Pupil Responses to Teacher Questions: Cognitive Level, Length, and Syntax

RICHARD A. COLE*
DAVID M. WILLIAMS

EDUCATORS have long recognized the influence of teacher questions on the thinking behaviors of pupils (Hall and Hall, 1916; Taba and Elzey, 1964; Hunkins, 1970). Recent studies of classroom verbal interaction have focused on the social-emotional climate of the classroom (Amidon and Flanders, 1961; Flanders, 1965), on the time lapse between teacher questions and pupil responses (Rowe, 1969), and on the cognitive level of teachers' questions (Clegg, 1967; Davis and Tinsley, 1968). However, a review of the literature reveals a paucity of data concerning the immediate response of pupils to teacher questions.

With the exception of those by Gallagher (1965) and Hunkins (1967, 1968), studies of classroom verbal interaction tend to assume, rather than empirically test, the supposedly strong, positive correlation between the level of teacher questions and pupil responses. Gallagher provides some evidence to support the assumption that the pupil's expressive thought level is dependent upon the teacher's style of questioning. Hunkins has shown that pupils trained with written materials containing a predominance of higher cognitive level questions scored significantly better on application and evaluation items of a post-test than did pupils trained with lower cognitive level questions. However, Hunkins' studies were not concerned with immediate pupil verbal responses.

Gall (1970) discusses the need to pay particular attention to pupil responses in the analysis of classroom verbal interaction and suggests criteria for such analysis. These include: (a) complexity of the response; (b) use of data to justify or defend the response; (c) clarity of the phrasing; and (d) length and quality of the response. The purpose of this paper is to attempt to operationalize a number of Gall's criteria in order to measure whether there is any empirical relationship between these criteria and the level of teacher questions.

Problem. In order to explore relationships between teacher questions and pupil responses, the authors undertook the operationalization of Gall's suggested criteria into appropriate categories for coding and analysis. This study was designed to sample a cross section of classroom verbal interactions in order to test the following null hypotheses:

1. There is no significant correlation between the cognitive level of teacher questions and:
   a. The cognitive level of pupil responses
   b. The length of pupil responses
   c. The syntax of pupil responses.

* *Richard A. Cole, Curriculum Specialist, Portland Public Schools, Oregon; and David M. Williams, Assistant Professor of Education, University of British Columbia, Vancouver*

2. There is no significant correlation between the cognitive level of pupil responses and:

a. The length of pupil responses

b. The syntax of pupil responses.

Procedure. An observation guide (see Table 1) for the coding and recording of paired observations (that is, Teacher Question—Pupil Response) was utilized in gathering the data. It is an attempt to operationalize such "Gall" criteria as response complexity, length, and "quality." The cognitive level of teacher questions and pupil responses was independently coded at one of three levels, based upon modifications of the Gallagher-Aschner categories (1963). Pupil responses were also coded on three levels of response length and syntax. The response and syntax categories were chosen on the bases that they are mutually exclusive and easily codified. Interjudge reliability in coding questions and responses was .92.

The ground rules that guided data collection were as follows:

1. All paired observations of teacher questions and pupil responses occurring during each observation period were recorded.

2. Teacher questions that did not elicit pupil responses were *not* coded.

3. When a series of responses from different pupils followed a single teacher question, each response was coded as forming a new observation pair with the initial teacher question.

4. When in doubt between categories 1 and 2, or categories 2 and 3, observers recorded the observation in the least frequently observed category (see Amidon and Flanders, 1967, p. 24). Rule 4 was invoked in less than one percent of the coding decisions.

Data were gathered by monitoring audio

Teacher Question		*Pupil Response*	
Cognitive Level	Cognitive Level	Response Length	Syntax
1 Cognitive–Memory	1 Cognitive–Memory	1 One to three words	1 Word or phrase
2 Convergent thinking	2 Convergent thinking	2 Four to nine words	2 Simple sentence
3 Divergent and evaluative thinking	3 Divergent and evaluative thinking	3 Ten or more words	3 Complex, compound, or multiple sentence(s)

Table 1. Observation Guide for the Coding of Paired (Teacher Question—Pupil Response) Observations

Response Level

		R_1	R_2	R_3	
Question Level	Q_1	f=55 F=32	f= 3 F=11	f= 2 F=17	60
	Q_2	f= 7 F=18	f=19 F= 7	f= 9 F=10	35
	Q_3	f= 7 F=19	f= 2 F= 6	f=25 F= 9	34
		69	24	36	129

Response Length

		RL_1	RL_2	RL_3	
Question Level	Q_1	f=44 F=26	f=11 F=11	f= 5 F=23	60
	Q_2	f= 6 F=15	f= 9 F= 7	f=20 F=13	35
	Q_3	f= 5 F=14	f= 5 F= 7	f=24 F=13	34
		55	25	49	129

Response Syntax

		S_1	S_2	S_3	
Question Level	Q_1	f=46 F=28	f= 8 F= 9	f= 6 F=23	60
	Q_2	f= 8 F=17	f= 7 F= 5	f=20 F=13	35
	Q_3	f= 7 F=16	f= 4 F= 5	f=23 F=13	34
		61	19	49	129

f = actual frequencies

F = expected frequencies (based on marginal totals)

$X^2 = 101.66$ (4 *df*)

$p < .001$

$C = .66$

$X^2 = 51.95$ (4 *df*)

$p < .001$

$C = .52$

$X^2 = 46.53$ (4 *df*)

$p < .001$

$C = .51$

Table 2. Summary of Data Concerning Teacher Question Level (Q_1, Q_2, Q_3) by Pupil Response Level (R_1, R_2, R_3), Response Length (RL_1, RL_2, RL_3), and Response Syntax (S_1, S_2, S_3)

tapes of portions of social studies, science, and health lessons conducted by eight different teachers (grade levels ranged from grade 2 to grade 6). The two authors audited and codified all observations. The data gathered comprised 129 paired observations, or a mean of 16 observations per teacher.

On the assumption that our scales would yield nominal, or at best ordinal, data, the Contingency Coefficient "C" (Siegel, 1956) was selected as the measure of association between question level and response level, length, and syntax. Although it has the advantage of requiring the fewest assumptions about the data, the Contingency "C," because it requires certain minimum frequencies in the uncorrelated cells of the contingency tables, may be regarded as a conservative measure of correlation. Significance was tested by means of the X^2 test, and

Teacher Questions		Pupil Responses	Contingency Coefficient	X^2
Cognitive Level	by	Cognitive Level	.66	101.66*
Cognitive Level	by	Response Length	.52	51.95*
Cognitive Level	by	Response Syntax	.51	46.53*

* Significant at the $p < .001$ level.

Table 3. Summary of Table 2—Cognitive Level of Teachers' Questions by the Cognitive Level, Length, and Syntax of Pupils' Responses

the level of significance required to reject the null hypotheses was $p < .05$.

Analysis of the Data. Tables 2 and 3 summarize the data collected and the analysis of the cognitive level, length, and syntax of pupil responses by the cognitive level of teacher questions. The contingency coefficient ($C = .66$) and the chi square value ($X^2 = 101.66$, 4 degrees of freedom) permit rejection of the null hypothesis that the cognitive level of pupil responses is independent of the cognitive level of teacher questions. Inasmuch as the maximum value that the "C" coefficient can attain for a 3 x 3 contingency table is .816 (Siegel, 1956, p. 201), the "C" values of .66, .52, and .51 are indicative of strong positive correlations. Tables 2 and 3 show that the length and syntax of pupil responses are significantly related to the cognitive level of teacher questions.

		Response Length			
		RL_1	RL_2	RL_3	
Response Level	R_1	f = 50 F = 28	f = 15 F = 14	f = 3 F = 26	68
	R_2	f = 1 F = 10	f = 8 F = 5	f = 16 F = 10	25
	R_3	f = 2 F = 15	f = 4 F = 8	f = 30 F = 13	36
		53	27	49	129

		Response Syntax			
		S_1	S_2	S_3	
Response Level	R_1	f = 57 F = 34	f = 8 F = 10	f = 4 F = 26	69
	R_2	f = 1 F = 11	f = 9 F = 4	f = 14 F = 9	24
	R_3	f = 4 F = 17	f = 2 F = 5	f = 30 F = 13	36
		62	19	48	129

f = actual frequencies

F = expected frequencies (based on marginal totals)

$X^2 = 86.63$ (4 *df*)

$p < .001$

$C = .63$

$X^2 = 86.22$ (4 *df*)

$p < .001$

$C = .63$

Table 4. Summary of Data Concerning Pupil Response Level (R_1, R_2, R_3) by Pupil Response Length (RL_1, RL_2, RL_3) and Syntax (S_1, S_2, S_3)

Tables 4 and 5 summarize the data and analysis of the association between the cognitive level of pupil responses and the length and syntax of those responses. Regarding the question of whether or not response length and syntax are reliable indices of the response cognitive level, Table 5 summarizes tests of the null hypotheses that length and syntax are not significantly related to cognitive level. Chi square values of Table 5 permit rejection of both null hypotheses.

Pupil Responses			Contingency Coefficient	X^2
Cognitive Level	by	Response Length	.63	86.63*
Cognitive Level	by	Response Syntax	.63	86.22*

* Significant at the $p < .001$ level.

Table 5. Summary of Table 4—Pupil Responses: Cognitive Level by Length and Syntax

Findings. Analysis of the data permits rejection of all the null hypotheses within the overall level of probability of $p < .05$. Significant chi square values for all comparisons enable rejection of the null hypotheses. We may conclude that the cognitive level, length, and syntax of pupil responses are highly contingent upon cognitive level of teacher questions. Furthermore, there is a significant association between the cognitive level of pupil responses and the length and syntax of those responses.

Discussion. These findings are not, of course, surprising. The study does, however, provide empirical support for the assumption that the characteristics of pupil responses are significantly related to the level of teacher questions. Though this study does not attempt to examine all pupil response characteristics, it does illustrate the possibilities for operationalizing some of the criteria suggested by Gall (1970, p. 715). Further attempts to operationalize such response characteristics as originality, plausibility, and the evidential base of the response are indicated.

Rowe (1969) has already demonstrated that time lapse between the teacher's question and the pupil's response is a significant variable related to pupil response

characteristics. Further investigation needs to be made of Rowe's suggestion that time lapse, or "wait-time," influences both teacher questioning behavior *and* the characteristics of pupil responses.

A potentially useful methodological finding is that the length and syntax of pupil responses are highly related to the cognitive level of the response. This would suggest that, in situations in which researchers are attempting to code classroom verbal interaction while monitoring audio tapes on which pupil responses are not entirely clear, length and syntax might be reliable indices of the cognitive level of pupil responses.

The finding that response cognitive level is closely related to response syntax suggests that attention to sentence structure might very well improve the cognitive level of pupil thought. However, the more likely possibility is that the asking of higher level questions stimulates higher level responses and that higher level responses require greater syntactical complexity.

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