DOCUMENT RESUME

ED 059 094 SE 013 312

AUTHOR	Evans, Thomas P.
TITLE	Flanders System of Interaction Analysis and Science Teacher Effectiveness.
PUB DATE	Mar 70
NOTE	23p.; Paper presented at the annual NARST meeting, Minneapolis, Minnesota, March 8, 1970
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	*Effective Teaching; *Instruction; *Interaction Process Analysis; *Research Reviews (Publications); *Secondary School Science; Teacher Characteristics
IDENTIFIERS	Flanders System of Interaction Analysis

ABSTRACT

The Flanders system of Interaction Analysis is used to determine whether a teacher is indirect or direct in his approach to motivation and control in the classroom. The system describes, rather than evaluates, teacher behaviors in the order in which they occur, in any subject at any level. It does not, however, include nonverbal behaviors and student-student interaction. A review of ten studies using the system in science classes provides evidence that the technique is useful for identifying some aspects of science teacher effectiveness. But, because of the limitations of the research design and the Flanders system, contradictory and inconsistent results, and inadequate descriptions of the design in many studies, no clear relationship between teaching style and teacher effectiveness can be shown. Recommendations concerning appropriate criterion measures, modifications of Flanders' system, research design and reporting, and further questions for analysis, arise from the review. (AL)

FLANDERS SYSTEM OF INTERACTION ANALYSIS AND SCIENCE TEACHER EFFECTIVENESS

Thomas P. Evans
Assistant Professor
Department of Science Education
OREGON STATE UNIVERSITY
Corvallis, Oregon

A paper presented to the Forty-Third Annual Meeting of the National Association for Research in Science Teaching, Minneapolis, Minnesota, March 8, 1970.

FLANDERS SYSTEM OF INTERACTION ANALYSIS AND SCIENCE TEACHER EFFECTIVENESS

Educational researchers have long aspired to identify and predict teacher effectiveness. Efforts can be traced back to the beginning of the century when the efficiency movement in industry was at its height. The most common research design has been concerned with selecting a criterion or set of criteria, measuring the criterion, and correlating the criterion measurement with intelligence scores, academic marks, subject-matter preparation, and/or personality traits of teachers. The characteristics or behaviors of teachers, as measured by rating scales, and pupil achievement have been the most frequently used criteria of effectiveness. Reviews of this research have generally not been positive. They usually conclude with summary statements indicating that the existing research is conflicting and inconclusive and that we still do not know how to identify effective teachers.

Within the past decade, a large number of researchers has attempted to identify effective teachers through the use of systematic observation of classroom behaviors. The system most frequently used has been the Flanders System of Interaction Analysis (hereafter referred to as the Flanders system). Reviews of this research are beginning to appear, and they are distinctly more positive than the earlier reviews of teacher effectiveness. Based on summary statements by Kleinman (1), Soar (2), Campbell and Barnes (3), and Flanders (4), it would appear that systematic observation of classroom behavior is the most promising technique to date for identifying teacher effectiveness.

PURPOSE

Interest in the optimism currently being expressed in the area of teacher effectiveness forms the basis of this paper. Its purposes are as follows: (1) to present a description of the Flanders system and a discussion of its strengths and limitations, (2) to review research on science teacher effectiveness which employed the Flanders System to measure classroom interaction and (3) to provide recommendations for further research and practice.

FLANDERS SYSTEM

Description of System

The Flanders system is composed of ten categories (Table 1) and is primarily concerned with the emotional climate of the classroom resulting from verbal interactions between the teacher and pupils (5). Basically, the system involves the categorization of verbal classroom interaction into ten categories by a trained observer. The observer may directly observe the classroom, or he may analyze audio recordings, video recordings, or tapescripts of the classroom interaction. At the end of each three-second interval, the observer records the category number which best represents the events just completed. These numbers are recorded in columns to preserve the original sequence of events. Marginal notes are used to explain any unusual happenings in the classroom. A double line is drawn when there is a change in class formation, subject under consideration, or communication pattern. A series of numbers between two lines indicates a single activity period. At the end of the observation period, the observer includes any additional notes that he may later need to interpret adequately the classroom interaction.

The series of numbers for each observed activity are interpreted after being placed into a 10 X 10 matrix in the following manner. First, a ten is added to the beginning and end of each series unless a ten is already present. This insures that the entire series begins and ends with the same number, and a ten is used because it theoretically affects the interpretation of teacher influence the least. Secondly, the numbers are marked off in overlapping pairs. Thirdly, a tally is placed into the matrix for each pair of overlapping numbers. The first number of a pair indicates the row, and the second indicates the column. Fourthly, the total number of tallies in each row and column are calculated. Tabulations in the matrix can be checked by making certain that the number of tallies in the matrix is one less than the total number of encoded behaviors in the series.

A completed matrix provides the possibility of a large number of interpretations of classroom interaction. However, only the ID and id Ratios are considered here. They were the interpretations most frequently used by researchers who utilized the Flanders system to investigate science teacher effectiveness.

The ID Ratio or the ratio of indirect to direct teacher statements is calculated by dividing the total number of tallies in categories 1, 2, 3, and 4 by the total number of tallies in categories 5, 6, and 7. An ID Ratio of 1.0 means that there is an indirect teacher statement for each direct teacher statement (6). The average indirect teacher has an ID Ratio of 0.7, and the average direct teacher has an ID Ratio below 0.4 (3).

The id Ratio (Revised ID Ratio) is used to determine whether a teacher is indirect or direct in his approach to motivation and control. It is calculated by dividing the total number of tallies in categories 1, 2, and 3 by the number of tallies in categories 6 and 7 (6). The average indirect teacher has an id Ratio of 2.0, and the average direct teacher has an id Ratio below 1.0 (3).

Strengths and Limitations

As a tool for the analysis of teaching-learning situations, the Flanders System has both strengths and limitations. Therefore, it seems appropriate to identify some of these before reviewing research concerning the Flanders system and science teacher effectiveness.

Failure to distinguish between teacher behaviors and teacher characteristics has constantly been a source of confusion for those persons investigating teacher effectiveness. Consequently, a major strength of the Flanders system is that it provides an objective method for distinguishing teacher behaviors from teacher characteristics. It represents an effort to count teacher verbal behaviors rather than to apply some global title such as "warm" or "aloof." A second strength is the attempt to describe rather than to evaluate teaching-learning situations. The use of a matrix to analyze data is a third strength. Plotting ten categories into a matrix results in one hundred individual cells and increases the number of possible interpretations of classroom interaction. Additional strengths follow: (1) the sequence of events are preserved, permitting a study of the on-going classroom interaction as it evolves; (2) the system is relatively easy to learn and to use; (3) the categories and procedures are defined in such a way that independent observers, after a period of training, are able to reach a high level of intercoder agreement; and (4) the system is not restricted to any particular subject area or grade level.

A major limitation of the Flanders system is its failure to include nonverbal behaviors. Research by Balzer (7), Evans (8), Galloway (9), and Parakh (10) provides evidence that a significant number of nonverbal behaviors do occur in the classroom and that they can be encoded with a high level of inter-observer agreement. Failure to provide for student-student interaction is a second limitation. In fact, the system is limited in the whole area of student participation. Amidon reinforces this point when he stated that "no exact interpretation of much of student verbal behavior is provided for in the system" (11, p. 205). The use of ground rules to eliminate disagreements in encoding is a third limitation. These rules increase inter-observer agreement, but their use could result in questionable descriptions of classroom interaction. A fourth limitation is the failure of the system to make allowances for differences or extremes within each category. For example, allowances are not made for different kinds of teacher questions. Mild and vehement praise are simply treated as praise, and a distinction is not made between silence and confusion. A fifth limitation involves the method for calculating inter-observer agreement. It does not take into account the sequential nature of the data. A sixth and concluding limitation is that the system is inappropriate for certain classroom activities, e.g., students working at seats on individualized work, teacher using audio-visuals or tools which do not require teacher talk and students working in small groups and not interacting with the teacher.

REVIEW OF RESEARCH

A search of the literature was made, and ten studies were identified which employed the Flanders or a modified Flanders system to research teacher effectiveness. A review of these studies revealed four general designs or styles of research. The first design was illustrated by the research of Cook (12) and La Shier (13) and involved the following steps: (1) science teachers or student teachers were selected, and their students were pretested using several criterion instruments; (2) after the classroom interaction was analyzed over a predetermined period of time, the ID and/or id Ratios were calculated for each teacher; (3) posttests were administered; and (4) the teachers' ID and id Ratios were correlated nonparametrically with posttest medians, median gains, or adjusted posttest means.

Research by Schirner (14), Campbell (15), Yager (16) and Snider (17) exemplified the second design. It differed primarily from the first design in that interaction ratios were used to rank and to identify upper (indirect) and lower (direct) groups of teachers. Statistical tests were usually applied to reveal that the interaction ratios of the two groups were significantly different. After the adjusted posttest means and/or mean gain scores were calculated for each class, a t-test, Mann-Whitney U test or F-test was used to compare the results of the two teaching styles.

The research by Gold (18) and Pankratz (19) represented a third style of research. The highest (effective) and lowest (less effective) ranking groups of teachers were selected by means of three teacher rating scales. Next, the classroom interaction of these two groups was analyzed using an expanded Flanders system. A t-test was used to compare the two groups with respect to ID and id Ratios and the percentages of time spent in each category.

Role playing characterized the fourth style of research. Both Lauren (20) and Citron (21) provided science teachers with training in interaction analysis. Each teacher was assigned to create a definite classroom climate. Criterion instruments were administered, and correlations were calculated between student achievement as one variable and average ID Ratio or students' perception of classroom climate as the other variable.

Table 2 presents a summary of the criteria of effectiveness, criterion instruments, and results reported by the ten researchers who used the Flanders system to investigate science teacher effectiveness. The table reveals that student achievement and teacher ratings were the criteria for judging effectiveness. Student achievement was the most frequently used criterion and included the areas of critical thinking, subject-matter, nature of science and scientists and attitude. The criterion instruments for each achievement area are listed in the table under the appropriate heading. The number of times each instrument was used can be determined by adding the numbers in the reported results columns across from the name of the instrument.

Teacher ratings were used by two researchers as a criterion of effectiveness. The rating scales and reported results are listed in Table 2. Teachers, principals, and students rated the science teachers on several factors including general teaching ability, personal adjustment, dogmatism, types of structure (indirect or direct), human relations, and teacher-pupil relationships. These factors were assumed by the researchers to be important to teaching success. The ratings on the three criterion instruments were combined into a composite score and treated as if they were obtained from a single instrument.

Before examining the reported results in greater detail, a further explanation should be made of the reported results section in Table 2. It includes the results of testing the equality of two group means, and it also includes the results of testing the association between two variables in a population. Therefore, a tally in the significant difference column may indicate a significant difference between the achievement of students taught by an indirect teacher and the achievement of students taught by a direct teacher, or it may indicate a significant positive correlation between student achievement and teaching style. A distinction can be made between the types of results by referring to the letters in the reported results column and the explanation in the legend of Table 2.

Twelve of the twenty-eight reported results were significant in favor of indirect teachers, and three were significant in favor of direct teachers. Each was significant at the 5 per cent level. The remaining results indicated that there were no significant differences between teaching styles with respect to the criterion measurements. Accepting these results at face value would support the recent optimism concerning teacher effectiveness. Yet, when a careful examination was made of the ten studies, limitations and procedures were identified which questioned the generalizability of many of the studies and/or the validity of their reported results. The following discussion points out some of these limitations and questionable procedures and is limited to those studies which reported significant results. Its intent is not merely to criticize but simply to provide a more objective view of the reported results concerning the use of the Flanders system to investigate science teacher effectiveness.

Yager (16) reported that eighth grade biology students taught by an indirect teacher achieved significantly more than students taught by a direct teacher on the Watson-Glaser Critical Thinking Appraisal, Test on Understanding Science and Silance Scale for Measuring Attitude Toward Any School Subject. Students of the direct teacher achieved significantly higher on the Nelson Biology Test. Yager suggested teaching style as a possible explanation of the results, but he did not rule out the possibility of other factors being involved. He stated that the results should be interpreted as tentative, because the study involved only two teachers and two sections of students. Further limitation was the use of Blue Version BSCS materials with eighth grade students.

La Shier (13) found significant correlations of .51 and .56, respectively, between gains in median achievement on a self-constructed subject matter test (Animal Behavior Test), class medians on the Michigan Student Questionnaire and the ID Ratios of biology student teachers. Rosenshine (22) has pointed out, however, that the study was of questionable generalizability because student teachers were used to teach a BSCS laboratory block to eighth grade students.

The results of companion studies by Pankratz (19) and Gold (18) were inconsistent with one another. Pankratz reported that two groups of physics teachers (effective and less effective) were significantly different with respect to certain categories of verbal behavior and id Ratios. Indirect influences, as compared to direct influences, were employed by the effective physics teachers more often than by the less effective physics teachers. But, the ID Ratios of the two groups were not significantly different. Gold found no significant differences between effective and less effective groups of biology teachers when he compared their ID Ratios, id Ratios and mean total of time spent in each category of classroom interaction. In fact, he found that the classroom interaction of the two groups was remarkably similar. A major limitation of both studies, and possibly the reason for the inconsistent results, was the use of rating scales to select effective and less effective teachers. Biddle and Ellena (23) have pointed out the general futility of using rating forms to research teacher effectiveness.

Schirner (14) investigated the effects of the type of earth science class, teaching style and teachers' philosophical orientation on various student outcomes. ID Ratios were used to rank seventeen teachers, and a high (indirect) and a low (direct) group were selected. After comparing student outcomes on six criterion instruments, it was found that students of indirect teachers achieved significantly higher scores on the ESCP Final Test than students of direct teachers. Since the report failed to include adequate descriptions of the indirect and direct groups of teachers, the study is of questionable generalizability. Ranking teachers on the basis of ID Ratios and selecting an upper and lower 27 per cent may have resulted in extremes as far as this sample was concerned, but it did not ensure indirect and direct groups of teachers; i.e., the entire sample may have been toward one end or the other of the indirect-direct continuum. It will be noted that this limitation clearly presents itself in some of the following studies.

The study by Campbell (15) involved the relationship between cognitive and affective process development of junior high low achievers and the interaction ratios of their teachers. Students taught by indirect teachers were reported as achieving significantly higher than students taught by direct teachers on the Sequential Test of Educational Progress, Campbell's Curosity Inventory and Scale of Scientific Attitudes. These results are of doubtful generalizability for the following reasons. First, the five direct teachers had a combined id Ratio of 1.32. According to Campbell and Barnes (3), the average direct teacher has an id Ratio below 1.0. Here, then, is an example of the possible flaw just mentioned regarding the Schirner study. Secondly, the stability of interaction ratios was studied for five of the junior high teachers, and it was concluded that a teacher's interaction ratio was unstable from class to class and from year to year. If this were true, it may not have been possible to reliably select indirect and direct teachers from a sample of their classroom behavior. Thirdly, only the predominant lecture activity was used for determining the id Ratios. This assumes the lecture activity as the only contrasting treatment, whereas other variables, such as teacher and pupil behaviors in laboratory and discussion activities, are likely to influence criterion measurements. Fourthly, the significant results on two of the criterion instruments were primarily due to losses in mean achievement rather than gains. In one case, both groups lost, but students taught by direct teachers lost the most.

The relationship between teacher effectiveness and directness of teacher influence during selected class activities was investigated by Snider (17). The ratios of indirect teacher influence to indirect plus direct teacher influences (I/I+D) were used to select five indirect and five direct teachers from a group of seventeen physics teachers. When all teaching activities were considered, no significant differences were found in student achievement between the two groups. This result should have been expected, because the ID Ratios, calculated from the teachers' interaction matrices, revealed that two of the five indirect teachers had ID Ratios well below 0.7. Thus, five indirect teachers were not compared to five direct teachers. When just the lecture activity was used to select the groups, students of direct teachers achieved significantly higher than students of indirect teachers on the Regents Physics Examination and Test on Understanding Science. Such results are questionable; they were inconsistent with the first set of results and with the results reported by Yager (16), Cook (12) and Schirner (14). Since each teachers' interaction matrix for the lecture activity was not presented, the individual ID Ratios could not be determined, but the ID Ratios for all seventeen teachers in the lecture activity was 0.29. This was much lower than the ID Ratio of 0.36 for all activities and suggested that there may have been very little contrast in classroom climate between the two groups in the lecture activity.

Lauren (20) investigated the relationship between student achievement and student reports of teacher-pupil interaction. After receiving training in interaction analysis, each teacher played contrasting roles by being indirect in two classes and direct in two classes. Tape recordings of classroom interaction were used to monitor and to ensure that each teacher played his proper roles. A student survey was used to measure students' perception of classroom climate. The data were analyzed, and a significant positive correlation was reported between students' perception of classroom climate and achievement by slow learners on teacher constructed earth science tests. A significant positive correlation was reported between students' perception of classroom climate and the percentage of indirectness (I/I+D) obtained through interaction analysis. However, these results should be interpreted with caution for the following reasons: (1) only two teachers were involved in the study; (2) significant positive correlations were not found between students' perception of classroom climate and other interaction ratios such as ID and id Ratios; (3) descriptions of the teacher constructed criterion instruments were not presented; and (4) two of the indirect classes were actually direct according to reported ID Ratios of 0.33 and 0.30.

The study by Citron (21) involved the use of interaction analysis to search for more effective methods of teaching high school biology to slow learners. Biology teachers were given training in interaction analysis and assigned certain teaching roles. Classes were monitored at monthly intervals to ensure that the correct treatment was being applied. During the first semester, students were subjected to one of the following three teaching styles: (1) varying from indirect to direct, (2) varying from direct to indirect, and (3) intermediate. During the second semester, students were taught by a teacher with a high, low or intermediate ID Ratio. A negative correlation was reported between students' total performance on the BSCS Special Materials tests and change in ID Ratio, and a positive correlation was reported between students' total performance on the BSCS Special Materials tests and ID Ratio. Although these correlations were significant at the .05 level, the study was of questionable generalizability because of the procedures used and the manner in which the study was reported. None of the interaction data was presented; therefore, the meaning of high, low, intermediate and varying ID Ratios could not be properly interpreted. The procedure of using a single teacher to play, simultaneously, three roles to three groups of students was unrealistic. In fact, role playing itself was questionable if the roles were different from the teachers' normal classroom behavior. The classroom interaction was monitored, but the data were not presented. Data from the study by Lauren (20) revealed that monitoring the classroom did not cause all of the teachers to play their assigned roles. Hanny (24) has suggested that some student teachers in his research, trained in interaction analysis, assumed the expected role in the presence of an observer. After the observer left the classroom, student teachers returned to a role similar to their normal behavior. This may have happened in Citron's study, but without additional data, it cannot even be assumed that the teachers' played the assigned roles while the observer was present.

Two additional limitations should be mentioned which were common to all of the reviewed studies. They were limited by the adequacy of the Flanders system for systematically observing behavior in the science classroom and laboratory. The obvious limitations of the system were identified. A further limitation of the studies was the degree to which the criterion instruments were valid and reliable measures of science teacher effectiveness.

In summary, the reported results (Table 2) provided evidence that the Flanders system was an effective technique for identifying certain aspects of science teacher effectiveness. But, after the studies were analyzed in greater detail, it was concluded that the relationships between teaching style, as measured by the Flanders system, and science teacher effectiveness were far from being clear. This conclusion was based on the following: (1) limitations of research and Flanders system, (2) contradictory and inconsistent results, (3) use of questionable research procedures, (4) acceptance of faulty assumptions, (5) large number of nonsignificant results and (6) inadequate descriptions of research.

RECOMMENDATIONS

Although the review does not clearly reveal definite relationships between classroom interaction and science teacher effectiveness, it does not negate the probability that such relationships exist. The problem was and is to identify these relationships and, then, to explain whey they occur. Each of the ten studies has contributed to the overall picture of science teacher effectiveness; they represent pioneer efforts in applying systematic observation to the study of science teaching and learning. The researchers have attempted to identify what really takes place in the science classroom and have set a precedent for future research of teaching-learning situations.

Several recommendations for future research and practice were identified from an analysis of the ten studies on science teacher effectiveness. The following discussion focuses on eight of these recommendations. The order does not suggest a hierarchial arrangement. If the recommendations are implemented, the likelihood of identifying certain aspects of science teacher effectiveness should be improved.

The first recommendation is related to the relevance of criterion measures. Researchers should have some assurance that teachers, who participate in teacher effectiveness research, know what the criterion instruments purport to measure and agree upon these measurements as legitimate objectives of their science teaching. Unless the objectives are understood and agreed upon by science teachers, it does not seem reasonable to use measures of these objectives as the basis for comparing their teaching styles.

The second recommendation concerns the restrictive nature of the Flanders system for describing classroom interaction. Flanders deserves a great deal of praise for the ingenuity of his system, but researchers should not consider the results of applying the system to science classrooms as a complete description of teacher-pupil interaction. Flanders has apparently been aware of his system's limitations, because he has recently expanded the number of categories from ten to twenty-two (25). The expanded system deals primarily with the emotional climate of a classroom, but it also differentiates among different kinds of teacher questions, teacher information and pupil responses. The silence or confusion category has been changed into two categories--constructive and non-constructive use of time. The system, however, should be further expanded to include nonverbal behaviors if it is to provide an adequate description of classroom interaction.

The third recommendation is for researchers to apply more than one category system to the same teaching-learning situations. This could be accomplished by means of cooperative research efforts and the use of video tape recordings. Classroom behavior is so complex that a satisfactory description may never be obtained from the use of any one system. In addition, very little is known about the relationship among the various systems for systematically observing classroom behavior.

Several of the studies on science teacher effectiveness were judged to be of questionable value, because the reports were inadequate and/or incomplete. When descriptions are vague and data are omitted, studies cannot be properly interpreted. Replication also becomes difficult. Therefore, the fourth recommendation is for researchers to report their investigations in a more accurate and complete manner.

Discrepancies sometimes exist between reviews of identical research, e.g., Campbell and Barnes (3) and Rosenshine (22). The exact reasons for these discrepancies are not readily discernible, but they may be related to the large amount of time and energy involved in securing and analyzing original research documents. Some reviewers rely on abstracts and short articles, because original research documents are difficult to obtain and to analyze once they are obtained. Critical details are commonly omitted from abstracts and short articles, and their use could result in misinterpretations of research. The fifth suggestion is a possible way to alleviate some of the discrepancies which result from using abstracts and short articles for reviewing research. That is, comprehensive reviews of original research documents should be acceptable as doctoral dissertations (22). In depth studies of original research documents could result in major contributions to teacher effectiveness research.

The sixth recommendation is related to research that is designed to contrast indirect and direct teaching styles. Researchers should analyze the classroom behaviors of teachers until they have definitely identified indirect and direct groups of science teachers. This analysis should include samples of behavior in each type of teaching activity, because a teacher's behavior differs from one activity to another. The interaction data for each teacher should accompany the report. These procedures would reduce problems associated with role playing and selection of indirect and direct teachers from a limited sample. The review revealed that indirect and direct teaching styles were not assured through role playing or by ranking and selecting upper and lower interaction ratios of a limited number of science teachers.

A two-variable research paradigm was used by a majority of the researchers who investigated science teacher effectiveness. Efforts were made to identify relationships between classroom behavior and student outcomes. Classroom behavior was the independent, and student outcomes were the dependent variables. Other variables, such as class size, time of day, amount of individual consultation, distraction by jobs, extracurricular activities, time spent in study, aptitude, motivation and personality, were ignored or theoretically controlled by means of sampling techniques and/or statistical treatments. The results of using a two-variable paradigm to research teacher effectiveness have largely been fruitless and suggest the seventh recommendation. Researchers should create new paradigms for research on teacher effectiveness which include classroom behavior, teacher, environmental, pupil and criterion variables.

The eighth and concluding recommendation is aimed specifically at a consideration of individual differences. Researchers should investigate the effects of teacher-pupil interaction on differentiated rather than on heterogeneous groups of students; i.e., interation of treatment and learner variables should be examined. This recommendation is based on the assumption that there is not one best way to teaching anything to all students. For example, treatment A may be more effective than B for certain students, and treatment B may be more effective than A for other individual students. If the assumption is true, it would be more productive to investigate the relationships in the example rather than trying to determine the effects of treatment A versus B on a heterogeneous group of students. One of the reasons we know so little about teacher effectiveness is that most of the accumulated evidence applies to some generalized "average student" and, thus, to no one (26).

REFERENCES

1. Kleinman, Gladys S. "Assessing Teacher Effectiveness: the State of the Art." Science Education 50: 234-238; 1966.

2. Soar, Robert S. "New Developments in Effective Teaching." American Biology Teacher 20: 43-47; 1968.

3. Campbell, James R. and Barnes, Cyrus W. "Interaction Analysis-A Breakthrough?" Phi Delta Kappan 50: 587-590; 1969.

4. Flanders, Ned A. "Teacher Effectiveness." Encyclopedia of Educational Research. (Edited by Robert Elbel.) New York: The Macmillan Co., 1969. Fourth edition, 1423-1437.

5. Amidon, Edmund J. and Flanders, Ned A. The Role of the Teacher in the Classroom. Minneapolis, Minnesota: Paul S. Amidon and Associates, 1963.

6. Flanders, Ned A. Interaction Analysis in the Classroom: A Manual for Observers. Ann Arbor: School of Education, University of Michigan, 1964.

7. Balzer, LeVon. "An Exploratory Investigation of Verbal and Nonverbal Behaviors of BSCS Teachers and Non-BSCS Teachers." Unpublished Ph.D. dissertation, The Ohio State University, 1968.

8. Evans, Thomas P. "An Exploratory Study of the Verbal and Nonverbal Behaviors of Biology Teachers and Their Relationship to Selected Personality Traits." Unpublished Ph.D. dissertation, The Ohio State University, 1968.

9. Galloway, Charles M. "An Exploratory Study of Observational Procedures for Determining Teacher Nonverbal Communication." Unpublished Ed.D. dissertation, University of Florida, 1962.

10. Parakh, Jal S. "A Study of Teacher-Pupil Interaction in High School Biology Classes." Unpublished Ph.D. dissertation, Cornell University, 1965.

11. Amidon, Edmund J. "The Observational Technique of Interaction Analysis Applied to the Classroom: Procedures and Limitations." Interaction Analysis: Research and Theory. (Edited by Edmund Amidon and John Hough.) Chapter 2, 194-206. (Mimeographed.)

12. Cook, Robert E. "The Effects of Teacher Methodology Upon Certain Achievements of Students in Secondary School Biology." Unpublished Ph.D. dissertation, University of Iowa, 1967.

13. La Shier, William S. "An Analysis of Certain Aspects of the Verbal Behavior of Student Teachers of Eighth Grade Students Participating in a BSCS Laboratory Block." Unpublished Ph.D. dissertation, University of Texas, 1965.

14. Schirner, Silas W. "A Comparison of Student Outcomes in Various Earth Science Courses Taught by Seventeen Iowa Teachers." Unpublished Ph.D. dissertation, University of Iowa, 1967.

15. Campbell, James R. "Cognitive and Affective Process Development and Its Relation to a Teacher's Interaction Ratio." Paper presented at Annual Meeting of National Association for Research in Science Teaching Pasadena, California, February, 1969.

16. Yager, Robert E. "Comparison of Teaching Outcomes Between Two Teachers of Secondary Biology." American Biology Teacher 30: 816-819; 1968.

17. Snider, Ray M. "A Project to Study the Nature of Physics Teaching Using the Flanders Method of Interaction Analysis." Unpublished Ph.D. dissertation, Cornell University, 1966.

18. Gold, Louis L. "Verbal Interaction Patterns in the Classrooms of Selected Science Teachers: Biology." Unpublished Ph.D. dissertation, The Ohio State University, 1966.

19. Pankratz, Roger S. "Verbal Interaction Patterns in the Classroom of Selected Science Teachers: Physics." Unpublished Ph.D. dissertation, The Ohio State University, 1966.

20. Lauren, Paul. "Classroom Verbal Interaction and the Achievement of Selected Learnings in Earth Science by Slow Learners in High School." Paper presented at Annual Meeting of National Association for Research in Science Teaching, Pasadena, California, February, 1969.

21. Citron, Irvin M. "The Search for More Effective Methods of Teaching High-School Biology to Slow Learners Through Interaction Analysis." Paper presented at Annual Meeting of National Association for Research in Science Teaching, Pasadena, California, 1969.

22. Rosenshine, Barak. "Interaction Analysis--A Comment." Philadelphia: College of Education, Temple University, 1970. (Typewritten.)

23. Biddle, Bruce and Ellena, William. Contemporary Research on Teacher Effectiveness. New York: Holt, Rinehart and Winston, 1964.

24. Hanny, Robert J. "The Relationship Between Selected Personality Characteristics and Teacher Verbal Behavior." Unpublished Ph.D. dissertation, The Ohio State University, 1966.

25. Flanders, Ned A. "Subscripting Interaction Analysis Categories: A Twenty-Two Category System." Ann Arbor: School of Education, University of Michigan, 1967. (Mimeographed.)

26. Snow, Richard E. and Salomon, Gavriel. Aptitudes and Instructional Media. Stanford, California: Stanford University, 1968.

TABLE 1

SUMMARY OF
CATEGORIES FOR INTERACTION ANALYSIS (5, p. 12)

TEACHER TALK	INDIRECT INFLUENCE	1. ACCEPTS FEELING: accepts and clarifies the feeling tone of the students in a nonthreatening manner. Feelings may be positive or negative. Predicting and recalling feelings are included.
		2. PRAISES OR ENCOURAGES: praises or encourages student action or behavior. Jokes that release tension, not at the expense of another individual, nodding head or saying "uhhuh?" or "go on" are included.
		3. ACCEPTS OR USES IDEAS OF STUDENT: clarifying, building, or developing ideas or suggestions by a student. As teacher brings more of his own ideas into play, shift to category five.
		4. ASKS QUESTIONS: asking a question about content or procedure with the intent that a student answer.
	DIRECT INFLUENCE	5. LECTURES: giving facts or opinions about content or procedure; expressing his own idea; asking rhetorical questions.
		6. GIVES DIRECTIONS: directions, commands, or orders with which a student is expected to comply.
		7. CRITICIZES OR JUSTIFIES AUTHORITY: statements intended to change student behavior from nonacceptable to acceptable pattern; bawling someone out; stating why the teacher is doing what he is doing, extreme self-reference.
STUDENT TALK		8. STUDENT TALK-RESPONSE: talk by students in response to teacher. Teacher initiates the contact or solicits student statement.
		9. STUDENT TALK-INITIATION: talk by students, which they initiate. If "calling on" student is only to indicate who may talk next, observer must decide whether student wanted to talk. If he did, use this category.
		10. SILENCE OR CONFUSION: pauses, short periods of silence, and periods of confusion in which communication cannot be understood by the observer.

TABLE 2

SUMMARY OF CRITERIA OF EFFECTIVENESS, CRITERION INSTRUMENTS AND RESULTS REPORTED BY TEN RESEARCHERS USING FLANDERS SYSTEM TO INVESTIGATE SCIENCE TEACHER EFFECTIVENESS

Criteria of Effectiveness and Criterion Instruments	Reported Results		
	Significant Difference Favoring Indirect Teachers	No Significant Difference	Significant Difference Favoring Direct Teachers
I. Student Achievement			
A. Critical Thinking			
1. Watson-Glaser Critical Thinking Appraisal	1[a]	2[a,b]	0
B. Subject-Matter			
1. BSCS Comprehensive Final Test	0	2[a,b]	0
2. BSCS Special Materials Tests	1[b]	0	0
3. ESCP Final Test	1[a]	0	0
4. Teacher and Researcher-Constructed Tests	2[b,b]	1[a]	0
5. Nelson Biology Test	0	0	1[a]
6. Regents Physics Examination, June, 1965	0	1[a]	1[a]
7. Cooperative Physics Test	0	1[b]	0
8. Test of Science Knowledge, Part I	0	1[a]	0
9. Test of Science Knowledge, Part II	0	1[a]	0
10. Sequential Tests of Educational Progress	1[a]	0	0

TABLE 2--Continued

Criteria of Effectiveness and Criterion Instruments	Reported Results		
	Significant Difference Favoring Indirect Teachers	No Significant Difference	Significant Difference Favoring Direct Teachers
C. Nature of Science and Scientists			
1. Test On Understanding Science	1[a]	2[a,a]	1[a]
2. Process of Science Test	0	1[b]	0
D. Attitude			
1. Silance Scale for Measuring Attitude Toward Any School Subject	1[a]	0	0
2. Michigan Student Questionnaire	1[b]	0	0
3. Campbell's Scientific Curosity Inventory	1[a]	0	0
4. Scale of Scientific Attitudes	1[a]	0	0
II. Teacher Ratings			
A. Factors Assumed Important to Teaching Success			
1. Teacher-Rating Scale[c]			
2. Student-Opinion Questionnaire[c]	1[a]	1[a]	0
3. Teaching Situation Reaction Test[c]			

[a]Test for determining the equality of two group means was used.

[b]Test for determining the association between two variables in a population was used.

[c]The Scores on these instruments were combined into a composite score for each teacher.