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ABSTRACT

A study was undertaken to determine (1) if six student teachers who received instruction (in eight weekly individual or group training and feedback sessions) in the use of Bloom's taxonomy would operate within the classroom at a higher cognitive level than a control group of six who received equal time instruction using a placebo-type treatment; (2) if two groups of trainer observers (administrators who were experienced in the taxonomy and cooperating teachers who were introduced to the taxonomy in much the same manner as their student teachers) could agree between and within themselves as to the cognitive level of questioning occurring within the classroom during the teacher-pupil dialogue as measured on the Teacher-Pupil Question Inventory (TPQI); and (3) if there were a difference in the percentage of above-memory questions asked by teachers who had training in the use of the taxonomy and those who had no training. Each student teacher made a weekly tape recording of a social studies lesson; tapes of the third, fifth, and seventh weeks were rated by both groups of observers. Analysis of the data, using chi square and analyses of variance, showed a significant difference favoring the experimental group of student teachers, and test results found no significant difference in the rating scores of the observers. (Conclusions and recommendations are included. Appendixes contain the TPQI and a summary of the taxonomy, as modified by Sanders in 1966.) (JS)

INCREASING THE COGNITIVE LEVEL OF CLASSROOM QUESTIONS IN SOCIAL STUDIES: AN APPLICATION OF BLOOM'S TAXONOMY

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An increasing body of evidence suggests that the majority of classroom questions, whether oral or written, are limited to those that require little more than a memorized response (Clegg, 1968). Despite the high level objectives often found in social studies curricula, students are seldom asked to apply, analyze, synthesize, or evaluate the body of facts, concepts or generalizations they study. Since classroom questioning is an integral part of cognitive classroom behavior, it is essential that methods be found that will enable teachers to raise the cognitive level of their questions.

Related Research

In the literature reviewed by Farley (1968) a number of studies were cited which dealt with various aspects of questioning: teacher's oral questions in the primary grades (Floyd, 1960); in secondary school social studies classes (Davis and Tinsley, 1967), in textbooks (Davis and Hunkins, 1966); and in questions relating to Guilford's model of cognitive processes (Gallagher, 1965). Each of these studies pointed clearly to the predominence of teacher questions at what Bloom (1956) has called the knowledge level. Operationally defined, such questions require students to recall a response from memory. In a series of studies Hunkins (1967, 1968, 1969) has shown the differential effect upon learning of questions specifically prepared at the analysis and evaluation elvels of Bloom's taxonomy.

The present study took a different approach from those reported above. The investigators sought to determine if there would be an increase in the cognitive level of teacher's classroom questions when training was provided in the use of Bloom's taxonomy. By making teachers aware of the different cognitive levels, it was hypothesized that there would be an increase in the frequency and percentage of higher level questions asked by teachers. This study makes use of a scoring instrument known as the Teacher Pupil Question Inventory (TPQI) developed by Davis and Tinsley (1967), and certain procedures for the taining of teachers and observers in the use of the taxonomy which were developed in an earlier study by Clegg, Farley and Curran (1967). As on the Davis-Tinsley study, a modified version of Bloom's taxonomy was used (Sanders, 1966). Operational definitions and examples of each category are given in Appendix A.

The present study differs from those mentioned above in two respects: (1) The scores of the experimental group were compared with those of a control group, and (2) a placebo-type treatment was used with the control group to lessen the possible influence of a Hawthorn effect since the treatment variable was being used with only one group and there was a possibility of interaction among subjects outside the experimental situation.

Objectives

This study was undertaken to determine if:

1) Student-teachers who had received instruction in the use of Bloom's taxonomy would operate within the classroom at a higher cognitive level than student-teachers who had not received instruction in the taxonomy.

2) Two groups of trained observers (a group of raters, and a group of experienced classroom teachers) could agree between and within themselves as to the cognitive level of questioning occurring within the classroom during the teacher-pupil dialogue as measured on the Teacher-Pupil Question Inventory (TPQI).

3) There were a difference in the percentage above-memory questions asked by a group of student teachers that had had training in the use of Bloom's taxonomy and two other groups: (a) a comparable group that had had no such training, and (b) the group reported previously by Davis and Tinsley (1967) which also had had no training in the use of the taxonomy.

Setting

This study was conducted in two randomly selected communities in Western Massachusetts during an eight week student-teaching period in 1967-68. It involved twelve student teachers from the University of Massachusetts who were assigned to a participating elementary school in one of the two communities, thus making two groups of six student teachers each. The groups were then designated as experimental and control groups. There was no evidence of any systematic bias in the selection or assignment of the student teachers to the groups. It was also determined beforehand that none of the student teachers had been introduced previously to the Bloom taxonomy.

Procedure

During the eight week period, one of the experimenters met with the student teachers once a week at the two schools according to a prearranged schedule for individual or group training and feedback sessions.

The schedule for the experimental group varied slightly from that of the control group since only the experimental group was to have knowledge of the taxonomy. Instead of discussing the taxonomy with the control group, equal time was devoted to discussing the Flanders system of interaction analysis, which was used as the placebo-type treatment.

Each student-teacher in the experimental and the control group was requested to make a weekly tape recording of a social studies lesson. Only the tapes of the third, fifth, and seventh weeks were used for evaluation

purposes relating to this experiment, although all the tapes were used by the experimenter in the feedback sessions mentioned above.

The experimenter also met each week with the experienced teachers (called co-operating teachers) to whom the student-teachers of the experimental group had been assigned. The co-operating teachers were introduced to the taxonomy in much the same manner as were the student-teachers. On the fourth, sixth, and eighth weeks of the experimental period, the co-operating teachers were asked to rate, by means of the TPQI, a randomly selected portion of each tape made during the previous week. Only tapes from the experimental group were rated by the co-operating teachers.

To avoid the confounding effect of experimenter bias, neither of the two writers of this paper participated in rating any of the tapes. A second group of raters was made up of two public school administrators, called investigators. These investigators were doctoral candidates in an educational research program and had extensive knowledge of the taxonomy and the TPQI. The investigators listened to and rated the same taped segments as the co-operating teachers. The investigators also rated a like number of tapes associated with the control group. In recording the data on the succeeding pages the investigators are listed as R_1-R_2, while the co-operating teachers are listed as R_3-R_8.

As was stated earlier, the measuring instrument was a Teacher Pupil Question Inventory (TPQI). The TPQI is a single sheet which provides space for the rater to record the level of each question and the level of the response (see Appendix B). Twenty scores (ten teacher questions and ten pupil responses) were recorded from each lesson. The sum of these scores was used as a composite achievement score of one student-teacher as determined by one rater.

Another phase of the experiment was to tabulate the frequency at which each level of question was used. Percentage figures were then obtained and were used for testing purposes. Only the investigators' ratings (R_1-R_2) were used in this part of the study.

To determine if the objectives, stated earlier, had been achieved, four null hypotheses were tested. They were:

1) There is no difference in the level of cognitive classroom behavior achieved by a group of student-teachers who have had instruction in the use of the Bloom-Sanders taxonomy, and a group of student-teachers who have had no instruction in the use of the taxonomy.

2) There is no difference between investigators (R_1-R_2) in their rating of student-teachers, using the TPQI as a measuring device.

3) There is no difference among investigators (R_1-R_2) and co-operating teachers (R_3-R_8) in their rating of student-teachers, using the TPQI as a measuring device.

4) There is no difference in the percentage of memory questions asked by a group of student-teachers who have had training in the use of the taxonomy (experimental group) and (1) a group of student-teachers who have had no training in the use of the taxonomy (control group); and (2) a group of student-teachers previously reported in the literature who have had no training in the use of the taxonomy (Davis and Tinsley, 1967).

Design

To test the first two hypotheses, a four factor design with repeated measures was used. The factors included (1) the treatment variable of whether the student-teachers had training in the use of the taxonomy, (2) the student-teacher variable, (3) the rater (investigators) variable, and (4) the trial variable.

To test the third hypothesis, a three factor design with repeated measures was used. The factors included (1) the student-teacher variable, (2) the rater (two investigators and six co-operating teachers) variable, and (3) the trial variable.

The data associated with the factors involved in hypotheses one, two, and three were examined by the analysis of variance method.

A 2 x 2 chi-square table was used to obtain an answer to the fourth hypothesis.

Findings

The data used to test hypotheses one and two are shown in Table 1. This table is made up of the investigators' ratings of both the experimental and control groups. Co-operating teachers' rating do not apply here.

Table 1

Investigators' (R_1 and R_2) Composite Scores for Experimental (T_1) and Control (T_2) Groups Over Three Time Time Periods (C_1-C_3)

T_1

	C_1		C_2		C_3	
	R_1	R_2	R_1	R_2	R_1	R_2
S_1	49	38	42	44	43	42
S_2	40	34	32	36	52	48
S_3	50	42	39	47	50	47
S_4	24	24	40	37	35	37
S_5	50	49	42	51	45	48
S_6	41	45	40	46	46	44

T_2

	C_1		C_2		C_3	
	R_1	R_2	R_1	R_2	R_1	R_2
S_1'	36	41	29	29	32	33
S_2'	32	33	31	38	30	30
S_3'	31	36	36	32	33	38
S_4'	32	23	40	34	33	28
S_5'	37	35	43	33	46	40
S_6'	33	35	37	33	34	28

An analysis of variance test was used to obtain answers pertaining to hypotheses one and two. Results of this test are shown in Table 2.

Table 2

Summary of Analysis of Variance Test
of Mean Scores for Treatments (T)
and Investigators (R)

Source	Sum of Squares	Degrees of Freedom	Mean Squares	Observed F Values	
Treatments	1208.68	1	1208.68	11.88	*
Time Periods	57.03	2	28.51	.78	NS
Raters	10.13	1	10.13	.53	NS
Student Teachers (within treatments)	1017.14	10	101.71		
Treatment x Time	70.86	2	35.43	.96	NS
Treatment x Raters	8.68	1	8.68	.45	NS
Time x Raters	20.58	2	10.29	1.27	NS
Time x Student Teachers (within treatments)	731.11	20	36.56		
Student Teachers x Raters (within treatments)	190.36	10	19.04		
Treatment & Time x Raters	93.86	2	46.93	5.80	NS
Time x Student Teachers x Raters (within treatments)	161.89	20	8.09		

*significant (p .01)

Test results showed significant differences ($p < .01$) between treatments. Therefore, hypothesis one was rejected. It was concluded that student-teachers who have had training in the use of the taxonomy achieved a higher level of cognitive classroom behavior than student-teachers who have had no instruction in the taxonomy.

The results also showed no difference between investigators. Therefore, hypothesis two was accepted. It was concluded that investigators, using the TPQI as a measuring device, agree in their ratings of student-teachers.

The data necessary to test hypothesis three appear in Table 3. The table contains scores relating only to the experimental group. Both the investigators' (R_1-R_2) and co-operating teachers' (R_3-R_8) ratings are included here.

Table 3

Raters' (R_1-R_8) Composite Scores for Experimental Group (T_1) Over Three Time Periods (C_1-C_3)

	S_1			S_2			S_3			S_4			S_5			S_6		
	C_1	C_2	C_3	C_1	C_2	C_3	C_1	C_2	C_3	C_1	C_2	C_3	C_1	C_2	C_3	C_1	C_2	C_3
R_1	49	42	43	40	32	52	50	39	50	24	40	35	50	42	45	41	40	46
R_2	38	44	42	34	36	48	42	47	47	24	37	37	49	51	48	45	46	44
R_3	53	40	41	37	35	36	45	48	50	26	39	41	43	47	41	32	52	34
R_4	39	40	37	38	30	33	43	54	52	26	40	42	49	41	41	33	60	40
R_5	52	53	38	36	30	36	53	60	53	39	41	40	46	46	41	44	50	42
R_6	52	55	35	42	37	40	63	50	56	2 9	46	43	39	64	57	47	62	44
R_7	47	43	38	38	35	48	45	47	55	32	48	46	43	48	51	29	61	41
R_8	52	54	33	45	33	41	54	45	57	27	41	41	46	52	60	41	54	47

Hypothesis three was tested by means of analysis of variance. Results are shown in Table 4.

Table 4

Summary of Analysis of Variance Test of Mean Scores for Raters (R_1-R_8)

Source	Sum of Squares	Degrees of Freedom	Mean Square	Observed F Value	
Time	408.85	2	204.42	.95	NS
Student Teachers	4141.64	5	828.33	15.17	*
Raters	467.44	7	66.78	1.22	NS
Time x Student Teachers	2142.74	10	214.27	5.14	*
Time x Raters	1068.60	14	76.33	1.83	NS
Student Teachers x Raters	1910.80	35	54.59		
Time x Student Teachers x Raters	2915.15	70	41.65		

*Significant (p .01)

The results showed no significant difference among raters. Therefore, hypothesis three was accepted. It was concluded that there is no difference among investigators and co-operating teachers in their ratings of student teachers, using the TPQI as a measuring device.

It is noteworthy to point out that tests relating to student-teachers showed significant differences. Although it was not the intention of this study to prove individual differences among teachers, the statistical design made such a test possible. Of course, the finding was expected.

To obtain answers pertaining to hypothesis four, it was first necessary to devise frequency and percentage charts for both the experimental and control groups. Subsequently, percentages of memory and above-memory questions, asked by each group, were obtained. The frequency and percentage tables appear in Table 5. Only the two investigators (R_1-R_2) rated teachers questions in this phase of the study.

Table 5

Frequency and Percentage of Student-Teachers Questions Arranged by Cognitive Levels as Rated by Investigators (R_1-R_2)

Control Group

Cognitive	S_1'		S_2'		S_3'		S_4'		S_5'		S_6'		Total	
Levels	f	%	f	%	f	%	f	%	f	%	f	%	f	%
1 Memory	18	30	23	38	18	30	25	42	11	18	18	30	113	31
2 Translation	29	48	29	48	30	50	24	40	35	58	35	58	182	51
3 Interpretation	10	17	8	13	10	17	11	18	14	23	7	12	60	17
4 Application	3	5	0	0	2	3	0	0	0	0	0	0	5	1
5 Analysis	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6 Synthesis	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7 Evaluation	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Experimental Group

Cognitive Levels	S_1 f	S_1 %	S_2 f	S_2 %	S_3 f	S_3 %	S_4 f	S_4 %	S_5 f	S_5 %	S_6 f	S_6 %	Total f	Total %
1 Memory	5	8	15	25	9	15	23	38	4	.7	2	3	58	16
2 Translation	29	48	29	48	19	32	26	43	14	23	35	58	152	42
3 Interpretation	25	42	15	25	30	50	11	18	42	70	22	37	145	40
4 Application	0	0	0	0	1	2	0	0	0	0	1	2	2	1
5 Analysis	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6 Synthesis	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7 Evaluation	1	2	1	2	1	2	0	0	0	0	0	0	3	1

Percentages of memory questions and above-memory questions were then used to contrast, by chi-square, the experimental group with (1) the control group; and (2) the Davis-Tinsley group. Figures for the Davis-Tinsley group were 61 per cent memory and 39 per cent above-memory.

Test results related to Hypothesis Four are given in Table 6.

Table 6

Chi-Square Tests Comparing Experimental Group With (1) Control Group And (2) Davis-Tinsley Results

	Memory Level	Above Memory	Chi-Square
Control Group	31	69	6.3 *
Experimental Group	16	84	

	Memory Level	Above Memory	Chi-Square
Davis-Tinsley	61	39	42.6 **
Experimental Group	16	84	

* Significant ($p. < .05$)
** Significant ($p. < .01$)

Since significant differences were found in both the above tests, Hypothesis Four was rejected. Therefore, it was concluded that there was a difference in the percentage of memory questions asked by a group of student-teachers who have had training in the use of the Taxonomy and and two groups of student-teachers who have had no training in the use of the Taxonomy.

Conclusions

A number of conclusions can be drawn from this study. First, instruction in the use of the Taxonomy as a tool for clearly identifying the different levels of intellectual behavior does make difference in the quality (cognitive level) of questions that teachers ask. Second, since the TPQI is simple to use and appears to have high reliability, it may be a useful device for helping teachers to analyze and evaluate their own performance. Third, the close agreement among raters corresponds with earlier findings reported by Clegg et al (1967) and bolsters Clegg's suggestion that the Taxonomy can serve as a common educational language for the improvement of instruction.

Finally, it must be conceded that social study goals which call for higher levels of thinking are not being achieved through the use of questioning. A careful look at the frequency and percentage tables for both groups (Table 5) clearly shows that seldom was a question asked which went beyond the interpretation level. Consequently, the findings reported here provide additional support to those of Gallagher (1965), and Davis and Tinsley (1967), discussed earlier. Together, they challenge the time-honored practice of asking questions as a method of teaching. A corollary to the above is that teachers are not being given proper training in questioning techniques to successfully implement the higher levels of thinking in their classrooms.

Recommendations

The findings reported herein appear to suggest a promising approach toward the improvement of teacher education and pupil achievement. It appears desirable to include study of the Taxonomy in the teacher-training curriculum as a tool for raising the level of classroom learning. This might be done: (1) combining the teaching of the Taxonomy with some approach to the study of cognitive tasks; such as Taba's (1967) schema; or (2) using the Taxonomy with some adaptation of micro-teaching.

The success of the TPQI as a measurement of cognitive behavior suggests that the Taxonomy could be used with other measuring instruments. The Taxonomy might be used to add a cognitive dimension to the OScAR, Medley and Mitzel (1958, 1963), or it might be employed with Flanders' Interaction Analysis to determine the effect of teaching style on cognitive achievement.

In view of the small size of the sample used, this study should be replicated on a larger scale to verify the findings and conclusions presented here. A suggested modification might be to teach the Taxonomy in three phases. Phase one would concentrate on encouraging teachers to ask above-memory questions. Phase two would emphasize convergent thinking questions(applications, and analysis), while phase three would emphasize divergent thinking questions (synthesis, evaluation).

Several other questions might also be tested in subsequent studies. For example: (1) Will the cognitive response level increase if the pupil is taught to become aware of the level of his expected response? (2) Does eliciting longer answers from the pupil tend to raise the cognitive level of the response?

(3) Is there a correlation between the type of teacher (according to the Flanders model) and the cognitive level attained in the classroom (as measured by the Taxonomy)? (4) Do students operate at the same cognitive level in one subject as they do in another?

Summary

This study sought to determine if there would be an increase in the cognitive level of teacher's classroom questions when training was provided in the use of Bloom's taxonomy. By making teachers aware of the different cognitive levels, it was hypothesized that there would be an increase in the frequency and percentage of higher level questions asked by teachers. Two additional questions were asked: (1) Could a group of trained observers agree among themselves as to the cognitive level of the questions asked? (2) Was there a difference in the percentage of "above-memory" questions asked by teachers who had training in the use of the taxonomy and those who had no training.

Analysis of the data showed a significant difference favoring the experimental group of student-teachers. It was concluded that teachers who employ the taxonomy as a teaching tool will ask higher level questions in the classroom. Test results also found no significant difference in the rating scores of the observers when employing the TPQI. It was suggested therefore, that the simplicity and the reliability of the TPQI make it a useful device for helping teachers to analyze and evaluate their own performance, and that the taxonomy can serve as a common educational language for the improvement of instruction. It was recommended that study of the taxonomy be included in the teacher-education curriculum as a tool for raising the level of classroom learning, and that the taxonomy be added to as a cognitive dimension to existing instruments for observing classroom behavior such as the Medley and Mitzel OScAR or the Flander's system of interaction analysis.

APPENDIX A

A SUMMARY OF
BLOOM'S TAXONOMY OF EDUCATIONAL OBJECTIVES:
COGNITIVE DOMAIN AS MODIFIED BY SANDERS (1966)

Memory - ability to recognize or recall information presented earlier. It includes definitions, generalizations, and values.

Translation - ability to express information in a different form. A student translates when he expresses something in his own words. He also translates when he explains what he sees in a picture or draws a picture of something that he heard or read. Acting out of historical events is another form of translation.

Interpretation - ability to perceive a relationship between two ideas. This relationship is perceived by the student through use of his own common sense.

Questions which may be placed at the interpretation level tell the student explicitly what to do and have one or only a few logical answers. (e.g. Compare the Northern and Southern view on Slavery prior to 1860.) The different kinds of relationships include comparison, implication (informal deduction), generalization, (informal induction), value, skill of definition, quantity, and cause and effect.

> Note: If, in making comparisons, the student employs a more formal approach, using the rules of logic, he is operating at the analysis level.

Application - ability to use previously learned ideas, principles, and generalizations in new situations. This category is designed to give students practice in the transfer of training.

Questions are considered to be at the application level if they have problem-solving power, deal with the whole of ideas and skills, and include a minimum of directions as the student is expected to know what

to do. (e.g. In 1860, how did the North and South differ?) This question is much broader than the example used in the interpretation category. The difference between interpretation and application questions is that in the former the student is asked to illustrate the use of some abstraction to appropriate use.

Analysis - ability to break down material into its parts by employing the formal rules of logic. Since very little teaching time is given to formal instruction in the parts and processes of reasoning (induction, fallacies, deduction, and semantics), very few analysis questions can be employed in the average classroom.

> Note: Sanders does suggest that analysis questions related to developing generalizations by the inductive approach may be used with elementary school children.

Synthesis - ability to draw elements from many sources to form a unified structure not clearly perceived before.

Two important characteristics of synthesis questions are that they allow the student great freedom in seeking a solution, and that their solution requires a product in the form of a unique plan, a communication, or a set of abstract relations.

Evaluation - ability to make a judgement about the value of ideas, solutions, methods, materials, etc., using criteria developed by the student, himself (not by the teacher).

Evaluation questions require the student to perform two operations. First, he must establish appropriate standards or values. Second, he must determine how closely the idea or object meets these standards.

It is important to remember that evaluation questions deal with values and not with facts or opinions. They are always somewhat

subjective because either the standard cannot be proved to be correct, or the idea to be judged cannot be proved to violate the standard.

Note: Sanders holds that questions in which the teacher specifies the values for making a judgement fall under the interpretation category.

APPENDIX B

TEACHER-PUPIL QUESTION INVENTORY

Rater_____

1. Memory
2. Translation
3. Interpretation
4. Application
5. Analysis
6. Synthesis
7. Evaluation

Observation #
1 2 3

Subject

Total Score

	1	2	3	4	5	6	7	8	9	10
Teacher										
Pupil										
Teacher										
Pupil										
Teacher										
Pupil										
Teacher										
Pupil										
Teacher										
Pupil										

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