See Table I.) The age range of the students in the contract and control groups was from 13 to 16 with female students slightly outnumbering the males.

The BSCS biology course was primarily designed for college bound students and this was reflected in the grade point average of the students enrolled in the class. A total of 78 percent of the students participating in this study had previous grade point averages in the A and B ranges. It should be pointed out that these grade point averages were taken from the student's previous school year, which for most of the participants would be their freshman year.

The students that served as the contract group were matched with control group students from the other two participating classes. A comparison of the contract group and control group raw scores on the Watson-Glazer Critical Thinking Test indicated that at the beginning of the semester the average scores were approximately the same for both groups. (See Table II.)

The fact that the groups were matched by grade point average and age would make this similarity of scores understandable. In order to compare the pre-test scores statistically, a *t* test value was calculated comparing the contract and control groups scores. A *t* test value of

TABLE I. Compilation of Participating Students by Age, Grade, Sex and Grade Point Average.

	N	%
AGE		
Thirteen	6	10
Fourteen	13	21
Fifteen	39	65
Sixteen	2	4
SEX		
Male	26	44
Female	34	56
CLASSIFICATION		
Freshman	14	23
Sophomore	44	73
Junior	2	4
GRADE POINT AVERAGE		
3.5 - 4.0	14	23
3.0 - 3.4	16	27
2.5 - 2.9	17	28
2.0 - 2.4	10	17
1.5 - 1.9	3	5

TABLE II. Statistical Comparisons of Watson-Glazer Critical Thinking Test Scores

Group	Pre-Test	Post-Test	Difference
Contract	57.1	67.48	10.38
Control	57.4	60.5	3.1

t TEST COMPARISONS

Tests Compared	t Scores	Significance Level
Contract & Control Pre-Test	.13	Not Significant
Contract & Control Post-Test	3.56	.001
Control Group Pre & Post	1.43	.1
Contract Group Pre & Post	5.68	.001

.13 on this comparison indicated that significant differences were not found in these two groups ability to think critically. This would indicate that at the beginning of the semester the contract and control groups were statistically the same prior to the experimental treatment.

The post-test scores indicated that both groups improved in their critical thinking ability. A comparison of the pre- and post-test scores showed that the control group increased their mean scores from 57.4 to 60.5. In order to determine if this difference could be attributed to chance, a t test value was calculated comparing these scores. This test showed a t value of 1.43 which is significant at

the .1 level of significance. These data indicate that the improvement in the pre- and post-test scores was related to the method of instruction used and that this type of improvement would be observed only infrequently by chance.

The contract group improved their scores even more as the original mean of 57.1 was escalated to 67.5. The difference between the contract groups pre- and post-test scores showed a $\underline{t}$ test value of 5.68, significant at the .001 level of significance. Thus it is even more unlikely that the improvement by the contract group could have occurred by chance. The fact that both groups improved their scores significantly requires the analysis of the degree of improvement to determine if there is a significant difference between the two groups.

In order to compare the post-test scores statistically to determine if there was a significant difference in improvement between the two groups, the contract and control groups post-test scores were compared. This comparison of scores indicated a $\underline{t}$ test value of 3.56 which is significant at the .001 level. This indicates that the two groups, while not found to be different at the beginning of the experiment, were statistically different at the semester's end. With the .001 level of significance shown in this instance it can be safely assumed that the difference in scores was not a result of chance but rather, a difference produced as a result of the experimental treatment.

In order to determine how the students that participated in this study compared to the average student on the WGCT test, their

raw scores were compared to the national averages. The average pre-test score for the participating students was 57.2, compared with the national average of 56.4 for tenth grade students. (See Table III.)

TABLE III. Comparison of Watson-Glazer Critical Thinking Test Scores to National Averages

GROUP	MEAN
Portage Students	
Control Pre-Test	57.4
Contract Pre-Test	57.1
Control Post-Test	60.5
Contract Post-Test	67.5
National Averages	
Grade 9	53.6
Grade 10	56.4
Grade 11	58.8

The post-test scores for the Portage students were greater than the national average scores since the average score of 64 for the Portage students post-test would be in the 72nd percentile rank for an eleventh grade student on a nationwide basis.

In summarizing the results of the WGCT test, it was found that both the contract and control groups improved during the

semester. The level of improvement placed both groups above the national averages for eleventh graders. The improvement shown in the contract group scores was significantly greater than the control groups improvement and it was assumed that this difference was due to the experimental treatment.

In order to evaluate how the experimental treatment was related to the students knowledge of biology the Cooperative Science Biology Test was used. The scores from this test failed to show that significant differences existed between the contract and control groups pre-test scores. (See Table IV.) This was to be expected since the students had for the most part experienced the same science courses in junior high school and also were matched by grade point average. The average pre-test score for the control group was 29.6 while that of the experimental group was 29.3.

Analysis of post-test scores showed that both groups improved significantly in subject matter assimilation during the semester. The contract group mean showed an increase to 35.7, while the control pre- and post-test scores was 6.4 for the contract group and 6.6 for the control group. Statistical analysis of the data shows that while both groups significantly increased in their knowledge of biology. A significant difference was not found between the two group's post-test scores. The implication of these data was that the experimental treatment proved no better than the traditional approach in the teaching of biology subject matter.

TABLE IV. Statistical Comparisons of Cooperative Science Biology Test Scores

Group	Pre-Test	Post-Test	Difference
Contract	29.3	35.7	6.4
Control	29.6	36.2	6.6

t TEST COMPARISONS

Tests Compared	t Scores	Significance Level
Contract & Control Pre	.19	Not Significant
Contract & Control Post	.29	Not Significant
Control Group Pre & Post	3.69	.001
Contract Group Pre & Post	4.05	.001

A comparison of the test results with the national norms for high school students showed that the post-test mean of 35.9 for the Portage students was at the 59th percentile rank for the nation. (See Table V.)

TABLE V. Comparison of Raw Scores on Cooperative Science Biology Test Scores With National Norms.

GROUP	MEAN
Pre-Test Control	29.3
Pre-Test Contract	29.6
Post-Test Control	36.2
Post-Test Contract	35.7
National 10th - 12th-Grade	34.0

NATIONAL PERCENTILE RANKING

Range	Rank
33 - 34	50 %
35 - 36	59 %
37	64 %
37 - 39	72 %

The national mean was 34.00 for students in grades 10 - 12 which placed the Portage students slightly above the national average. In interpreting the results of this test it should be pointed out that the students participating in this investigation had completed only one semester of biology at the time of testing. If the improvement in test scores demonstrated during the first semester represents the type of improvement expected during the second semester, the results would place the participants well above the national mean.

It was interesting to note that achievement on the course semester exams, prepared by the instructor, produced results which differed from those on the standardized biology test. Besides the standardized test, a semester exam was administered at the end of the term and it indicated some variation between the control and contract groups. The control groups mean score on the semester exam was 53.4 while that of the contract group was 58.2. This showed a t value of 3.2 and is significant at the .005 level. The difference in results on the standardized achievement test and the semester exam might be explained by the nature of the tests. The semester exam

covered only the material that had been presented during that semester while the standardized test covered many areas of biology, including some subjects that had not yet been covered in class. These variations show that although a difference was not found on the standardized test the contract group did improve over the control group in specific areas of biology, as measured by the instructor-made test.

The students attitude toward the method of instruction can be extremely important in terms of obtaining involvement in any educational program. The success of any new form of instruction becomes dependent on how well it is received by the participants. Recognizing the need to evaluate how the students felt about contracting as a method of instruction, the "Finch Test On Attitude Toward The Method of Instruction" was used. This test was administered only at the end of the semester because for most of the students this was their first exposure to biology and to contracting. The mean score for the control group was 112 compared to a mean of 124 for the experimental group. (See Table VI.) This difference was found to show a t value of 1.82 which was significant at the .10 level of significance.

TABLE VI. Comparison of Scores on "Finch Test On Attitude Toward The Method of Instruction"

GROUP	MEAN
Contract	124
Control	112

t TEST COMPARISONS

Test Compared	t Score	Significance Level
Contract & Control Post	1.82	.10

The standard level of significance considered acceptable for most research is usually considered to be the .05 level or better. It should be kept in mind however that the difference shown in this test while failing to meet the .05 level requirement, would only be observed by chance in 10 out of 100 cases. The small sample size used in this investigation along with the fact that a t value of 1.82 was just short of the .05 significance level are factors which lean toward acceptance of the data.

The implication of the attitude testing was that the contract method appears to be superior to traditional methods in terms of development of positive attitudes toward the method of instruction. This investigator observed that the majority of the students who have worked under the contract system were reluctant to return to traditional classroom techniques. It appeared as though the students worked harder under the contract system, but also liked it better because they found it easier to recognize exactly what was expected of them.

The contracting system allowed the student to set his own goals in terms of grades and spelled out exactly what must be done to earn that grade. The presentation of behavioral objectives for each chapter gave the student a list of specific skills and knowledge that

would be covered on the chapter test. This clarification of objectives and grading procedures allowed the student to focus on a well defined target. The results of the contracting technique can be seen clearly in the grades achieved during the semester. (See Table VII.)

TABLE VII. Compilation of Semester Grades

GRADE	N	%
Contract Group		
A	12	40.0
B	13	43.3
C	4	13.3
D	1	3.3
E	0	
Control Group		
A	7	23.2
B	12	40.0
C	10	33.3
D	1	3.3
E	0	

The contract group's grade point average for the class was 3.2 on a 4 point system, while that of the control group was 2.8. This difference in grade point average demonstrated the effect of pre-

senting behavioral objectives to students and allowing them to work toward a grade of their choice.

CHAPTER IV

CONCLUSIONS, OBSERVATIONS AND RECOMMENDATIONS

Educational systems, in order to maintain themselves in our changing society, must also become the products of change. A continual search to find new and improved methods for imparting information and skills must be undertaken by today's educators. The contract system has many practical advantages over traditional approaches in it's very nature. The student is first of all given more freedom to select his own program of studies and is then given the responsibility to carry out his contract largely on his own. This combination of freedom along with responsibility seems to be consistent with the values we are continually trying to develop in our society. In the analysis of the statistical data developed in this investigation, the latent characteristics of the contract system should not be overlooked.

The fact that students are asked to take a more active part in the selection of their activities in a contract resulted in students selecting assignments that they are genuinely interested it. In many cases the students worked on projects individually instead of in groups, as is normally the case in the traditional approach. This individualization of instruction seemed to help develop the students ability to think for themselves. The danger of one dominant student leading the entire group thinking was largely avoided by the individualization process. Another factor that is avoided is the possible dominance of the instructor since the students are largely working

on their own.

The results of the critical thinking test indicated that the contract system was superior to the traditional approach in the development of logical thought processes. This might be explained by the fact that students were more physically and mentally involved in their work in contracting, thus making it less mechanical and more thought provoking. It also could be partially attributed to the large amount of laboratory time available for investigations. The individualization process resulted in students working on problems alone, or in small groups and the task of answering questions and forming conclusions was student centered. This resulted in a stimulation of individual thought processes because the traditional work group was not there to fall back on.

The results of the standardized biology achievement test failed to indicate that significant differences occurred between the contract and control groups. This standardized test covered a wide range of topics from the nature of science, to heredity and change. Some of the subject areas covered on the test had been covered in class, while other areas were not included in the first semester of study. The results of the semester exam might be considered more representative of student achievement since only the subject matter covered in class was tested.

Although the results on achievement were not clear because of the difference between the two test scores, the interpretation of this investigator was that the results favor the contract group approach. This viewpoint can also be supported by the comparison

made between the contract and control group's semester grades. The contract group's dominance over the control group in both semester exam scores and semester grades but not on the standardized test still leaves some question about the effect of contracting on achievement.

Student achievement under the contract method has been a difficult area for researchers to agree on. In studies by Nelson and Brian (1970) and Taylor (1969), the contract method failed to show that the contract method was significantly better than the traditional methods. Other studies such as those by Deall (1969) and Poppen (1971) seemed to favor the contract method. It seems that researchers, in general, have found it difficult to find concrete statistical data to support implications that contracting improves student achievement. The variation in results on student achievement under the contract system requires that future investigators single out this area for intense investigation.

Attitudes toward the method of instruction under the contract system appear to have been positively affected. Even though, the difference between the two groups test scores failed to reach the .05 significance level, the results surely favor the contract group. This investigator believes that with the intensity of the student involvement observed in the contract system, along with the results of the attitude test, that the students attitudes were positively affected.

The contract system tends to involve several advantages, even though these may not have been clearly indicated in the results.

Some of these advantages are as follows:

1. The student tends to know more specifically what is expected of him in achievement.

2. The contract method apparently helps provide for individual differences.

3. The responsibility for becoming educated tends to be shifted to the student.

4. The system offers the student more of a choice.

5. The instructor is better able to clarify his own objectives.

There are also some disadvantages which result in working with the contract system. The greatest problem observed by this investigator was the inability of some students to accept the responsibility required of them in this program. With class time made available to work on their own, it was sometimes difficult for some students to get going on their projects. The human characteristic to procrastinate often left a few students with a lot of work to complete in a short period of time. The grade point averages for the contract group shows that few students actually failed to complete their work.

Considering instructional problems, it was more difficult for the instructor to supply materials necessary for the variety of laboratory investigations going on at the same time. The amount of laboratory preparation was complicated because instead of supplying the solutions and materials for one experiment there were several for which to prepare. It seemed that most of the questions and problems occurred at the beginning of class time, which concentrated the demands on the instructor into a short period of time. This made the

starting of a new contract a rather hectic affair. Some of the other problems associated with contracting are as follows:

1. The amount of preparation required of the instructor is increased.

2. Students that lack initiative might not be able to handle the increased academic freedom.

3. The large number of activities taking place at the same time can make it difficult to help students when they need it.

4. The students have an increased freedom and if they abuse it, discipline problems could develop.

Weighing the problems and advantages of the contract system, this investigator feels the benefits outweigh the disadvantages.

The use of the contract method of instruction in high school offers a new and possibly valuable tool for the instructor. Because this is a relatively new technique of instruction there are still many questions about this procedure which researchers must answer. The effects of contracts with slow learners and in different subject areas are just two of the areas that should be explored. The results of this investigation indicated that the contract system has some definite advantages over the traditional approach and would make a worthwhile addition in the area of science education.

LITERATURE CITED

1. Bickford, Anita, 1963, Cooperative Science Biology Test Form B, Educational Testing Service, Princeton, New Jersey.
2. Deal, Louis, 1969, "Development and Implimentation of A Four-Year, Independent, Individualized, Modular Program, Fund Report," Office of Educational Bureau of Research.
3. Finch, Curtis R., 1969, "An Instrument To Assess Student Attitude Toward Instruction," Journal of Educational Measurement, 6:257-9.
4. Nelson, Dennis E. and Brian, C., 1970, "Effects of Contingency Management An Quasi-Individual Instruction on Academic Performance and Attitudes," American Institute for Research In Behavioral Sciences, Palo Alto, California.
5. Poppen, William A., 1971, "The Effect of Grade Contracts on Student Performance," Journal of Educational Research, 64:420-4.
6. Watson, Goodwin and Glazer, Edward M., 1964, Critical Thinking Appraisal, Harcourt, Brace & World, Inc., New York.

APPENDIX A

Sample Contract Chapter I

Behavioral Objectives

1. When presented with a number of specimens, be able to distinguish between living and non-living things.
2. Have the ability to list five general characteristics of living things.
3. When given a compound microscope, be able to focus on a prepared slide with both the low and high power objectives.
4. Write out at least two examples of how scientific principles have been used to solve a biological problem.
5. Compare the life cycle of the Anopheles mosquito with that of the Plasmodium parasite.
6. Write out the order of events that led to the solution of the malaria mystery.
7. Define the following terms; physiology, biology, morphology, ecology, hypothesis.

Required Work	Point Value
1. Read Chapter I and pass test	30
2. Lab Ex. I-2	10

Optional Work

1. Guide Questions and Problems p. 18 in text.	20
2. Inquiry I-I Lab Text	15

3.	Inquiry I-3 Lab Text	15
4.	Inquiry I-4 Lab Text	15
5.	Build model of electron microscope	20
6.	Problem presented on tape recorder	15
7.	Lab on characteristics of living things. Biol. File	20
8.	Lab. 1-10 Measurement. Biol. File	15
9.	Lab to get acquainted with living things. Biol. File	20
10.	Lab on "Life or Non-Life". Biol. File	15
11.	Lab on the nature of living things Biol. File	15
12.	Oral report on Redi's experiments	10
13.	Oral report on "Malaria" from Scientific American.	15

Circle the optional assignments that you wish to work on and the grade you would like to contract for.

40 - 50 D

50 - 70 C

70 - 85 B

85 -100 A

The chapter test must be passed to receive credit for this contract. A penalty of 15 points will be charged for each additional test necessary to pass it.

Name_____Date_____Hour_____