Effect of Instructional Technique Employing Wert Dialysis Box on Biology Student Achievement

W. G. Wert
Department of Life Sciences
Indiana State University, Terre Haute, Indiana 47809
and

C. E. Kline
Department of Education
Purdue University, Lafayette, Indiana 47907

Abstract

A comparison was made between student achievement in biology classes employing a conventional lecture method as opposed to those using the Wert Dialysis Box and a single concept film of the same device through a demonstration-discussion method. An experiment was conducted with 120 junior high school students using 3 control and 3 experimental ability groups. Pre and post-achievement tests which included six concepts and dialysis terminology were administered to each group.

Learning and retention were significantly improved in students of average ability by the demonstration-discussion method in conjunction with the Wert Dialysis Box and the use of the concept film. In all other instances improvement was noted but it was not of significance.

Introduction

It was hypothesized that biology students would achieve more by the demonstration-discussion method in conjunction with the use of a single concept movie and using the Wert Dialysis Box, than by the conventional lecture method alone. An experiment was conducted regarding the effectiveness of biology teaching by these two methods of instruction. In each instance, two comparable groups of classes were taught the principles of intercellular movement. The control groups were taught by lecture of the conventional classroom technique. The experimental groups were instructed via demonstration-discussion by using the Wert Dialysis diffusion box and a single concept movie, both of which were developed by one of the writers (3). The participating students were enrolled in six junior high school biology classes. Groups I and II (both BSCS biology classes composed of high ability-grouped students) were designated as control and experimental groups, respectively. Groups III and IV were average ability biology classes from the same school. Determination of ability was made by participating schools on the basis of past student achievement; only Groups I and II used BSCS material. Groups V and VI were from another school in which the classes were heterogeneously grouped.

Methodology

The Wert Dialysis Box used with the experimental groups is a glass-lined box 1.75 inches wide by 7.5 inches long by 3.25 inches high. The box holds five inflated dialysis bags in a series which simulate cells of a plant or an animal body. The bags are filled with various diffusable substances to show diffusion (Fig. 1). The first

dialysis bag was filled with a 0.25 N solution of ammonium hydroxide; the three middle bags contained anthocyanin extracted from purple cabbage; the fifth dialysis bag held a 0.25 N concentration of hydrochloric acid.

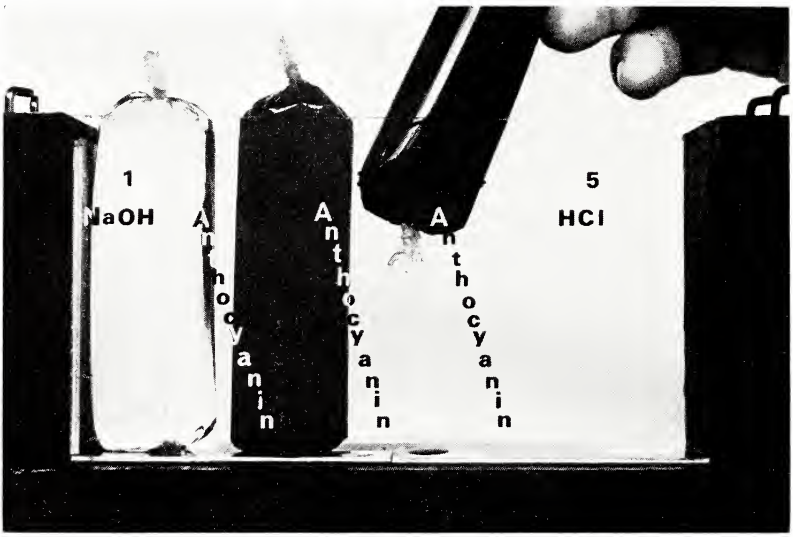

FIGURE 1. *Preparing the Wert Dialysis Box for demonstration.*

A single concept, time-lapse, 8 mm color movie, "Simulated Movement in Cells" enabled the students to see in 90 seconds the action which takes place in 2 hours in the Wert Dialysis Box.

A short test consisting of 12 questions was constructed and given as a pre-test and post-test to obtain information from each class. Each group was allowed 10 minutes to finish the test. The test was given in each class as a pre-test, followed by approximately 20 minutes of instruction after which the test was administered as a post-test. The test was designed to measure the understanding of concepts and terms concerning the principle of diffusion between plant or animal cells. The questions were developed to examine six interrelated concepts.

The materials and concepts covered in the control and the experimental classes were the same with the exception that the Wert Dialysis Box and the accompanying 8mm concept film were used in the experimental classes. One individual presented all the lessons.

The demonstration dialysis-diffusion box was started at the beginning of each teaching presentation in the experimental classes. No specific reference was made to it during the class except as referred by the students and the teacher in conjunction with other points of discussion. Immediately after a brief discussion of the concept film, the post-test was given.

The students' papers were checked and tallied at the conclusion of each session. Tables were developed to compare percentage of improvement of post-test over pre-test for each group. The results were checked for significance using the log likelihood method (2).

Results and Discussion

Group I and Group II were both BSCS biology classes. Group I was the control group and Group II was the experimental group. The control and experimental groups showed an improvement of nearly 17%, and 18%, respectively. The results are found in Table 1. The group improvement by percentage was obtained by taking the number of students in each group and multiplying by the points possible, then dividing this figure into the total points obtained on each pre-test and post-test and multiplying by 100. The amount achieved by control Group I was 47.6% on the pre-test and 64.1% on the post-test, making a difference of 16.5% (Table 1). The results for experimental Group II were found to be 17.7% (Table 1). A gain of 1.2% was the difference between 17.7% and 16.5%. The G-statistic, using the log likelihood method regarding control versus experimental group, was 0.02 which was not significant (Table 2). The null hypothesis that the BSCS experimental class would show the greatest improvement of all the groups was rejected.

TABLE 1. *Comparison of pre-test and post-test performance of three sets of control* versus *experimental groups.*

Test Group	Percentage Score		
	Pre-test	Post-test	Change
BSCS Classes			
Control	47.6	64.1	16.5
Experimental	51.8	69.5	17.7
Average Ability Classes			
Control	44.6	51.8	7.2
Experimental	48.4	63.8	15.4
Heterogeneous Classes			
Control	45.7	55.8	10.1
Experimental	46.6	51.4	4.8

TABLE 2. *Log likelihood ratio test. (Two degrees of freedom in each test).*

Test	G-Statistic
School "A" Junior High School (BSCS classes)	0.02 n.s.
School "A" Junior High School (Average ability classes)	7.406*
School "B" Junior High School (Heterogeneous classes)	2.88 n.s.

* Significant at 5% level; n.s., Non Significant.

The results of Groups III and IV are shown in Table 1. Group III (control) showed a gain of 7.2%, post-test over pre-test. Similarly, Group IV (experimental) showed a gain of 15.4% (Table 1). The log likelihood G-statistic was 7.406, which indicated significantly better (5% level) performance by the experimental group (Table 2). The improvement shown by Group IV was attributed to the improved learning techniques.

The null hypothesis that the average ability class experimental group would exceed the average ability control group was not rejected.

An operational hypothesis that the heterogeneously-grouped experimental class (Group VI) would show significant gain was rejected. The experimental class (Group VI) improved only 4.8% in the post-test over the pre-test while the control class (Group V) showed an improvement of 10.1% (Table 1). Using the log likelihood method, control group versus the experimental group, the G-statistic was 2.88 and not significant (Table 2).

Conclusions

1) The biology classes composed of average ability students achieved more through the demonstration-discussion method in conjunction with the use of the Wert Dialysis Box and a prepared single concept movie than by the conventional lecture method.

2) No significant gain in achievement was found in the BSCS classes or in the heterogeneously grouped classes when the two instructional approaches were compared.

3) An atmosphere of inquiry was created in the experimental groups involved in the demonstration-discussion method which appeared to focus student attention on the concept being presented. In addition, the instructional utility of the practical technique of coordinated media—the Wert Dialysis Box and the single concept film—was demonstrated. The results of this experiment support De Cecco's statement "That increasing amounts of both audial and visual information do not lead to greater learning." (1).

Literature Cited

1. DeCecco, John P. 1968. The psychology of learning and instruction: Educational psychology. Prentice-Hall, Inc., Englewood Cliffs, New Jersey. 800 p.

2. Sokal, Robert R., and Rohlf, James. 1969. Biometry. W. H. Freeman and Co., San Francisco, Cal. 776 p.

3. Wert, William G. 1969. Simulated movement in cells. Amer. Biol. Teacher 31:372-378.