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A Comparison of Achievement in Biology in an Individualized and Group Approach to BSCS Biology

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In January of 1970 the author completed a study at The University of Iowa. In general the purpose of the study was to compare student outcomes as a result of exposure to an individualized and a group approach to teaching the Biological Sciences Curriculum Study (BSCS) course (7),(8).

During the 1968-69 school year the students used the *BSCS: Molecules to Man* (2) as the basis for group instruction while the students in the individualized approach used an adaptation of *BSCS: Molecules to Man* (6). This approach mainly emphasized the self-pacing aspect of individualized instruction. The same teacher was employed throughout the study.

The areas of student outcomes under consideration were (1) achievement in biology, (2) understanding of science, (3) critical thinking ability, and (4) attitude of the student toward science.

This article is the first in a series of subsequent articles concerned with comparing achievement between the two groups. Future articles will consider other aspects where comparisons were made.

To determine what effect the two approaches to teaching BSCS Biology had on the various student outcomes, testing instruments were given on a

pretest and posttest basis. These tests and their subtests were analyzed by an analysis of covariance which followed the procedure recommended by Lindquist (13). All analysis of covariance results were reported as F-tests. Instruments only given at the end of the year were treated as posttests. These tests were analyzed by an analysis of variance procedure recommended by Lindquist and the results were reported as t-tests. The *BSCS Comprehensive Final Examination* (3) and the *Nelson Biology Test* (16) were the tests given to measure relative rates of achievement of the concepts of biology.

The analysis of covariance results in Table 1 indicates a statistically significant difference between the two groups on the *BSCS Comprehensive Final Examination* (BSCS Final). A significant difference did not exist on the *Nelson Biology Test* (NBT) but, like the BSCS Final, the individualized group had a greater adjusted posttest mean than did the group approach.

Many studies concerned with the effect of an approach to instruction compare a "newer" biology curriculum to a so-called "traditional" course. The three "BSCS Versions" and "BSCS Laboratory Blocks" were compared on the basis of student outcomes. Studies

by Grobman (10), Lisonbee, Lorenzo, and Fullerton (14), Lance (11), and Lewis (12) compared one or another of the three BSCS Versions to a traditional course. Moore (15) went a step farther and controlled the teacher variable by using a superior teacher to teach both BSCS and traditional courses. The results of these studies indicate that BSCS students learn as much traditional biology, as measured by the NBT, as do students in traditional biology and outperform them on the BSCS Final.

Table 1

Analysis of Covariance Results for Achievement in Biology

$H_0: \mu_G - \mu_I = 0$	$\alpha = 0.05$	$n_G = 20$	
$H_1: \mu_G - \mu_I \neq 0$	$F(1,37) = 4.105$	$n_I = 20$	
Instrument	Approach: Group (G) Individualized (I)	Adjusted Posttest Mean	F
BSCS Comprehensive Final Examination	G	24.67	10.00*
	I	30.68	
Nelson Biology Test	G	29.89	3.78
	I	35.11	

*Statistically significant difference.

Gennaro (9) varied the approach to instruction by comparing a "Laboratory Block" approach to a "traditional" approach to teaching BSCS Yellow Version. Other studies by Baumel (1), Coulter (4), Newman (17), Oliver (18), and Taylor (21) used the lecture versus discussion approach to teaching as a means of comparison. In general, there were no definite results to favor one approach over another.

The trend in many of the studies of achievement in biology compare the newer curricula with the traditional course. In both courses the approach

is forced-pacing in a group situation. In general, the results indicated that students in the newer curricula do better on their particular achievement tests than do students in the traditional curricula and the traditional students do better on their particular tests. These results are not surprising if one will consider that the curricula and teacher variables for the most part were not controlled. The various curricula would naturally be oriented toward the tests designed for that course and different teachers may have varying effects on student outcomes.

This study attempted to control these variables. Thus the evaluation of student outcomes between two approaches to teaching BSCS Biology would appear to be more meaningful. The results of this study indicate that students in the individualized class had a greater achievement in biology than did students in the group approach. These results were present on the BSCS Final and the NBT which was not specifically designed for BSCS Biology.

Evidence from studies by Dutton (5), Richard (19), and Steiner (20) reveal that science instruction can be individualized at the elementary, secondary, and college level of education. Because this study and some of the others mentioned previously included students of varying ability, individualized instruction shows promise for students of different levels of ability. Each student is given the opportunity to work at a rate suitable for his level of ability. The student is free from the pressure of group competition and can work in an atmosphere

more conducive to his particular needs. However, if the need for the spirit of competition is present, the opportunity is available. With this in mind, perhaps science teachers should give more consideration to the possibility of individualizing their science classes.

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