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ABSTRACT

This study was an attempt to relate attitude, critical operation, terminal achievement and residual performance to the use of behavioral objectives while teaching a Basic Science I class. The vocational students who were the subjects of this study exhibited similar characteristics, having IQ's ranging from below 70 to 105 and reading levels from second to ninth grades. Treatment for the experimental group differed only in one respect. During the lecture that initiated each daily module, each student in this group was given a copy of the behavioral objectives to be used as a study guide. A student was to consider his efforts in completing the module successful when he was capable of doing all the tasks specified by the objectives. Following the completion of eight modules, a two-day test requiring manipulative demonstrations of the skills taught was given. Analysis of variance was used to determine significant differences between treatments and among ability groups. Prior knowledge of behavioral objectives produced significantly better performance by all in terminal achievement, critical operations, residual achievement and attitude toward instruction. The Iowa Test of Educational Development ability levels affected performance. Significant F ratios showed positive attitude gains for the experimental population. (Author/EB)

The Use of Behavioral Objectives by Basic Vocational Science Students

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INTRODUCTION

In the priorities of educational research, the problems of designing proper objectives has received considerable attention in recent years. As a controversial issue in the array of innovations in this area, the use of behavioral objectives has been exposed to both educational acclaim and denunciation.

The behavioral approach to instructional objectives has gained a great deal of support from educators at all levels. It is philosophically in accord with other contemporary innovations such as individualization, inductive methodology and the multi-media approaches. In addition, it is a procedure that many educators intuitively recognize as beneficial.

Although the use of behavioral objectives has been advocated by many educators since the appearance of Bloom's Taxonomy[1], sound philosophical and psychological agruments exist to discourage their popularity. Proponents of this cautionary approach state that behavioral objectives are dehumanizing, difficult to formulate, and trivial in their scope. They claim that objectives of this form obstruct creativity and fail to deal adequately with a synergistic learning process. Finally, they argue that the failure of learning theorists to fully explain the learning process should prohibit behavioralization of any educational goals.

The opposing school of thought argues that so long as objectives are carefully chosen the creativity of the classroom will not be stifled. The use of objectives from the higher taxonomic levels will prevent a fixation with factual knowledge. The specification of behavioral outcomes will permit a constant vigilance for questionable peda-

gogic methodology and emphasis. Thus society can more easily define the outcomes deemed appropriate and evaluate the resulting student products. Popham[2] feels that this will precipitate an era of public awareness and teacher accountability that will create an overall benefit to education.

Behavioral Objectives and the Three Phases of Education

The opposing viewpoints seem to be concerned with the validity of the use of behavioral objectives in the first and third phases of the educational process which are curriculum organization and evaluation. Intuitive arguments on both sides concern the advisibility of employing behavioral objectives in the curriculum phase.

In this phase, objectives are of primary value to the instructor in that the process of organization concerns structuring content material to fit the needs of the student. The preparation of all instructional strategies falls into this phase. Evaluation, the third phase of instruction holds promise as an area in which behavioral objectives also present possible usage. The application of behavioral goals to student performance can enable the teacher to readily define the degree of progress made by an individual pupil as well as identify areas of difficulty.

Statement of the Problem

In the pursuit of answers to the questions surrounding the use of behavioral objectives in the implementation phase, the following hypothesis was established.

> The student's use of behaviorally stated objectives can facilitate the learning process in a basic science course for vocational students at the high school level when compared to students that do not use these objectives.

To ascertain the manner in which the students would benefit from

exposure to behavioral objectives, four sub hypothesis were formulated as follows:

1. Prior knowledge and use of behaviorally stated objectives will increase student achievement on a terminal test that measures student performance of tasks specified by the objectives.

2. The use of behaviorally stated objectives will facilitate the completion of critical operations designed to enable the student to accomplish the objectives. These critical operations will be identified from the daily modular worksheets.

3. Students who use behaviorally stated objectives will develop a better attitued toward instructional methodology and learning techniques than students who are not exposed to statements of behavioral objectives.

4. Students who learn through behavioral objectives will retain information over an extended period of time better than students who do not have access to behavioral objectives.

Related Research

Previous studies by Hershman[3] and Bryant[4] indicate the possibility of achievement gains in slow learners and students of low motivation by a process of implementation in science designed around behavioral objectives. The vocational students who were the subjects of this study exhibited similar characteristics having IQ's ranging from below 70 to 105 and reading levels from second to ninth grade.

Neither Hershman nor Bryant obtained significant results, but both concluded that significance could have been masked by other operational variables. The present study differs from their previous research in the attempt to relate attitude, critical operation, terminal achievement

and residual performance to the use of behavioral objectives by vocational students.

Olsen[5], in studying the effect of behavioral objectives on retention and class performance, suggests that providing the student with objectives can enhance performance on achievement tests. His findings further assert that retention is increased in high, middle and low ability groups by students using behavioral objectives.

Doty[6] noted that prior knowledge of objectives tended to induce higher performance in industrial arts while practice at achieving goals showed a negligible effect.

In comparing singular presentation, daily presentation and no presentation of behavioral objectives, Ferre[7] found the most significant gains in mathematics achievement were related to daily exposure to the objectives. Ferre'e attempt to relate improvement in attitude by Balls' Mathematics Attitude Scale resulted in no statistically significant developments. In addition, no positive correlation was found to exist between achievement and attitude.

Herron[8], subjecting three ability groups to behavioral objectives prior to instructor-made college chemistry tests, indicated that low ability members of the experimental group did better on all three exams than control students of comparable ability who used no behavioral objectives. However, in only one case was the differences significant: the middle ability experimental group outperformed the control group on the second examination. Herron was quick to point out that this one but modest significant result may have been due to several key uncontrolled variables or to chance alone.

Rowan[9] found that in presenting behavioral objectives to an exper-

imental group and then reversing the pattern so that the initial control group had the objectives during the second phase of the study, performance was not significantly affected. However in surveying the population for preference of method following the study, Rowan found that the experimental treatment of instruction preceded by behavioral objectives was significantly favored over the control treatment.

Patton[10] found that presentation of behavioral objectives did not significantly alter achievement in a college educational psychology class when compared with a class having no objectives. However, Patton noted that student attitudes were more positive toward the prior exposure to behavioral objectives and concluded that the benefit from such practice may lie in the affective rather than the cognitive domain.

Weinberg[11] reached similar conclusions in a study involving bowling students. While not significantly altering their performance, the students preferred statements of behavioral objectives prior to instruction for their guidance function. Perhaps the failure of objectives to stimulate achievement gains in this case can be explained in the light of the intensely motor skill oriented activity under study.

Holtz[12] noted higher mean scores on 4 college genetics examinations for a group of students involved in independent study based upon behavioral objectives. Holtz used small groups in this comparison and pretest results indicated that superior ability may alone be responsible for better performance of the independent study groups. But with a mean average of 13 per cent higher an all examinations, Holtz maintained that good students can be quite successful in an independent study situation based upon behavioral objectives.

Procedure

In order to develop decisive emperical demonstration of the validity of the sub hypotheses the population of 146 vocational students was divided into experimental and control groups. While the experimental group was occupied with shop work for the first two weeks of the study, the control group was given instructional treatment. While the experimental group attended classes, the control group was involved in shop work using the facilities at the Williamsport Area Community College.

Because the two groups were at different institutions throughout the treatment, in-school contact between them was virtually non-existent. Both experimental and control groups consisted of three heterogeneously grouped sections of 94 per cent male senior and junior students of the Williamsport Area High School vocational department.

Ability Grouping the Population

Iowa Test of Educational Development (ITED) percentile scores for math and science were combined and the mean for each student was computed. These mean scores ranged from 2 to 59.5 in both the experimental and control group. The criteria used to stratify the populations functioned to identify the separate ability groups within the experimental and control. The mean of these combined scores was 27.83 for the control group and 28.81 for the experimental. A t value of .4302 revealed no significant difference ($p > .05$) in the abilities of the samples prior to treatment as measured by the ITED scores.

On the basis of these mean ITED scores, the students in both the experimental and control groups were separately divided into three ability groups. The ranges for each ability group within both experimental and control were the same. The low ability mean scores ranged

from 2 to 19 and contained twenty six control and the same number of experimental subjects. The two middle groups ranged from 20 to 38 and contained thirty control and twenty experimental students. Twenty control and twenty four experimental subjects composed the high ability groups with mean scores ranging from 40 to 59.5.

Experimental and Control Treatments

Both experimental and control groups met daily for Basic Science I class during the three afternoon periods from March 5 until March 30 1973. The researcher was the class teacher for these students.

Treatment for the control group consisted of eight instructor developed modules designed to teach critical measuring skills required in using the metric system for linear, liquid and weight measurement. Use of scientific apparatus for measurement was also stressed. The subjects of the eight modules follow:

1. Metric Linear Measurement
2. Metric Area Measurement
3. Metric Volume Measurement
4. Metric Liquid Measurement
5. Measurement by Displacement
6. Metric Weight
7. Metric Weight
8. Centigrade Temperature and Angles

During the class time, the students, working in small groups, practiced each operation. Students were given about five minutes of lecture at the beginning of each class period that consisted of an introduction to the module and specifications of the procedures required to successfully complete it. Each student also received a worksheet for each module, procedures for each operation, space for recording the data from each operation and several questions that required application or understanding of the modular content. These worksheets were collected and analyzed daily.

Treatment for the experimental group differed from that of the control group only in one respect. During the short lecture that initiated each daily module, the experimental group students were given a copy of the behavioral objectives for that module. The subjects were told that the objectives were to be used as a study guide for the module and that a student should consider his efforts in completing the module successful when he was capable of doing all of the tasks specified by the objectives. Readibility tests were applied to the objectives for each module. The objectives were then rewritten to conform to levels of 7.5 or lower. The control received neither objectiver nor placebos.

During the class period of each group, the instructor circulated throughout the room and assisted the students in completing the operations required by each module. The modular worksheet from the previous day was returned to the student and any areas of difficulty were explained. The instructor attempted to respond to all student inquires by avoiding direct answering in favor of inductive questioning that would lead the student to a correct procedure for the modular operation. When this process failed, direct instruction was employed to assist the student toward the correct procedure.

The four sub-hypotheses mentioned earlier were tested by the following procedures:

Terminal Achievement

Following the completion of the eight modules by the experimental and control groups, a two day test was given. The test contained twenty items; ten were administered each day. The test required manipulative demonstration of the measuring skills taught through the eight modules. The test was a laboratory practical using five

item multiple choice responses. The results were computer scored.

The twenty problem settings were placed at various stations throughout the testing room. The students moved in unison from one station to the next. Two minutes were allowed at each station although the time period was extended to accommodate any subject who was still in the process of completing an item. Following the test period, the students were allowed to re-examine any item that posed particular difficulty for them. Items for the test were selected from the modular objectives.

Analysis of variance was used to uncover significant differences between treatments and among ability groups.

Critical Operations

For each of the eight instructional modules, a series of operations that were critical to the successful completion of the modular objectives was identified. As the student completed each module, he submitted the worksheet for analysis. The number of correct worksheet responses were recorded for each critical operation. A total of nineteen critical operations were designated and these included sixty-six total responses on the worksheets. The maximum point value for any critical operation was five, based on the number of correct responses concerning that operation on the worksheet. Since the modular worksheets contained from one to five questions concerning each operation, the highest point value ranged in a similar fashion. Thus, the total number of critical operations score was computed.

These scores were used in an analysis of variance to determine the difference between treatments and among the three ability levels.

Attitude

Following the administration of the terminal testing program, an instructor developed attitude scale was implemented. Ten items were included in the scale and these were designed to measure student satisfaction with the instructional methodology used in the eight modules. Each item contained five choices ranging from an answer expressing complete satisfaction assigned a point value of five to total dissatisfaction valued at one. The subjects responses were added for all ten items. Thus the scores ranged form a completely negative 10 to a totally positive 50. Two way analysis of variance was used to determine differences between the treatments and among levels of ability.

Residual Achievement

To measure the effect of the two treatments on the three ability levels over an extended period of time, the terminal achievement test was again administered. The subjects were unaware of the retesting prior to the administration so no student preparation was expected. The procedures used in the terminal testing program were identical to those employed for the residual test. This retest was given exactly three weeks after the completion of the eight modules. Two way analysis of variance was again used to uncover differences among the treatments and ability levels.

Pearson Product Moment Correlation Coefficeint

Following the application of the two way analysis of variance, Pearson Product Moment Correlation coefficients were obtained from the data to acertain the extent of interrelationship among the four criterion instruments.

Results and Analysis of Findings

Following the procedural pattern outlined previously, the research program was implemented. Data concerning each of the four sub-hypotheses were exposed to the appropriate treatment.

Terminal Achievement

Null hypothesis 1. There is no significant difference in performance on a terminal achievement test among high, middle and low ability groups of students receiving or not receiving statements of behavioral objectives prior to instruction.

The scores from the twenty item achievement test administered following the eight instructional modules were treated with the two way analysis of variance. Means and standard deviations for the results of the terminal achievement test in each ability group are shown in Table 1.

TABLE 1

TERMINAL ACHIEVEMENT TEST DATA SUMMARY

	Experimental			Control		
	High	Middle	Low	High	Middle	Low
Mean	15.5	14.3	12.8	11.7	10.9	10.1
SD	1.4	2.0	2.3	1.9	2.5	3.6

TABLE 2

RESULTS OF THE ANALYSIS OF VARIANCE
FOR THE TERMINAL ACHIEVEMENT TEST

Sources of Variation	df	sum of squares	mean squares	f ratio
Interaction	2	15.758	7.879	1.443
Groups	2	93.706	46.853	8.526*
Treatments	1	355.287	355.287	64.656*

* Indicates significance at the .05 level

The results of the analysis of variance for the terminal achievement test are summarized in Table 2.

The results of the analysis of variance between treatments and among groups indicate that the experimental group significantly outperformed the control on the terminal achievement test. Thus Null hypothesis 1 was rejected.

Critical Operations

Null hypothesis 2. There is no significant difference in performance of a series of critical operations among high, middle and low ability groups of students receiving or not receiving statements of behavioral objectives prior to instruction.

Each subjects' scores from the checklist of critical operations were tabulated. The scores ranged from 37 to 66 out of a total possible point accumulation of 66. Means and standard deviations are summarized in Table 3.

TABLE 3

CRITICAL OPERATIONS CHECKLIST DATA SUMMARY

	Experimental			Control		
	High	Middle	Low	High	Middle	Low
Mean	62.69	62.10	59.69	51.55	51.90	50.07
SD	2.09	5.18	4.13	5.20	5.01	5.56

The results of the analysis of variance for the critical operations checklist are presented in Table 4.

TABLE 4

RESULTS OF THE ANALYSIS OF VARIANCE FOR THE CRITICAL OPERATIONS CHECKLIST

Sources of Variation	df	sum of squares	mean squares	f ratio
Interaction	2	12.420	6.210	0.282
Groups	2	167.201	83.600	3.840*
Treatments	1	3794.424	3794.424	174.290*

* Indicates significance at the .05 level

The results of the analysis of variance between treatments and among groups led to the rejection of the second Null hypothesis in favor of the experimental groups.

Attitude

Null hypothesis 3. There is no significant difference in attitude change among high, middle and low ability groups of students receiving or not receiving behavioral objectives prior to instruction.

The ten item attitude measuring instrument was administered on the second day of achievement testing. Cumulative scores ranged from 10 to 50. Table 5 lists the means and standard deviations of the results.

TABLE 5

ATTITUDE SCALE DATA SUMMARY

	Experimental			Control		
	High	Middle	Low	High	Middle	Low
Mean	40.08	40.08	39.00	36.05	35.16	36.25
SD	5.32	5.66	4.89	5.53	4.98	5.32

The results of the analysis of variance for the attitude scale are summarized in Table 6.

TABLE 6

RESULTS OF THE ANALYSIS OF VARIANCE FOR THE ATTITUDE SCALE

Sources of Variation	df	sum of squares	mean squares	f ratio
Interaction	2	54.594	27.297	0.985
Groups	2	4.263	2.131	0.077
Treatments	1	606.842	606.842	21.919*

* Indicates significance at the .05 level

On the strength of the significant f ratio for the variance between treatments, Null hypothesis 3 was rejected in favor of the experimental group.

Residual Achievement

Null hypothesis 4. There is no significant difference in scores on a residual achievement test administered three weeks after the termination of the instruction among high, middle and low ability students receiving or not receiving statements of behavioral objectives prior to instruction.

Three weeks after the completion of the eighth module, the achievement test was again administered to determine the effect of time on the experimental treatment of the subjects. With twenty possible correct responses, the subjects scores ranged from 6 to 18. Table 7 summarizes the means and standard deviations for the ability groups.

TABLE 7

RESIDUAL ACHIEVEMENT TEST DATA SUMMARY

	Experimental			Control		
	High	Middle	Low	High	Middle	Low
Mean	14.9	13.6	11.7	12.4	12.3	11.1
SD	1.6	2.4	2.4	1.9	2.3	2.7

The results of the analysis of variance for the residual achievement test are summarized in Table 8.

TABLE 8

RESULTS OF ANALYSIS OF VARIANCE FOR THE RESIDUAL ACHIEVEMENT TEST

Sources of Variation	df	sum of squares	mean squares	f ratio
Interaction	2	20.842	10.421	1.938
Groups	2	125.947	62.973	11.562*
Treatments	1	70.932	70.932	13.023*

* Indicates significance at the .05 level

Because of the significant f ratios from the analysis of variance between treatments and among groups, Null hypothesis 4 was rejected at the .05 level in favor of the experimental group .

Pearson Product Moment Correlation

Following the analysis of variance, the data were exposed to a Pearson Product Moment Correlation computation in order to establish the degree of interrelationship within the results. Table 9 presents the coefficients resulting from the treatment. As with the analysis of variance, the .05 level was established as the level for acceptance of significance.

TABLE 9

PEARSON PRODUCT MOMENT CORRELATION COEFFICIENTS

	Terminal Achiev.	Attitude	Crit. Op.
Attitude	.6162*		
Critical Oper.	.6847*	.6048*	
Residual Achiev.	.5940*	.4471*	.5358*

* Indicates significance at the .05 level

A significant correlation existed between all four criterion instruments. The highest overall correlation existed between terminal achievement and the other three variables.

Treatment of Significant f Ratios

Following the analysis of variance, the results of each criterion instruments were examined with t tests to ascertain if the groups performed as stratified. Table 10 shows the results of these tests.

TABLE 10

t RESULTS AMONG ABILITY LEVELS FOR TREATMENTS

	High	Middle
Terminal Achievement		
Middle	4.561*	
Low	48.950*	2.572*
Attitude		
Middle	1.055	
Low	.855	1.729
Critical Operations		
Middle	1.684	
Low	3.139*	1.205
Residual Achievement		
Middle	2.126*	
Low	5.271*	2.934*

* Indicates significance at the .05 level

As with the analysis of variance, the .05 level was chosen for establishment of significance of the t values. The results presented in Table 10 indicate that the groups performed as separate populations as stratified in both the terminal and residual achievement tests where all three t values were significant at the .05 level. The operations index yielded significant t values only on the test between the high and low ability groups. Positive but not significant t values were developed for all three t tests in the attitude scale.

The criteria used to identify the three ability levels within the experimental and control was the mean score on the ITED math and science test. Since this is a performance related instrument, one would expect the performance criteria in this research to parallel the stratification as the significant t values indicate.

Conclusions and Recommendations

Summary of the Findings

After the statistical treatment of the data and analysis of the findings, the following conclusions were warranted.

Prior knowledge of behavioral objectives produced significantly better performance by all three levels in terminal achievement, critical operations, residual achievement and attitude toward instruction.

ITED ability levels affected performance on terminal achievement, residual achievement, and critical operations. These differences were significant between high, middle and low groups for both terminal and residual achievement while critical operations were significantly different between high and low groups.

The Pearson Product Moment Correlation coefficient demonstrated a significant correlation between scores on the four instruments.

Discussion

The results of this study are compatible with the research findings of the proponents of behavioral objectives. Findings by Olsen[5], Doty[6], and Herron[8] are supported by the performance gains reported herein for terminal and residual achievement. The results for the critical operations phase also support performance related benefits from prior knowledge of behavioral objectives.

Significant f ratios showing positive attitude gains for the experimental population disagree with those who caution that implementation of behavioral objectives is dehumanizing.

The positive correlation between attitude and achievement obtained in this study contradicts the statement by Ferre[7] who found no interrelationship between the two.

Conclusions

The strength of the results in all four sub hypothesis categories indicate that a program of instructional implementation based upon student use of behavioral objectives can be a successful technique for teaching metric measuring skills necessary in the secondary science program. In all phases of the research, the experimental treatment was significantly favored over the control and the four null hypothesis were rejected.

The results indicate that the classroom teacher can facilitate the performance gains of his students through the use of behavioral objectives. Attitude as well can be enhanced through this procedure.

Recommendations

Analysis of the data accumulated for this research and, to a lesser extent, observation of student behavior during this study elicited the

following recommendations for further examination.

The small group learning emphasizing student participation in practice sessions seemed well suited to the use of behavioral objectives by pupils. It is questionable whether the experimental treatment would be equally successful when methods such as the traditional lecture demonstration or newer open classroom techniques are employed.

Secondly, the attitude scale was, of necessity, a generalized survey of student reaction to the instructional technique. A more specific survey of student attitude toward selected pedagogic practices, as well as science in general, would assist teachers in pin pointing areas in which behavioral objectives can be most useful.

Because the experimental population consisted chiefly of students who have traditionally been regerred to as "slow learners", the results of this study should be examined in the light of students whose ability lies at the opposite end of the intelligence spectrum. It is entirely feasible that the experimental treatment applied herein would produce different results in populations of higher ability students.

The nature of the eight modules used in this study lend themselves well to a series of practice sessions that eventually result in the acquisition of a measuring skill. Future research could explore the use of behavioral objectives in subject areas that do not lend themselves to repeated practice.

Throughout the study, the researcher noted that in the experimental group, students used the statements of behavioral objectives to assist one another in the completion of the module requirements. Although noted in the control group, these experimental group "student teacher" sessions were more frequent and better organized. Certainly this socializing

effect should be explored in more detail.

Finally the results indicate that the role of behavioral objectives in improving classroom attitude and performance merits additional investigation.

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