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Introduction

American education has been in a constant state of change during the last half-century. Some of the changes in science education are being questioned by the critics. Some of the criticism has come about because of the emphasis on subject matter content and very little emphasis, if any at all, on values.

Science education must be part of the movement to a more humanistic education for young people. One method that teachers can use to help determine the direction of science education is to try and teach for and measure the affective behavior of their students.

This paper is a brief summary of a study that was conducted to answer the following question: How does the affective behavior of high school science students differ and change during a semester as measured with an affective domain instrument?

Sample

The sample for the study included eight science classes consisting of the following: (1) 45 ninth grade Introductory Physical Science (IPS) students; (2) 46 tenth grade biology students; (3) 47 eleventh and twelfth grade chemistry students, and (4) 52 eleventh and twelfth grade physics students.

Procedure

The *Affective Domain Measuring Scale (ADMS)* instrument was used to gather the data from the 190 students in the sample. The test is designed so that one form may be used for pre-test activities and the other form for post-test activities. Both forms could also be used together. The whole test and both forms have median scores of 5.8. Student scores of 5.8 or greater represent positive affective feelings toward science and less than 5.8 negative affective feelings.[1]

The data was collected in pre- and post-test settings. It was then analyzed by calculating mean scores and applying the correlated "t"-test for a significance evaluation.

Results

The ADMS mean scores and significance levels are summarized in Table 1.

Table 1

ADMS MEAN SCORES and SIGNIFICANCE LEVELS

Group		Number of Students	Mean	Significance Level
Eight Science Classes				
	Pre	185	6.98	.001
	Post	185	6.40	
MALES				
	Pre	129	7.23	.001
	Post	129	6.68	
FEMALES				
	Pre	56	6.39	.02
	Post	56	5.77	
IPS				
	Pre	43	6.31	.01
	Post	43	5.34	
Biology				
	Pre	46	5.86	NSD
	Post	46	5.64	
Chemistry				
	Pre	44	7.70	.01
	Post	44	6.95	
Physics				
	Pre	52	7.93	NSD
	Post	52	7.67	
Females	Pre	57	6.39	.02
Males	Pre	132	7.18	
Females	Post	56	5.77	.02
Males	Post	129	6.68	

The comparison between the mean scores of the students from the pre- and post-test revealed a "t"-ratio of 4.54 which indicates significance between the two means at the .001 level. The comparisons between the mean scores of the males and the mean scores of the females on the pre- and post-tests gave significance of .001 and .02 respectively. It is interesting to note that the males' mean scores were still significantly higher than the females on both pre-tests and post-tests.

Mean scores from pre- and post-test data for the four disciplines were compared. The mean scores from students in IPS and Chemistry gave significant changes at the .01 level. The mean scores from pre- and post-test settings of the physics and biology students were slightly different, with the biology students experiencing the smaller change.

A comparison of the mean scores of the female students and the male students for the pre- and post-test exercises gave "t"-ratios of 2.36 and 2.43 respectively. Both t's indicated the difference between the means to be significant at the .02 level.

Comparisons of the mean scores of the students in the various science classes were made using the pre-test data. The "t"-ratio was significant at the .001 level for physics to biology, physics to IPS, and chemistry to biology comparisons. The "t"-ratio was significant at the .01 level for chemistry to IPS comparison. The physics to chemistry and biology to IPS comparisons were not significantly different.

Comparisons of the mean scores of the students in the various science classes were made using the post-test data. The "t"-ratio was significant at the .001 level for physics to biology and physics to IPS comparisons. The "t"-ratio was significant at the .05 level for physics to chemistry and chemistry to biology comparisons. The biology to IPS comparison was not significantly different.

A total of 21 comparisons were made. Sixteen comparisons were significant at the .05 level or beyond with five comparisons not statistically significant. Table 2 summarizes the 21 comparisons.

The physics students indicated the most favorable affective behavior of all students. Their mean scores on both pre- and post-test settings were the highest. Student scores from chemistry, biology and IPS followed hierarchically. The hierarchical placement of these scores is what might be expected.

Table 2

SUMMARIZATION OF 21 COMPARISONS

Twenty-one ADMS Score Comparisons	Significance Level
1. Science students pre- to post-test	.001
2. Male students pre- to post-test	.001
3. Female students pre- to post-test	.02
4. IPS students pre- to post-test	.01
5. Biology students pre- to post-test	NSD
6. Chemistry students pre- to post-test	.01
7. Physics students pre- to post-test	NSD
8. Males to Females — pre-test	.02
9. Males to Females — post-test	.02
10. Physics to Chemistry — pre-test	NSD
11. Physics to Biology — pre-test	.001
12. Physics to IPS — pre-test	.001
13. Chemistry to Biology — pre-test	.001
14. Chemistry to IPS — pre-test	.01
15. Biology to IPS — pre-test	NSD
16. Physics to Chemistry — post-test	.05
17. Physics to Biology — post-test	.001
18. Physics to IPS — post-test	.001
19. Chemistry to Biology — post-test	.05
20. Chemistry to IPS — post-test	.01
21. Biology to IPS — post-test	NSD

The mean scores of the students within the science classes were less on the post-test than on the pre-test. Table 3 summarizes these findings.

Table 3

MEAN SCORES OF SCIENCE STUDENTS ON THE *ADMS*

Groups	Pre-test Means	Post-test Means	Difference
Physics	7.93	7.67	−.26
Chemistry	7.55	6.95	−.60
Biology	5.86	5.64	−.22
IPS	6.27	5.34	−.93

This is an unfortunate finding, because it suggests that the teachers are sending the students away from class with a more unfavorable behavior toward science than they had when they entered. This contradicts what Mager[2] encourages science teachers to do. He suggests that students should leave a class feeling at least as good about the subject as they did when they entered.

The reasons for the lower mean scores are complex. Teaching methods and techniques, administration of the post-test (one week before finals), the specific content material in certain courses (example — in IPS the topic was atomic structure with very little hands-on activity), and the rate of teaching content material (teachers rushing to *cover* all the material) are all contributing factors causing lower post-test scores. It should be pointed out that the physics and chemistry students were still quite positive in their affective behaviors with the biology and IPS students .16 and .46 on the unfavorable side of the 5.8 median score (the range of the instrument is from 1.2 to 9.9) respectively.

Summary

The ADMS was used as the measuring instrument on the eight selected science classes in the sample. Comparisons were made between: (1) the mean scores of the 56 female and the 129 male students; and (2) the mean scores of the 52 physics students, 47 chemistry students, 46 biology students, and 45 IPS students. A total of 21 comparisons were checked. Sixteen of the 21 comparisons were significant beyond the .05 level.

The affective behaviors of high school students toward science are affected by a host of factors. None of the factors contributing to the students' affective behaviors were assessed in this study. This study was conducted to determine if affective behaviors of high school students' changed during a semester and the results indicated that the affective behaviors did indeed change.

The measurement of the affective behavior of high school science students should become a component of instruction that all teachers use.

The results of affective measurements should be used to help direct and design science curriculum as well as to help improve classroom instruction.

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Epidemic

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Approximately 100,000 teenage girls in the United States become pregnant each year. Teenage childbearing in the United States rates among the world's highest. More than half of the teenagers in the United States are sexually active. Ten percent of all 13-year old girls, and over 51 percent of the 19-year olds are impregnated each year.

Only six states require sex education and only 29 states have health education (not sex education). Hundreds of localities forbid sex education and/or birth control education. Six of 10 schools with sex education programs exclude birth control information. A problem of this magnitude is too large to ignore. Solutions to the problem, such as sex education (including birth control), are controversial. The fact remains that over half of our teenage population is experiencing sexual activity regardless of what adults think about the propriety of the subject in the classroom. It would seem that sex education including birth control would alleviate many of the social and personal problems created by teenage pregnancies which have reached epidemic proportions.

Reference

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