

1970

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Recommended Citation

Fulton, Harry F. (1970) "A Consideration of Student Understanding of Science in Two Approaches to BSCS Biology," *Iowa Science Teachers Journal*: Vol. 8: No. 2, Article 11.

Available at: <https://scholarworks.uni.edu/istj/vol8/iss2/11>

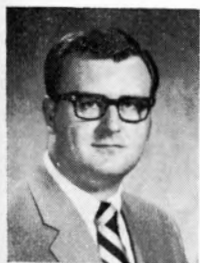
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A Consideration of Student Understanding of Science in Two Approaches to BSCS Biology*

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The understanding of science by students is considered by science educators to be a worthwhile goal in the teaching of science. Attempts have been made to achieve this goal in the various curricula that have been developed, and the Biological Sciences Curriculum Study is one of these curricula.



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Several studies have been attempted to measure the understanding of science as a student outcome in a particular course such as BSCS Biology. In most studies the *Test On Understanding Science* (TOUS) (1) was the most common instrument used.

To determine the effect of the individualized or group approach on student understanding of science two instruments were given on a pretest and posttest basis. They were the *Test On Understanding Science* (TOUS) and the *Facts About Science Test* (FAS) (5).

The results of the analysis of covariance in tables 1 and 2 indicate a statistically significant difference between the two groups in student understanding of science. This difference revealed a greater adjusted posttest score by the students in the individualized class. All TOUS subtests, except for one, and the TOUS total test showed a significantly higher score by the individualized group. The results on the FAS lend support to the TOUS results because both tests are concerned with student understanding of science.

The results of the study indicate that students being taught BSCS Biology by two different approaches varied in their understanding of science as measured by the TOUS and FAS. The trend in these results favored the individualized instruction over the group instruction.

The results of the individualized approach in the understanding of science indicate that students working individually are better able to gain a greater understanding of science. Working individually the students appear to be more active in the process of making observations, collecting data, interpreting data, working with hypotheses, and drawing conclusions. Perhaps this participation gives the student an opportunity to play the role of a scientist and thus better understand science and the scientist.

*This article is the second in a series appearing in the *Iowa Science Teachers' Journal*, (3).

Table 1
Analysis of Covariance Results for the
Test On Understanding Science

$H_0: \mu_G - \mu_I = 0$	$\alpha = 0.05$	$N_G = 20$
$H_1: \mu_G - \mu_I \neq 0$	$F(1,37) = 4.105$	$N_I = 20$

Instruments	Approach: Group (G)	Adjusted Posttest	F
	Individualized (I)	Mean	
TOUS: The Scientific Enterprise	G	8.72	7.782*
	I	10.68	
TOUS: The Scientist	G	8.75	16.275*
	I	11.70	
TOUS: Method and Aim of Science	G	10.03	4.011
	I	11.92	
TOUS: Total	G	26.89	30.193*
	I	34.61	

*Statistically significant difference

Table 2
Analysis of Covariance Results for the
Facts About Science Test

$H_0: \mu_G - \mu_I = 0$	$\alpha = 0.05$	$N_G = 20$
$H_1: \mu_G - \mu_I \neq 0$	$F(1,37) = 4.105$	$N_I = 20$

Instruments	Approach: Group (G)	Adjusted Posttest	F
	Individualized (I)	Mean	
FAS: Understanding Science as an Institution	G	24.83	0.215
	I	25.47	
FAS: Knowledge of Scientists as an Occupational Group	G	22.46	7.020*
	I	26.39	
FAS: Total	G	47.08	5.354*
	I	52.57	

*Statistically significant difference

It seems that in the group situation it is difficult for the teacher to get every student actively involved in the class. In the individualized class the student works more independently with the result that he is more involved and any guidance from the teacher is usually for a specific need and usually requested by the student. Once drawn to the attention of the teacher further investigation can establish other areas that may need attention but it is still student-initiated. Hopefully the student who is more independent and actively involved in the study of science would gain a better understanding of

science. This is not to say that some students do not need more or less guidance. The individualized approach allows the teacher to give more attention to those students who need this guidance yet be available for the needs of the more advanced student should the opportunity arise.

Perhaps for a student to understand science and the scientist he has to have the freedom to act as a scientist searching for answers to problems. To use the tools of science, become involved in the processes of science, develop open-mindedness, and see the role of the human mind in the scientific endeavor perhaps the student needs the freedom of individualized instruction. Of course, this will be attained to different degrees by various students of varying abilities but the individualized approach can provide for these needs. Too often the group approach does not allow the teacher to consider these problems to any great extent because of the restrictions, unintentional or otherwise.

If an understanding of science is a goal of science teaching then it would seem reasonable to propose that educators use the most effective means of attaining that goal in our science classes. The individualized approach would certainly seem to be an effective means to aid students in reaching this goal whether they are in elementary, secondary, or the college level.

These results are consistent with the results of similar studies which attempt to compare the understanding of science in science classes taught by different approaches. Yager and Wick (6), Gennaro (3), and Sorenson (4) conducted studies of this type. Yager and Wick used the BSCS Blue Version and altered teacher emphasis while Gennaro used the BSCS Yellow Version as the basis for a multireference approach. Sorenson used laboratory blocks as the basis to compare laboratory-centered and lecture-demonstration-centered instruction. These studies showed varying results in student understanding of science when students were exposed to different approaches to teaching science.

The results of this study indicate that students in an individualized approach to BSCS Biology achieved a greater understanding of science than did students in the group approach. Thus it seems reasonable to encourage teachers of science to consider the use of individualized instruction in the teaching of science.

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