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ABSTRACT

The purpose of this study was to examine the combined effects of student participation and of realistic levels of vagueness terms on student achievement and attitudes. Ninety-six sixth graders from a middle school in Georgia were randomly assigned to one of eight groups defined by possible combinations of two teacher uncertainty conditions, two bluffing conditions, and two participation conditions (use or nonuse of a handout). Each group was given a 20-minute audiotaped mathematics lesson on Euler's formula while they observed overhead projections and blackboard demonstrations. Examples of the types of lessons are included. An analysis of variance indicated that student achievement was not significantly affected by uncertainty, bluffing, or participation. However, student attitudes were significantly affected. (MNS)

Verbal Clarifying Behaviors, Student Participation, and Student Attitudes in Mathematics

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Running Head: Clarity and Attitudes

Verbal Clarifying Behaviors, Student Participation, and Student Attitudes in Mathematics

Recent research has identified relationships between teacher verbal behaviors and student achievement. For example, Smith (1977) and Smith and Cotten (1980) indicated that certain phrases used by teachers significantly affect achievement in mathematics. Similar findings concerning achievement in science were reported (Smith & Bramblett, 1981). In each of the three studies cited above, the teacher's use of phrases referred to as "vagueness terms" was investigated. A high frequency of teacher vagueness terms reduced clarity of communication and therefore reduced student comprehension of the teacher's lesson. Smith (in press) classified vagueness terms according to whether they indicated a degree of teacher uncertainty (e.g., maybe, might, perhaps, usually, sometimes, ordinarily, several, various, sort of, almost, about, somehow, somewhere) or whether they were filler phrases that added nothing substantive to the communication (e.g., actually, anyway, frankly, so to speak, you know, in fact, of course, in essence, and so on, in a nutshell, obviously). Hiller, Fisher, and Kaess (1969) referred to such filler phrases as "bluffing" phrases. Smith (in press) reported that uncertainty phrases produced a negative effect on the learning of mathematics, but that bluffing phrases had no significant relation with mathematics learning.

Research such as that of Good and Grouws (1979) and Robitaille (1975) indicates that mathematics teachers are more effective when they allow their students to participate actively in developmental activities rather than to engage in passive intake of information. Smith and Edmonds (1978) studied the effect of teacher vagueness terms and degree of student involvement on student achievement in mathematics. High frequencies of vagueness terms significantly reduced student acheivement. Student participation during mathematics lessons generally increased student achievement, but the increase was not statistically significant.

Previous research concerning teacher vagueness terms and student participation in mathematics classes has focused primarily on effects on student achievement rather than on student attitudes or perceptions. Smith and Land (1980) found that extremely high frequencies of teacher vagueness terms in mathematics lessons resulted in significantly lower attitudes of students in terms of their perceptions of teacher preparation and of teacher competence. Cooney (1982) suggested that much of the previous research on vagueness terms in mathematics classrooms has focused on lessons in which the frequency of vagueness terms has been unusually high. For example, based on observations of 20 high school algebra teachers, Smith (1977) found that these teachers used an average of 2.2 vagueness terms (both uncertainty and bluffing terms) per minute of teacher talk, with the standard deviation being 0.8. Yet, to study the effect of vagueness terms on achievement, Smith and Cotten (1980) constructed mathematics lessons in which an average of 8.6 vagueness terms per minute of teacher talk was used. Smith and Land (1980) constructed lessons in which an average of 7.5 vagueness terms per minute of teacher talk was used. Therefore, the purpose of the present study was to examine the combined effects of student participation and of more realistic levels of vagueness terms (uncertainty terms and bluffing terms) on student achievement and on student attitudes.

Method

Subjects

A total of 96 sixth-graders from a Richmond County (Georgia) middle school participated in this study. Approximately 90% of the sample was Caucasian, and 47% of the sample was female. The students were from predominately middle class families. Each student was randomly assigned to one of eight groups (n=12 each), which were defined by possible combinations of two teacher uncertainty conditions (uncertainty, no uncertainty), two bluffing conditions (bluffing, no bluffing), and two participation conditions (participation, no participation).

Procedure

Each of the eight groups was presented a 20-minute audiotaped mathematics lesson while they observed overhead projections and demonstrations on the blackboard concerning related content. The lessons were audiotaped by the same person and were scripted to ensure that the only variations were in the presence or absence of uncertainty, bluffing, and participation. The same person showed the same overhead projections and performed the same blackboard demonstrations for each lesson. The lessons were audiotaped to control for extraneous variables and to ensure desired levels of uncertainty, bluffing, and participation.

Each of the eight lessons focused on concepts in elementary topology concerning traversibility of curves. The content that was covered included a statement of Euler's formula concerning networks in a plane, statements characterizing vertices in networks, and necessary and sufficient conditions concerning traversibility of curves. Much of this material is discussed by Posamentier and Stepelman (1981). Briefly, a curve is "traversible" provided it can be traced with pencil without missing any part of the curve and without going over any part twice. Traversibility of a curve can be determined by examining the vertices of the curve. On an informal basis, this subject matter can be taught at the middle school or junior high school level.

As each tape recorded lesson was played, overhead projections and blackboard work were used to supplement points made in the recording.

Student comprehension of the lessons was determined by administering a 20-item test immediately after each lesson was completed. The test focused on the concepts mentioned previously, with emphasis on identifying curves that are traversible and on applying Euler's formula concerning faces, vertices, and edges in networks. The split-half reliability of the test was .84.

Immediately after the students completed the test, they were administered a 12-item lesson evaluation (see Table 1). This cluster of items was reported by Smith and Land (1980) as relating to teacher use of vagueness terms. The numbers for each item of the lesson evaluation were used for scoring purposes.

Insert Table 1 about here

One half of the lessons were constructed so that 2.46 uncertainty terms per minute of teacher talk were included. Based on observations of 20 mathematics teachers, Smith (in press) determined that an average of 1.80 uncertainty terms per minute of teacher talk was used, and the standard deviation was 0.66. Therefore, the 2.46 terms per minute of teacher talk used in the pres study is one standard deviation above the previously determined mean. The remaining one half of the lessons contained no uncertainty terms.

One half of the lessons were constructed so that 1.50 bluffing terms per minute of teacher talk were included. Smith (in press) found that mathematics teachers used an average of 0.67 bluffing terms per minute, but that teachers who used a high frequency of these phrases tended to use approximately 1.50 per minute. The remaining one half of the lessons contained no bluffing terms.

One half of the lessons were begun by giving the students handouts containing tables involving vertices in various networks. As the lessons progressed, the students were required to fill in information in the tables. This requirement kept these students actively involved in the lesson. The other one half of the lessons did not involve the handouts and therefore did not ensure student participation. Students who were presented the lessons without the handouts were actively involved only through their own initiative.

The following excerpt is from the lesson containing no teacher uncertainty, no teacher bluffing, and no student participation. Five minutes of preliminary work had taken place in the lesson prior to this excerpt.

"There is an equation that tells a relationship between the number of faces, edges, and vertices in any network. The equation is F+V-1=E, where F is the number of faces, V is the number of vertices, and E is the number of edges. (Overhead profector is used to show equation). Looking at the table we have constructed on the blackboard, for the first network we have drawn we have 3+6-1=8. For the second network we drew, we have 4+10-1=13. Our equation works for all networks we can draw. We can use the equation to solve problems about networks. For example, if a network has two faces and four vertices, we can find out how many edges the network has."

The corresponding following excerpt is from the lesson containing teacher uncertainty terms but no bluffing terms and no participation. The uncertainty terms are italicized.

"There is an equation that generally tells a relationship between the number of faces, edges, and vertices in any network. The equation is F+V-1=E, where F is the number of faces, V is the number of vertices, and E is the number of edges. (Overhead projector is used to show equation). Looking at the table we have constructed on the blackboard, for the first network we have drawn we have 3+6-1=8. For the second network we drew, we have 4+10-1=13. Our equation pretty much works for all networks we can draw. Maybe we can use the equation to solve problems about networks. For example, if a network has two faces and four vertices, we can somehow find out how many edges the network has."

The corresponding following excerpt is from the lesson containing teacher bluffing terms but no uncertainty terms and no participation. The bluffing terms are italicized.

"Obviously, there is an equation that tells a relationship between the number of faces, edges, and vertices in any network. The equation is F+V-1=E, where F is the number of faces, V is the number of vertices, and E is the number of edges. (Overhead projector is used to show equation). Looking at the table we have constructed on the blackboard, for the first network we have drawn we have 3+6-1=8. For the second network we drew, we have 4+10-1=13. Our equation works for all networks we can draw, so to speak. We can use the equation to solve problems about networks. For example, if a network has two faces and four vertices, we can find out how many edges the network has, you know."

The corresponding following excerpt is form the lesson containing student participation but no uncertainty or bluffing terms. Directons concerning participation are italicized.

"There is an equation that tells a relationship between the number of faces, edges, and vertices in any network. The equation is F+V-1=E, where F is the number of faces, V is the number of vertices, and E is the number of edges. (Overhead projector is used to show equation.) Looking at the table we have constructed on the blackboard, for the first network we have drawn we have 3+6-1=8. Record the results for Network 1 in the table on your handout. For the second network we drew, we have 4+10-1=13. Record the results for Network 2 in your handout. Our equation works for all networks we can draw. We can use the equation to solve problems about networks. For example, if a network has two faces and four vertices, we can find out how many edges the network has."

The lessons containing both uncertainty and bluffing were constructed by including all uncertainty terms and bluffing terms from the other lessons. A similar procedure was used to construct lessons containing other combinations of uncertainty, bluffing, and student participation. The uncertainty terms, bluffing terms, and directions for participation were scripted into the lessons as naturally as possible. The only differences in the lessons were in the presence or absence of uncertainty, bluffing, and participation.

Results

A 2(uncertainty vs. no uncertainty) X 2 (bluffing vs. no bluffing) X 2 (participation vs. no participation) analysis of variance was performed on the student achievement scores as well as on the 12 lesson evaluation scores. With achievement as the dependent variable, there were no significant main effects or interactions. The mean achievement score for the 96 students was 10.8 (out of a possible 20 points) and the group means ranged from 9.6 to 11.7. Although student achievement was not affected significantly by uncertainty, bluffing, or participation, significant findings were obtained concerning student perceptions and attitudes about the lessons. Table 2 summarizes the group means and standard deviations for each of the 12 lesson evaluation items. Table 3 shows the F ratios resulting from the analyses of variance.

Insert Tables 2 and 3 about here

Teacher uncertainty significantly affected response item 5 (clear explanations) and item 11 (teacher prepared). For both items, the presence of uncertainty terms caused a significant decrease in the ratings.

Teacher bluffing significantly affected response item 6 (stayed on main subject), with presence of bluffing terms significantly reducing ratings.

Student participation significantly affected item 1 (teacher confident), item 5 (clear explanations), and item 12 (teacher lazy). For items 1 and 5, participation produced higher ratings than no participation. Interestingly, for item 12, students who were required to participate perceived the teacher as being significantly more lazy than did students who were not required to participate.

Significant interactions occurred between uncertainty and bluffing for item 1 (teacher confident) and item 5 (clear explanations). In both cases, the combination of no uncertainty terms and no bluffing terms resulted in higher student ratings.

Finally, significant three-way interactions involving uncertainty, bluffing, and participation were found for item 5 (clear explanations), item 8 (irritating speech pattern), and item 12 (teacher lazy). For item 5, the (no uncertainty, no bluff, no participation) group and the (no uncertainty, bluff, participation) group gave highest ratings, whereas the (uncertainty, no bluff, no participation) group and the (no uncertainty, bluff, no participation) group gave lowest ratings. For item 8, the (no uncertainty, no bluff, no participation) group gave the highest ratings, and the (no uncertainty, no bluff, participation) group as well as the (no uncertainty, bluff, no participation) group gave the lowest ratings. For item 12, the requirement of student participation resulted in students rating the teacher as being lazier, except for the participation condition that contained no teacher uncertainty and no teacher bluffing.

Discussion

This study differs from previous research on teacher clarity in that inhibitors of clarity (uncertainty and bluffing) were investigated at frequency levels that represented typical teacher behaviors. For example 25% of the mathematics teachers observed by Smith (in press) used a frequency of uncertainty terms near or above the frequency selected for this study. Further, 10% of the teachers observed by Smith (in press) used a frequency of bluffing terms near or above the frequency selected for the present study. Although these levels of uncertainty and bluffing did not significantly reduce student achievement, student perceptions (concerning teacher clarity, teacher preparation, and teacher staying on main subject) were affected significantly. One conclusion, therefore, is that relatively low levels of teacher uncertainty and bluffing can influence student perceptions even when such levels do not inhibit achievement.

The requirement that students participate resulted in students rating the teacher as being clearer and more confident. Further research is necessary to determine why the teacher was perceived as being lazier when students were required to participate. A tentative explanation is that the students in this study perceive teachers who dominate the flow of the lesson by controlling the information being processed (e.g., filling in charts, performing computations) as being less lazy than teachers who use a student-centered approach in which students are responsible for the processing of information.

A final suggestion resulting from results of this study is that teacher trainers and teacher evaluators focus on teacher behaviors that can be quantified objectively. According to Gage (1978), such behaviors may provide keys for developing theories of instruction.

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Table 1
Lesson Evaluation

Item	Score: Definite no	no	yes	Definite yes
1. The teacher was confident.......	1	2	3	4
2. I was confident of the materials being presented................	1	2	3	4
3. The teacher was serious about the lesson......................	1	2	3	4
4. The lesson frustrated me........	4	3	2	1
5. The teacher's explanations were clear to me....................	1	2	3	4
6. The teacher stayed on the main subject very well...............	1	2	3	4
7. The teacher really knew what he was talking about...............	1	2	3	4
8. The speech pattern of the teacher irritated me...................	4	3	2	1
9. The lesson irritated me.........	4	3	2	1
10. The teacher appeared nervous....	4	3	2	1
11. The teacher was prepared........	1	2	3	4
12. The teacher appeared lazy.......	4	3	2	1

Table 2
Group means and standard Deviations

Uncertainty (A)		No	No	No	Yes	Yes	Yes	No	Yes	
Bluffing (B)		No	No	Yes	No	Yes	No	Yes	Yes	
Participation (C)		No	Yes	No	No	No	Yes	Yes	Yes	Totals
Response item	1.	3.3 (0.8)	3.7 (0.5)	2.9 (0.5)	2.6 (0.8)	2.9 (0.7)	3.4 (0.5)	2.9 (0.9)	3.3 (0.9)	3.1 (0.8)
	2.	2.9 (0.9)	2.8 (0.9)	2.7 (1.0)	2.5 (0.7)	2.8 (0.8)	2.9 (0.8)	3.3 (0.6)	3.1 (0.7)	2.9 (0.8)
	3.	3.3 (1.1)	3.4 (0.5)	3.3 (0.7)	3.5 (0.5)	3.2 (0.4)	3.5 (0.7)	3.1 (1.0)	3.4 (1.0)	3.3 (0.8)
	4.	3.3 (1.0)	3.3 (1.0)	3.2 (1.1)	2.5 (0.8)	2.7 (1.1)	3.4 (0.9)	2.8 (1.0)	3.3 (1.0)	3.0 (1.0)
	5.	3.6 (0.9)	3.0 (0.7)	2.6 (1.2)	2.3 (0.8)	2.8 (0.9)	3.3 (0.5)	3.6 (0.5)	2.8 (1.1)	3.0 (0.9)
	6.	3.4 (0.7)	3.7 (0.5)	2.8 (1.1)	3.4 (0.7)	3.0 (0.9)	3.6 (0.7)	3.2 (0.6)	3.3 (0.7)	3.3 (0.8)
	7.	3.8 (0.4)	3.4 (0.8)	3.4 (0.7)	3.3 (0.9)	3.3 (0.8)	3.3 (0.9)	3.0 (0.9)	3.5 (0.8)	3.4 (0.8)
	8.	3.7 (0.7)	2.4 (1.2)	2.5 (1.2)	2.9 (0.9)	3.1 (1.0)	3.2 (1.0)	2.8 (1.1)	3.2 (0.8)	3.0 (1.0)
	9.	3.5 (0.9)	2.9 (1.1)	3.3 (0.8)	2.8 (0.7)	2.9 (1.0)	3.2 (0.7)	3.1 (0.9)	3.1 (1.2)	3.1 (0.9)
	10.	3.4 (1.0)	3.2 (1.0)	3.5 (0.8)	3.2 (1.0)	3.3 (0.8)	3.2 (0.9)	3.2 (0.9)	3.3 (0.8)	3.3 (0.9)
	11.	3.7 (0.7)	3.6 (0.7)	3.7 (0.5)	2.9 (1.0)	3.1 (1.2)	3.4 (0.9)	3.2 (0.8)	3.2 (1.0)	3.3 (0.9)
	12.	3.3 (1.2)	3.7 (0.5)	3.8 (0.4)	3.8 (0.5)	3.7 (0.5)	3.0 (1.0)	3.3 (0.8)	3.3 (1.1)	3.5 (0.8)

Note. Figures in parentheses are standard deviations.

Table 3
F Ratios of ANOVAs

Response Item	Uncertainty (A)	Bluffing (B)	Participation (C)	AxB	AxC	BxC	AxBxC
1.	< 1	2.08	8.34[b]	5.32[a]	2.06	2.08	< 1
2.	< 1	1.13	3.30	< 1	< 1	1.00	1.70
3.	< 1	1.43	< 1	< 1	< 1	< 1	1.19
4.	1.56	1.15	1.56	< 1	3.54	1.56	< 1
5.	5.24[a]	< 1	4.19[a]	4.51[a]	< 1	1.17	8.01[b]
6.	< 1	9.26[b]	3.70	< 1	< 1	< 1	< 1
7.	< 1	1.14	< 1	2.54	3.44	< 1	< 1
8.	1.26	< 1	< 1	1.29	2.38	3.06	4.01[a]
9.	1.02	< 1	< 1	< 1	2.64	< 1	< 1
10.	< 1	< 1	< 1	< 1	< 1	< 1	< 1
11.	4.45[a]	< 1	< 1	< 1	2.72	1.39	< 1
12.	< 1	< 1	4.22[a]	< 1	2.39	1.06	4.22[a]

Source columns: Uncertainty (A) through AxBxC.

a. $p < .05$.

b. $p < .01$.