# MODIFICATION OF TEACHER BEHAVIOR THROUGH AN IN-SERVICE BIOLOGY METHODS COURSE

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This is to certify that the

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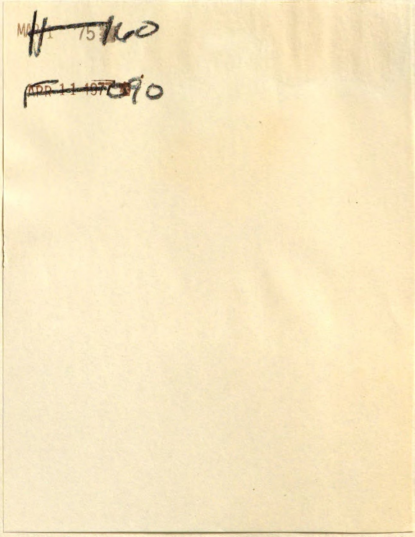
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A sample of 40 secondary school biology teachers was selected at random from 60 schools within a 60-kilometer radius from the city of Cebu, Philippines. Twenty were assigned to the experimental group and twenty to the control group. The treatment consisted of a 6-week in-service biology methods course aimed at developing teacher behaviors which promote inquiry learning given during the 1972 summer term at the University of San Carlos in Cebu City.

The data consisted of two class observations of each teacher during a two semester period. Verbal behaviors were recorded with a battery-operated wireless microphone and a radio cassette tape recorder. Non-verbal behaviors were

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The data consisted of two class observations of each teacher during a two semester period. Verbal behaviors were recorded with a battery-operated wireless microphone and a radio casette tape recorder. Non-verbal behaviors were

observed only at random and recorded with a 35 mm camera or in writing. The observed behaviors were classified according to the Biology Teacher Behavior Inventory categories and according to inferred intent as verbal and non-verbal. Totals of behaviors which predominate in 10-second intervals were determined. Significant differences in the mean ratios of the behavior categories studied between the experimental and control groups before and after the treatment were determined with t-tests.

Six experimental hypotheses were formulated in the null form for the study. The t-test results showed: (1) significant gains in the mean ratios of "student centered-teacher centered content development" behaviors and "scientific process-knowledge" behaviors but no significant differences in the mean ratios of "control-release", "positive-negative affectivity" and "facilitate communication"-total teacher behaviors, and (2) a significant increase in the mean ratio of behaviors indicative of an indirect pattern of influence to total teacher behaviors in the experimental group after the treatment.

Probability values obtained from the Chi Square Tests of independence between teacher behavior change towards an indirect pattern of influence and selected teacher and school variables ranged from less than 25% to more than 95%.

Based on the findings of the study the following conclusions were drawn: (1) Teacher classroom behavior was modified along a predicted pattern with an inquiry oriented biology methods course. (2) Teacher behavior was changed towards an increase in the use of "student centered content development" behaviors and "scientific process" behaviors but not in the use of behaviors which may stimulate, support, or reinforce inquiry such as "release", "positive affectivity" and "facilitate communication." (3) Teacher classroom behavior can be modified towards an indirect pattern of influence as defined by Flanders. (4) Performance on the Teaching Situation Reaction Test is a low predictor for teacher behavior change towards an indirect pattern of influence. (5) Teaching experience, previous training in in-service institutes, educational background, age, or marital status are fair indicators of teacher behavior change towards an indirect pattern of influence. This behavior change is independent of school variables such as school type, organization, and administration, although it is not independent of previous use of the BSCS materials in the school. There is definitely no independence between behavior change and school facilities available. (6) The Processes of Science Test in biology is a good predictor for change in teacher classroom behavior towards a scientific process orientation.

# MODIFICATION OF TEACHER BEHAVIOR THROUGH AN IN-SERVICE BIOLOGY METHODS COURSE

By

Araceli Gonzales Almase

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## ACKNOWLEDGEMENTS

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Acknowledgements are also due to Dr. Julian Brandou, Director of the Michigan State University Science and Mathematics Teaching Center and chairman of my guidance committee, for his assistance in the planning of my course program and in the development of this study; to the other members of my guidance committee: Dr. Jean Enochs, Dr. Martin Hetherington, and Dr. Ruth H. Useem, for their thoughtful criticism of the original thesis proposal and the final thesis draft; to the teachers and administrators of the schools included in the study for their cooperation and participation in the classroom observations; to the University of San Carlos for making available its facilities during the study; and to all of my friends and colleagues for their assistance in the various stages of this study.

My deepest gratitude goes to my parents, my children, and, most especially, to my husband without whose encouragement and understanding this study would not have been realized.

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TABLE OF CONTENTS


| CHAPTER | | Page |
|---|---|---|
| I. | INTRODUCTION | 1 |
| | Statement of the Problem | 2 |
| | Rationale for the Study | 3 |
| | The Significance of the Study | 7 |
| | Delimitations of the Study | 8 |
| | Definitions of Terms | 10 |
| | Overview | 13 |
| II. | REVIEW OF RELATED LITERATURE | 14 |
| | Category Systems Used In Observation of Teacher Classroom Behavior | 14 |
| | Teacher Behavior Patterns in Effective Teaching | 22 |
| | Teacher Characteristics and Teacher Classroom Behaviors | 26 |
| | Modification of Teacher Behavior | 30 |
| | Summary of Literature Reviewed | 34 |
| III. | RESEARCH DESIGN AND PROCEDURES | 36 |
| | The Research Design and Hypotheses | 36 |
| | The Population | 38 |
| | The Area Studied | 38 |
| | The Population Sampling | 38 |
| | The Experimental and Control Groups | 44 |
| | The Instruments | 46 |
| | Procedures for Observations and Analysis | 49 |
| | The Class Observations | 49 |
| | Analysis and Interpretations | 52 |
| | The Treatment | 57 |
| | The Course Program | 57 |
| | Class Organization and Management | 59 |
| | The Microteaching Unit | 60 |
| | The Pupils Taught During the Methods Course | 63 |
| IV. | ANALYSIS OF DATA AND DISCUSSION OF RESULTS | 67 |
| | The Classroom Observations | 67 |

TABLE OF CONTENTS--Continued

CHAPTER Page


Analysis of Observed Teacher Classroom Behaviors. . . . . 70
Hypotheses Testing and Statistical Analysis of Data. . . . . 72
The Hypotheses on Teacher Behavior Change. . . . . 72
The Hypotheses on Independence Between Teacher Behavior Change and Teacher and School Variables. . . . . 81

V. SUMMARY, CONCLUSIONS, AND IMPLICATIONS FOR FURTHER STUDY . . . . . 87

Summary . . . . . 87
Conclusions . . . . . 93
Recommendations and Implications for Further Study. . . . . 94

BIBLIOGRAPHY. . . . . 98

APPENDICES. . . . . 105

A. THE INSTRUMENTS. . . . . 105

Biology Teacher Behavior Inventory. . . . . 106
Teaching Situation Reaction Test. . . . . 110
Biology Faculty Information Sheet . . . . . 127
School Information Sheet. . . . . 128
Laboratory Facilities Check List. . . . . 129

B. DATA RECORD SHEET SAMPLE . . . . . 131

Sample of Transcript of Tape Recording of a Class Observation with Interpretations in Code. . . . . 132
Sample of Data Record Sheet . . . . . 134

C. SUMMARY OF RECORD OF CLASSROOM OBSERVATIONS. . 136

D. THE BIOLOGY METHODS COURSE OUTLINE AND OBJECTIVES . . . . . 149

E. GLOSSARY OF TEACHER CLASSROOM BEHAVIORS. . . . 155

F. STATISTICAL PROCEDURES AND SAMPLE COMPUTATIONS 168

LIST OF TABLES


| TABLE | | Page |
|---|---|---|
| 1. | Summary of School Characteristics in the Population and Sample Studied. . . . . | 41 |
| 2. | Laboratory Facilities Ratings of Schools in the Sample . . . . . | 42 |
| 3. | Distribution of Teachers in Experimental and Control Groups According to School Type. . . . | 42 |
| 4. | Comparison of Teacher Variables in the Experimental and Control Groups. . . . . | 45 |
| 5. | Summary of Record of Classroom Observations of Teachers in the Experimental Group Before and After the Biology Methods Course . . . . . | 137 |
| 6. | Summary of Record of Classroom Observations of Teachers in the Control Group Before and After the Biology Methods Course . . . . . | 139 |
| 7. | Total Number of Predominant Teacher Behaviors Observed in the Experimental Group Before and After the Biology Methods Course . . . . . | 141 |
| 8. | Total Number of Predominant Teacher Behaviors Observed in the Control Group Before and After the Biology Methods Course . . . . . | 143 |
| 9. | Computed Ratios of Teacher Classroom Behaviors Observed in the Experimental Group Before and After the Biology Methods Course . . . . . | 145 |
| 10. | Computed Ratios of Teacher Classroom Behaviors Observed in the Control Group Before and After the Biology Methods Course . . . . . | 147 |
| 11. | Mean Ratios of Teacher Behaviors Observed in the Experimental and Control Groups Before and After the Biology Methods Course . . . . . | 71 |

LIST OF TABLES--Continued


| TABLE | | Page |
|---|---|---|
| 12. | Data on t-Test Analysis of Differences Between Mean Ratios of Teacher Behaviors Studied in the Experimental and Control Groups Before the Biology Methods Course . . . . . | 74 |
| 13. | Data on t-Test Analysis of Difference Between Mean Ratios of Teacher Behaviors Studied in the Control Group Before and After the Methods Course . . . . . | 75 |
| 14. | Data on t-Test Analysis of Difference Between Mean Ratios of Teacher Behaviors Studied in the Experimental Group Before and After the Methods Course . . . . . | 76 |
| 15. | Data on t-Test Analysis of Difference Between Mean Ratios of Teacher Behaviors Studied in the Experimental and Control Groups After the Methods Course . . . . . | 78 |
| 16. | Chi Square Test of Independence Between Teacher Behavior Change and Selected Teacher and School Variables . . . . . | 82 |

## LIST OF FIGURES


| FIGURE | | Page |
|---|---|---|
| 1. | Map of the Philippines showing the location of the area studied . . . . . | 39 |
| 2. | Map of the province of Cebu showing the location of schools in the area studied. . . . . | 40 |
| 3. | Schedule of class activities . . . . . | 62 |

# CHAPTER I

## INTRODUCTION

The modification of teacher behavior to enhance student learning has been dealt with in a number of contemporary research studies in teacher education. Studies of pre-service and in-service teacher education programs have sought to find factors which influence teacher behavior in specific ways so that predicted changes will occur as a result of certain activities.

Empirical data are now available which suggest that a pattern of teacher behaviors essential to inquiry learning can be developed through an inquiry-oriented in-service methods course. It has been demonstrated that teacher behaviors can be changed towards a more indirect pattern of influence through a methods course aimed at developing teacher behaviors which are characteristic of student centered classrooms.[1] Such a pattern of influence, according to

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[1]Marilyn Loeffler Raack, The Effect of An In-service Education Program on Teacher Behavior. Ed. D. Dissertation, Univ. of Calif., L. A., 1967 (microfilm); Frederick B. Schmidt, The Influence of a Summer Institute in Inquiry Centered Sc. Ed. Upon the Teaching Strategies of Elem. Teachers in Two Disciplines. Ph. D. Dissertation Univ. of Oklahoma, 1969 (microfilm); John Carline, "In-service Training--Re-examined," Jour. of Res. & Dev. in Ed. IV (Fall, 1970), 103-115.

Flanders,[2] "increases pupil affective or attitudinal behaviors important to success at inquiry."

## Statement of the Problem

The primary objective of this study was to assess the effect of a Biological Science Curriculum Study (BSCS) biology methods course on a sample of secondary school biology teachers in the province of Cebu, Philippines. The course was designed to develop teacher behaviors which promote inquiry learning through microteaching situations, inquiry techniques, and an analysis of teacher behavior. Specifically the study attempted to determine whether:

(1) There was a change in the mean ratios of the following verbal and non-verbal teacher behavior categories that may stimulate, support, or reinforce inquiry as measured by the Biology Teacher Behavior Inventory (BTBI): (a) control-release behaviors, (b) positive-negative affectivity behaviors, (c) student centered-teacher centered content development behaviors, (d) scientific process-knowledge behaviors under the category of teacher centered content development behaviors, and (e) facilitating communication-total teacher behaviors.

(2) There was a change in the verbal and non-verbal behaviors indicative of an indirect pattern of influence of the

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[2]Ned A. Flanders, Teacher Influence, Pupil Attitudes and Achievement. Cooperative Research Monograph No. 12 (Washington, D. C.: Government Printing Office, 1965), 16.

teachers observed before and after the methods course as measured by the Biology Teacher Behavior Inventory and interpreted according to Flanders' definition of an indirect pattern of influence.

(3) These changes in the teacher behavior patterns indicative of an indirect pattern of influence were dependent on certain teacher personality characteristics such as the teacher's human relations ability, openness to new experiences and attitudes towards an indirect pattern of influence as measured by the Teaching Situation Reaction Test (TSRT)[3] and on teacher characteristics such as age, marital status, number of years teaching experience, educational attainment, proficiency in the processes of Science as measured by the Processes of Science Test in biology[4] and on certain school characteristics such as type, organization, administration, curriculum materials used and laboratory facilities available.

## Rationale for the Study

The scientific and technological gap between the Philippines and the more advanced countries has focused attention on the need to improve education in the sciences at all

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[3]J. B. Hough and J. K. Duncan, "Technical Review of the Teaching Situation Reaction Test," Sept. 15, 1966. (Mimeographed)

[4]Biological Science Curriculum Study, Processes of Science Test (N. Y.: Psychological Corporation, 1962).

levels. Changes in the country's science education programs are being made to meet the needs for national development and in keeping with progressive science curricula.

Philippine adaptations of new science curricula from abroad have been introduced in the high school and elementary levels. One of these new curriculum developments is the Philippine adaptation of the Biological Science Curriculum Study (BSCS) materials developed by the Science Education Center of the University of the Philippines. Through a limited number of summer institute programs in various universities and recently, through the Regional Science Teaching Centers throughout the country, the BSCS materials have been introduced into a number of schools in the Philippines. In spite of this, many of our high school biology teachers are still not prepared or are not being prepared to use these materials with optimum effectiveness.

Studies have shown that the new emphasis in science curriculum developments can be best achieved by the BSCS materials if taught by teachers trained in the BSCS philosophy and techniques.[5] Obviously, teachers need special orientation to teach modern biology effectively because drastic changes have been made in its structure, emphasis and teaching methodology. More laboratory activity, individual student

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[5]Glen Peterson, ed., New Materials and Techniques in the Preparation of High School Biology Teachers, BSCS Spec. Pub. 6 (Boulder, Colorado: BSCS, 1969), 3.

participation, and student learning in inquiry are being stressed in these new programs.

There is therefore a need of restructuring our pre-service and in-service teacher training programs in biology to make the BSCS materials more effective.[6] A survey done in 1969 on the undergraduate biology core curricula in selected teacher training institutions in Cebu City, Philippines, showed that the required methods courses are general in nature and do not prepare the students to teach modern biology.[7] The in-service programs sponsored by the National Science Development Board of the Philippines (NSDB) in Cebu City from 1963 up to 1970 have not remedied this deficiency in the pre-service training. The emphasis in these in-service programs has been mainly on competence in the content of modern biology. Very little, if any, effort has been placed on inquiry as an outcome of instruction.

An effective implementation of the BSCS curriculum in the region would require a biology methods course to develop teaching techniques consistent with the goals of scientific inquiry. It was for this purpose that the in-service biology methods course in this study was developed.

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[6]Dolores Hernandez and Benito S. Vergara, "Introducing Biology Curriculum Innovations in Philippine Schools," The American Biology Teacher, XXX (January, 1968), 29.

[7]Araceli G. Almase, "Content of Undergraduate Biology Core Curricula in Selected Teacher Training Institutions in Cebu City" (unpublished M. Ed. thesis, Univ. of the Philippines, Diliman, Q.C., 1969), 114-115.

The main objective of such a methods course is related to the growing recognition of the influence of teacher behaviors and teacher characteristics on the teaching-learning situation. Since the teacher determines, to a large extent, the content and controls student participation, the effectiveness and the nature of the learning experience are likely to be dependent on the decisions and behavior of the teacher.

It has been noted in a number of cases that student participation in class is limited by the general acceptance of the central role of the teacher. Balzer[8] pointed out in his observations on teacher and student inquiry in biology that the teacher may often be functioning as a distraction from student inquiry and that specific verbal and non-verbal behaviors of the teacher appear to lie at the core of the problem.

Development of inquiry requires teacher behaviors which stimulate and support inquiry and create a climate which promotes independent decision making and trying out of ideas.[9] These particular behaviors may be difficult to adopt in the Philippines because of the cultural background of the Filipino teacher which accepts "obedience to authority" as the highest

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[8]Abe LeVon Balzer, "Teacher Behaviors and Student Inquiry in Biology," The American Biology Teacher, XXXII (January, 1970), 26.

[9]Richard Suchman, Developing Inquiry (Chicago: Science Research Associates, Inc., 1966), 19-20.

form of virtue and the "submissive" nature of the Filipino student.[10]

Observations made by Carbonell[11] on the functional relationships of Filipino cultural values and methods of college teaching indicate that the cultural values of the student and the teacher affect, to a large extent, the nature and type of activity in the classroom. The predominant use of the lecture and the discussion methods in college teaching, appear to be related to students' general acceptance of the teacher as an "authority", and the teachers' respect for tradition.

However, there are no empirical data to support these observations. No study has been made to determine whether these observations are applicable to all academic levels and to biology teaching in particular, hence the need for research in this area.

## The Significance of the Study

No other research on biology teacher behavior and on specific changes in teacher behavior resulting from a biology

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[10]Perla Tayko and Catherine Walsh, "Science in the Elementary School: Philippine Cultural Values and Attitudes," Educational Perspectives, X (March, 1970), 25-27: Jaime Bulatao, "The Manileño's Mainsprings," Four Readings on Philippine Values, Publications of the Institute of Philippine Culture No. 2 (Q. C.: Ateneo de Manila Univ. Press, 1964), 50-86.

[11]Guadalupe A. Carbonell, "Functional Relationships of Filipino Cultural Values and Methods of College Teaching," St. Louis Univ. Res. Jour., III (Mar.-June, 1972), 31-37.

methods course has so far been done in the Philippines. The findings of this study may provide a research model for similar studies and the first data of this nature in the country. These data may serve as the basis for further researches on teaching and learning in a Philippine setting.

The findings of the study may provide data on the nature of behavior changes in Filipino teachers and its implications on the teaching of inquiry. The findings will also identify the specific teacher and school variables affecting behavior change.

The study may be of use in restructuring existing methods courses in the pre-service preparation of high school biology teachers in the region. The course may also be of interest and use to college biology teachers who are interested in upgrading their teaching competencies in terms of the new emphasis in biology teaching. With slight variations the model may be applicable to methods courses in the other fields of science at the elementary, secondary or collegiate levels.

## Delimitations of the Study

The study was limited to a population of 90 secondary school biology teachers in schools located within a 60-kilometer radius from Cebu City in the Philippines. It was assumed that the findings of this study can be generalized to the population of biology teachers in the area, undoubtedly

it can not be generalized to the population of all biology teachers in the Philippines.

Each teacher in the experimental and control groups was observed only twice, once during the pre-treatment and once during the post-treatment. Therefore, the total range and variation of the behavior categories studied could not be observed.

Classroom observations were limited only to teacher behaviors since the devices used for recording behaviors were primarily focused on the teacher. Only random observations of non-verbal teacher behaviors could be made although verbal behaviors were recorded in detail. Behaviors which predominated in 10-second intervals during the observations were the only ones counted.

The possible influence of general impressions of the teacher, the pupils, or the total situation during the classroom observations constituted another limitation to the study in spite of the awareness of the effects of this on the data obtained. No measures were taken to minimize the "halo effect".

Contact between teachers in the experimental and control groups during and after the methods course could not be controlled. The effect of this on behavior differences between the two groups after the methods course was not ascertained.

The teacher and school variables selected as possible predictors of teacher behavior change indicative of an

indirect pattern of influence was limited to those which were commonly used as criteria for the selection of teachers in in-service training programs. This was the first time that the Teaching Situation Reaction Test (TSRT) was used in the Philippines. Its potential, therefore, as a predictor of teacher behavior change has to be considered in terms of its unknown validity and reliability in the Philippines.

Whether the behavior change resulting from the methods course is permanent or temporary was not considered in this study, nor were the effects of a teacher behavior change towards an indirect pattern of influence on student inquiry behavior.

## Definitions of Terms

An inquiry oriented biology methods course, as used in this study, refers to the instructional program for the development or improvement of behavior patterns related to student learning in inquiry in biology teachers using the Biological Science Curriculum Study (BSCS) materials.[12]

Inquiry is a set of activities directed towards solving an open number of related problems in which the student has as his principal focus a productive enterprise leading to increased understanding and application. Success in any particular inquiry involves some, but probably not all,

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[12]Ben M. Harris and Wailand Bessent, Inservice Education (N. J.: Prentice-Hall, Inc., 1969), 2.

possible inquiry behaviors and skills. Among the behaviors identified as important to success at inquiry are those sometimes termed affective or attitudinal as: curiosity, openness, reality orientation, risk-taking, objectivity, precision, confidence, preserverance, satisfaction, respect for theoretical structures, responsibility, consensus and collaboration.[13] To stimulate and support inquiry in the classroom certain conditions must be present: freedom, a responsive environment, focus and low pressure.[14]

Concepts used to describe teacher influence refer to a series of acts occurring during some time period. When a particular series occurs again and again, it becomes familiar to an observer and he can identify it. Such a series is called a pattern of influence. A direct pattern of influence consists of a recurring series of verbal and non-verbal acts of the teacher that restrict freedom of action by focusing attention on a problem, interjecting teacher authority or both, while an indirect pattern of influence consists of those recurring series of verbal and non-verbal acts of the teacher that expand a student's freedom of action by encouraging his verbal and non-verbal participation and initiative. These

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[13]Evelyn Klinckmann, sup., Biology Teachers' Handbook (2nd ed.; N. Y.: John Wiley and Sons, Inc., 1970), 27, 48-53.

[14]Suchman, Developing Inquiry, 14-18.

include asking questions, accepting and clarifying the ideas or feelings of the students, and praising or encouraging students' responses.[15] In this study, the behavior categories in the Biology Teacher Behavior Inventory interpreted as constituting an indirect pattern of influence include the following: "release", "positive affectivity", "student centered content development" behavior categories, and the subcategories of "teacher centered content development" behaviors such as "scientific process" and "facilitates communication".

Teacher behavior is defined in this study as acts by the teacher which occur in the context of classroom interaction.[16] A behavior is identified as verbal when oral language is used in the teaching learning situation. Non-verbal behavior refers to those segments of teacher classroom behavior other than the use of oral language. This may include gestures, use of silence, facial expression and inflection of voice.[17]

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[15]Flanders, Teacher Influence, 7-9.

[16]Ned A Flanders, Analyzing Teacher Behavior (California: Addison Wesley Publishing Co., 1970).

[17]Thomas P. Evans and Abe LeVon Balzer, "An Inductive Approach to the Study of Biology Teacher Behavior," Jour. of Research in Science Teaching, VII (1970), 49.

A category system, according to Evans and Balzer,[18] is a set of mutually exclusive categories exhaustive of teacher classroom behaviors which were perceived as influencing teaching-learning situations. A category is a domain or division into which specific behaviors could be classified. The boundaries or limits of a category were stated and understood to include certain behaviors and to exclude all others.

Microteaching, according to Allen and Ryan,[19] is a teaching situation which is scaled down in terms of time and number of students.

## Overview

Chapter II is a review of related research in the following areas: (1) category systems used in observation of teacher classroom behavior, (2) teacher behavior patterns in effective teaching, (3) teacher characteristics and teacher classroom behaviors, and (4) modification of teacher classroom behaviors.

The statement of the experimental hypotheses tested and a detailed description of the research design and procedures are given in Chapter III. The data obtained are analyzed and discussed in Chapter IV. Chapter V contains a summary of the study, the conclusions and their implications for further study.

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[18] Ibid., 53.

[19] Dwight Allen and Kevin Ryan, Microteaching (California: Addison Wesley Publishing Co., 1969).

## CHAPTER II

## REVIEW OF RELATED LITERATURE

Pertinent to this study is a review of research in the following areas: (1) category systems used in observation of teacher classroom behavior, (2) teacher behavior patterns in effective teaching, (3) teacher characteristics and teacher classroom behaviors, and (4) modification of teacher classroom behaviors. No research of this nature has yet been done in the Philippines, hence all the literature reviewed are foreign.

### Category Systems Used In Observation of Teacher Classroom Behavior

Several methods of observation of teacher classroom behavior have been developed. Ryans[1] in 1963 reviewed the salient features of these developments in his assessment of teacher behavior and instruction starting with the observations of teacher classroom behavior done by Medley and Mitzel in 1958. His review included, among others, various kinds of

[1]David G. Ryans, "Assessment of Teacher Behavior and Instruction," Rev. of Ed. Research, XXXIII (October, 1963), 423-424.

rating scales described by Remmers, Ryans Classroom Observation Record and Glossary, the Teacher Characteristics Schedule, and Flanders' Interaction Analysis. In a later review Bruce[2] noted that although many of these early studies exploring teacher behavior do not have a direct bearing on teacher education, their implication on teacher education is significant, especially the descriptions of types of "behavior or classroom climates" and the search for patterns of relationships between these behavior climates and student or teacher variables.

One of the most widely used instruments designed for systematic observation of classroom interaction is the 10-category system developed by Flanders[3] between 1955 and 1960. With the use of the Classroom Interaction Analysis Flanders[4] was able to establish teacher influence patterns in the classroom as "direct" or "indirect" and to establish relationships between student behaviors and teacher behavior patterns. He confirmed his hypothesis that student achievement and classroom attitudes are significantly higher for those classes

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[2]Matthew H. Bruce, "Teacher Education in Science," Rev. of Ed. Research, XXXIX (October, 1969), 415-419.

[3]Ned A. Flanders, Analyzing Teacher Behavior (California: Addison-Wesley Publishing Co., 1970), 448 pp.

[4]Ned A. Flanders, "Teacher Influence, Pupil Attitudes and Achievement," Cooperative Research Monograph No. 12, U. S. Dept. of Health, Education and Welfare (Washington: U. S. Gov't. Printing Office, 1965), 18-19.

in which teachers are more "indirect" and "flexible" with data gathered from a sample of 16 mathematics teachers and 16 social studies teachers.

Hypothesizing that teacher behavior can be changed with interaction analysis, Roush and Kennedy[5] taught an experimental group of 16 teachers to use and apply Flanders' Interaction Analysis System and compared their communication patterns before and after the 8-hour training. Significant differences were observed in the Indirect/Direct behavior ratio to support their hypothesis. The basic assumption in their study was that modification of teacher behavior from a direct style to an indirect style produces a classroom climate conducive for pupil learning.

Classroom interaction analysis has also found use in pre-service teacher education programs as a means of assessing the nature of the verbal behavior of a student teacher to provide him with a feedback necessary for improving his teaching performance. The findings of several researches (Furst, 1965; Hough and Amidon,1963; Hough and Ober, 1966; Jerk, 1964) as cited by Bondi[6] and those cited by Bruce[7]

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[5]R. E. Rousch and V. J. Kennedy, "Changing Teacher Behavior with Interaction Analysis," Education, XCI (Fall, 1971), 220-222.

[6]Joseph C. Bondi, "The Effects of Interaction Analysis Feedback on the Verbal Behavior of Student Teachers," Ed. Leadership Research Supplement (May, 1969), 794.

[7]Bruce, "Teacher Education...," 416-417.

(McLeod, 1967; Matthews, 1966; Popham, 1965) show that the verbal behaviors of student teachers who had received training in interaction analysis differed from those who had no training in it. Bruce cited reports that student teachers trained in interaction analysis tend to be more "indirect".

Bondi[8] further confirmed these findings on the effects of interaction analysis feedback on the verbal behavior student teachers using a 13-category modification of Flanders' system of interaction analysis. His study shows that student teachers in the experimental group who received feedback analysis in their training tended to use more of the following behaviors than the control group: praise, positive affectivity talk, positive reinforcement after student-initiated talk, asking questions, accepting and clarifying student ideas; and more indirect teacher talk as opposed to direct teacher talk. Consequently, a decrease in the use of the following was reported: criticism of students, lecturing, and giving directions.

Modifications of Flanders' Interaction Analysis System have been developed in recent years for specific groups of teachers. One of these modifications is Parakh's[9]

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[8]Bondi, "The Effects of Interaction Analysis...," 795-799.

[9]Jal S. Parakh, "A Study of Teacher Pupil Interaction in BSCS Yellow Version Classes," The American Biology Teacher, XXX (December, 1968), 884.

Categories for Interaction Analysis for Biology Classes developed in 1965. Parakh expanded Flanders' Category system with the addition of categories of teacher and pupil behaviors which were primarily for science classes. These categories were grouped under 4 major divisions: the evaluative dimension, the cognitive dimension, the procedural dimension and the pupil talk dimension.

Parakh's report of his findings on teacher pupil interaction in BSCS Yellow Version biology classes using his category system are mainly descriptive of teacher and pupil behavior patterns. His major observations included a high percentage of teacher verbal behavior compared to pupil verbal participation especially pupil-initiated contributions. A high percentage of time is also spent on class routines, so much so, that the probability of its affecting the attitudinal and affective climate of the classroom is raised. Very little time is spent on motivational aspects such as praising, encouraging, and accepting student ideas.

The introduction of modern science curricula and the accumulation of evidence on the influence of teacher classroom behavior on the teaching and learning situation have led to a number of studies seeking refinement of procedures for observing teacher and pupil behavior in the science classroom. Freidel's[10] observations of a sample of science

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[10]Arthur William Freidel, "A Procedure for Observing Teacher and Pupil Behavior in the Science Classroom," New

classes resulted in the development of behavior categories based on a model of communications as synthesized by Galloway and a theory of interpersonal needs as postulated by Schutz. He arrived at the conclusion that the predominant behaviors in science classes are message behaviors of the teacher and the non-message behaviors of the pupils and that there is very little use of reinforcement behaviors by the teachers, a conclusion that is similar to those of other researches using Flanders' interaction analysis or its modifications.

Kondo[11] made a study of the questioning behavior of teachers in the Science Curriculum Improvement Study (SCIS) and the possible relationships between their questioning behavior and the different types of SCIS lessons. Questioning was studied in terms of their complexity, types of questions, teacher reactions to responses or to her own questions and the transition probabilities of one question type followed by the same or other types. Like many of the other studies on classroom behavior this study dealt primarily with verbal behaviors. The mechanism of non-verbal behaviors and their

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Approaches to Science Education Research. Abstract of papers presented to the 42nd Annual Meeting of the National Association for Research in Science Teaching (Pasadena: California, Feb. 6-9, 1969), 203.

[11]Allan Kiichi Kondo, "A Study of the Questioning Behavior of Teachers in the Science Curriculum Improvement Study Teaching the Unit on Material Objects," New Approaches to Science Education Research, Abstract of paper presented to the 42nd Annual Meeting of the National Association for Research in Science Teaching (Pasadena: California, Feb. 6-9, 1969), 4-5.

effects on classroom instruction and learning were assumed to be negligible or insignificant.

A realization of the importance of non-verbal cues and clues in conveying and receiving information led French and Galloway[12] to develop a modification of Flanders' Interaction Analysis to include non-verbal behaviors. The Indirect-Direct Encouraging-Restructuring (IDER) observational system, as their modification is referred to, contains categories of non-verbal behaviors for each category of verbal behavior in Flanders' system. Their findings from over 27,000 IDER tables show that the proportion of directly verbal behavior is not related to the proportion of restricting non-verbal behaviors exhibited nor is the proportion of indirect encouraging-verbal behaviors related to the proportion of encouraging non-verbal behaviors. Their observations note that teachers tended to be more encouraging than restricting in their non-verbal cues, but more restricting than encouraging in those non-verbal cues which refer to the category on use of student ideas.

The need for valid and reliable observations of teacher behaviors in interaction research have led to a refinement of the method of describing and observing biology teacher

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[12]Russell L. French and Charles M. Galloway, "A Description of Teacher Behavior, Verbal and Non-Verbal," ERIC REPORTS Ed 028 1 3 4 (Bethesda, Maryland: Leasco Information Products, 1969), 1-9.

behaviors. One of the newly developed techniques is the inductive approach to the study of biology teacher behaviors developed by Evans and Balzer[13] in 1970. From the empirical data gathered on representative verbal and non-verbal biology teacher classroom behaviors a category system was developed, the Biology Teacher Behavior Inventory (BTBI), composed of 7 major categories similar to the original category systems in Flanders' Interaction Analysis but more comprehensive.

Balzer,[14] in an exploratory investigation of verbal and non-verbal behaviors of the BSCS and non-BSCS teachers using the Biology Teacher Behavior Inventory, found no significant differences in behaviors between the BSCS and non-BSCS teachers except in the "Scientific Process" subcategory. BSCS teachers are evidently higher in "Scientific process" behaviors than the non-BSCS. Some aspects of behaviors correlate highly for the teachers observed but significant differences with respect to "Laboratory management", "Control", "Release", "Scientific process", "Facilitating communication", and "Negative affectivity" are present among the group.

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[13]Thomas Evans and LeVon Balzer, "An Inductive Approach to the Study of Biology Teacher Behaviors," Jour. of Res. in Science Teaching, VII (1970), 47-56.

[14]Abe LeVon Balzer, "An Exploratory Investigation of Verbal and Non-verbal Behaviors of BSCS and Non-BSCS Teachers," Ph. D. dissertation, The Ohio State University (Ann Arbor, Michigan: University Microfilms, 1969).

Teacher Behavior Patterns in Effective Teaching

One very important aspect in the use of interaction analysis is in research relating teacher behavior and pupil growth. Several studies have been made to identify relations between teacher behaviors and pupil achievement in the subject matter taught. A significant outcome of these researches with the use of the interaction analysis observation schedules is the empirical data now available to support the assumptions regarding relationships between teacher behaviors and subject matter achievement and pupil attitudes.

In a study of the relationships between teacher behaviors and pupil achievement in three experimental elementary science lessons, Wright and Nuthall[15] found evidence which suggests that greater pupil subject matter achievement could result from teachers who asked relatively direct questions, tended to provide an informative summary (structuring) at the end of a discussion topic, involved more pupils by redirecting each question to several pupils, made frequent use of thanks to pupil responses and provided comprehensive revision at the end of lessons.

Soar's[16] findings in a study of 55 elementary classes

[15]Clifford J. Wright and Graham Nuthall, "Relationships Between Teacher Behaviors and Pupil Achievement in Three Experimental Elementary Science Lessons," American Educ. Res. Jour., VII (November, 1970), 477-478.

[16]Robert S. Soar, "Research From Systematic Observation," Jour. of Res. and Development in Ed., IV (Fall, 1970), 116-121.

are in some way different from those of Wright and Nuthall. The criteria for observation of behaviors, however, were different and so were the subject matter achievements studied. In vocabulary, Soar noted that indirect teachers and a supportive classroom climate produced more growth than direct teachers and a negative and critical classroom did. In reading, the emotional climate made no difference although indirect teaching provided significantly greater growth. These observations corroborate earlier data reported by Soar[17] on teacher effectiveness. He found a high degree of correlation between subject matter achievement and a relatively leisurely pattern of teacher-pupil interchange in contrast to the use of drill which is more direct and a negative relationship between amount of criticism expressed by the teacher and the amount of subject matter growth.

A finding on the relationship between teacher behavior and pupil growth that is of special interest to biology is that of La Shier in 1966 as reported by Soar.[18] In a study done with students taking a BSCS Laboratory Block, he was able to establish an "unusually" strong relationship between indirectness of teacher style and both subject matter achievement and favorableness of attitude on the part of the pupils.

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[17]Robert S. Soar, "New Developments in Effective Teaching," The American Biology Teacher, XXX (January, 1968), 44-45.

[18]Ibid., 44.

Additional data gathered by Soar,[19] through interaction analysis studies, on the relationship between teacher behavior and pupil growth have implications on the teaching of biology as inquiry. High subject matter achievement was associated with the following pattern of teacher-pupil interchange:

> ... the teacher poses a problem, provides a limited unit of information for the pupils to respond to, then asks a question, followed by pupil answer or discussion which continues at some length, followed by a repetition of the cycle.

Inferences were drawn from their findings that indirect teacher behavior is important in the teaching of concepts and abstract learning.

A pattern of teacher-pupil interaction that is very much similar to the one described by Soar as related to high subject matter achievement was identified by Balzer[20] as necessary for inquiry in biology classes. The teacher poses a problem with a minimum of information, or the students take the initiative of selecting phenomena and identifying the problem without verbal presentation of the problem by the teacher. In the ensuing discussion, care is taken to use the "teachable moment", according to Suchman[21] for introducing

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[19] Ibid., 45.

[20] Abe LeVon Balzer, "Teacher Behaviors and Student Inquiry in Biology," The American Biology Teacher, XXXIII (January, 1970), 26-28.

[21] J. Richard Suchman, Developing Inquiry (Chicago: Science Research Associates, 1966), 21.

certain data or facts to the class. The teacher insures that his verbal and non-verbal behaviors support and maintain student inquiry. "Positive affectivity" behaviors have been identified as necessary to support inquiry, "negative affectivity" behaviors have been found to be inconsistent with the goals of open inquiry.

The criterion problem in research on teaching is, according to Gate,[22] a primary source of difficulty in measuring teaching. It appears from the few findings reviewed that the criteria of effectiveness in teaching vary with subject matter, intent or purpose of teaching and the group studied. More sophisticated procedures have to be developed to arrive at reliable criteria because of the complexity of the teaching-learning situation.

It may be safe to conclude from the data now available that in the teaching of biology as inquiry at the secondary level, where concepts and abstractions are already involved, an indirect teaching style and a supportive classroom climate may result in an increase in subject matter achievement and in the development of favorable pupil attitudes.

The extent to which teacher classroom behaviors is affected by external and internal factors has also been the subject of research in recent years. Like those studies on

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[22]N. L. Gage, "An Analytical Approach to Research on Instructional Methods," Phi Delta Kappan, XLIX (June, 1968), 601-602.

teacher behaviors in effective teaching, studies of the relation of personality traits and external conditions on patterns of teaching style need a higher degree of refinement of procedures.

## Teacher Characteristics and Teacher Classroom Behaviors

Ryans[23] review of early studies on internal factors affecting teaching behavior describes patterns of behaving styles which could be considered as personality traits or underlying characteristics. Such behaving styles as "friendly, warm, understanding, sensitive, sincere, emphatic, rapport maintaining, responsible, systematic, business-like, dependable, well-prepared, efficient-presentation, student-achievement-oriented, orderly, organized," "stimulating, imaginative, achievement motivating, active, resourceful, dynamic, personally-acceptable, attractive, good appearing, verbally expressive, communicative, professionally impressing", or "direct, dominative, teacher-centered, authoritarian versus indirect, integrated, permissive, child-centered", are descriptive of personality traits.

The question of whether teacher behavior patterns in the classroom are determined by personality traits and their relationship to classroom behavior or by teaching success or

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[23] Ryans, "Assessment of Teacher Behaviors...," 424-426.

by other performance indices has been dealt with in a number of studies. Of interest to this study are those of biology teacher characteristics and teacher classroom patterns.

Gold[24] studied the correlation between interaction of biology teachers in the classroom with human relations ability, openness to new situations and the feelings of comfort in using an indirect style of teaching as measured by the Teaching Situation Reaction Test (TSRT). His findings show that there were few differences in the interaction of teachers who scored relatively high on the TSRT and those who scored relatively low. Similar results were observed when interaction was correlated with the teacher-pupil relations and teachers' personal adjustment as determined by a Teacher Rating Scale and a Student Opinion Questionnaire.

Earlier studies reviewed by Evans[25] on the relationship between patterns of teacher classroom behavior and personality traits of teachers, such as those of Ryan (1960), Bowers and Soar (1961), and Travers et al. (1961), did not find any relationship between these factors or if there were

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[24]Louis Gold Lance, "Verbal Interaction Patterns in the Classroom of Selected Science Teachers: Biology," Ph. D. dissertation, The Ohio State University (Ann Arbor, Michigan: University Microfilms, 1966), 115-116.

[25]Thomas Parker Evans, "An Exploratory Study of the Verbal and Non-Verbal Patterns of Biology Teachers and Their Relationship to Selected Personality Traits," Ph. D. dissertation, The Ohio State University (Ann Arbor, Michigan: University Microfilms, 1968), 108-112.

any, the correlations were extremely low. A meaningful relationship was reported by Fowler and Soar, as cited by Evans,[26] between personality characteristics and attitudes of the teachers and the classroom behaviors of both teachers and pupils.

A comparison of personality measures for innovative male physics teachers with those for other male teachers made by Walberg and Welch[27] do suggest a relationship between "innovativeness" and personality characteristics. Their studies show that personality differences exist between those who were rated as innovative and those who were not and between those physics teachers and other science teachers.

Evans[28] suggested a similar relationship between teacher personality and biology teacher behavior patterns. He reported a high correlation between selected personality traits as measured by the Guilford-Zimmerman Temperament Survey (general activity, retraint, ascendance, sociability, emotional stability, objectivity, friendliness, thoughtfulness, personal relations, masculinity) and teacher classroom behavior as interpreted with the Biology Teacher Behavior Inventory. Because of the complexity of the nature of the

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[26] Ibid., 113-114.

[27] Herbert Walberg and Wayne W. Welch, "Personality Characteristics of Innovative Physics Teacher," Jour. of Creative Behavior, I (1967), 162-171.

[28] Evans, op. cit., 210-211.

study, Evans pointed out the need for greater sophistication of studies of this nature "beyond first order correlations" as did Bruce[29] in his review of science teacher personality and other characteristics.

Very few researches have been published relating teacher background and environmental conditions of the teacher to teacher behavior. Ryans[30] cited a previous study to establish relationships between certain behavior patterns and environmental conditions such as grade level, subject taught, size of school in which teaching occurred, size of community, socio-economic status of community in which teaching took place, cultural level of community and methodological emphasis of the school in which the teaching was done.

Competency in science, previous background in science and previous teaching experience have been found by Butts and Raun[31] to be significantly related to a change in a teachers perception of a curriculum innovation. The findings, however, of the research studies in their review suggest that previous teaching experience is not related to teacher behavior change especially after the first few years and that the amount of college training appeared to make little

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[29]Bruce, "Teacher Education...," 418.

[30]Ryans, "Assessment of Teacher Behavior...," 426.

[31]David P. Butts and Chester E. Raun, "A Study of Teacher Change," Science Education, LIII (January, 1969), 3-8.

difference in effective teaching behavior. Although subject matter competency was reported to be positively correlated with teaching effectiveness, it was not a major factor in the quality of teaching.

## Modification of Teacher Behavior

A number of researches in teacher education have sought to find means of influencing teacher behaviors in specific ways so that changes will occur and to identify what the changes would be. These investigations have been conducted in the pre-service and in-service teacher education programs involving methods courses.

Raack[32] studied the effects of an in-service program designed to help teachers learn to employ verbal teaching strategies that aid elementary pupils in attaining the goals of inquiry, self-initiation and self-evaluation of their own learning. Flanders System of Interaction Analysis and Sorenson's Q-Sort were used to measure teacher-role perception. The results of the study verified the following hypotheses: (1) that teacher behavior would change towards a more indirect pattern of influence with increased pupil verbal participation and initiation of participation, (2) that teacher behavior would affirm a description of the teacher's

[32]Marilyn Loeffler Raack, The Effect of An In-Service Education Program on Teacher Verbal Behavior. Ed. D. Dissertation, University of California, L. A. (Ann Arbor: University Microfilms, 1967).

classroom role congruent with an indirect approach to teaching, and (3) that there is a positive correlation between change towards an indirect teaching style and increased acceptance of the teacher's role consistent with an indirect teaching style. Results of the study also showed a positive correlation between a high dogmatism as measured by Rokeach's D-Scale and lack of desire or ability to increase their use of indirect teaching behavior.

Schmidt,[33] in a study of the influence of a summer institute on inquiry centered science education on elementary science and social studies teachers, reported that teaching behaviors could be modified within "statistically measurable limits through experiences that stress the philosophy and methodology of inquiry in science." His findings showed that the teachers used more of the "rational powers" (except recall) and the essential learning experiences after the summer institute. A decrease in the use of convergent and recall questions was also noted.

In a more recent study, Carline[34] investigated the effects of an in-service training program designed to enable

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[33]Frederick Benjamin Schmidt, "The Influence of a Summer Institute in Inquiry Centered Science Education Upon the Teaching Strategies of Elementary Teachers in Two Disciplines," Ph. D. dissertation, The University of Oklahoma (Ann Arbor: University Microfilms, 1969).

[34]John Carline, "Inservice Training--Re-examined," Jour. of Research and Development in Education, IV (Fall, 1970), 103-115.

teachers to recognize and use various verbal teaching behaviors and to assist them in analyzing their own verbal behavior in the classroom with Flanders System of Verbal Interaction Analysis. Teachers from two elementary schools were trained for a 2-hour period each day for four weeks. Results of his study confirm previous findings that teacher behaviors can be altered in a predicted direction with an intensive training program. A distinct increase in the use of motivating and reinforcing behaviors was observed among the experimental group of teachers after the in-service course.

Courses intended to develop self-awareness of teaching styles have also been developed in the pre-service teacher education programs. One such course described by Druger[35] was designed to enable prospective teachers to develop self-awareness of their teaching behaviors through a set of teaching experiences with feedback to enable self-evaluation of teaching behavior.

Many of the current teacher education programs reported that are employing behavior modification techniques in the preparation of prospective teachers are providing micro-teaching experiences. Much of the original research and use

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[35]Marvin Druger, "An Approach to a Science Methods Course," Science Education, LIII (December, 1969), 381-382.

of microteaching was conducted at Stanford by Dwight Allen[36] and his co-workers. Since then many other studies have been done evaluating the effectiveness of its use in in-service and pre-service programs.

Typical of these studies is that of Koran[37] on a science intern training program which included, among others, the "acquisition of a behavior repertoire" necessary for science teaching through the microteaching experiences. One aspect of the program was focused on the analysis of the behaviors of experienced science teachers in a variety of situations.

A study of the effects of verbal teaching behaviors of beginning secondary teacher candidates' participation in a program of laboratory teaching conducted by Davis and Smoot[38] shows that verbal teaching behaviors can be modified in specific ways. Aside from this a greater variety of teaching behaviors interpreted to be illustrative of behavioral flexibility is reported. Microteaching experiences with peers was the practice variable provided. In view of the sampling

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[36]Dwight Allen, "New Design for Teacher Education: The Teacher Intern Program at Stanford University," The Jour. of Teacher Education, XVII (Fall, 1966), 296-300.

[37]John J. Koran, "A Design for Pre-Service Science Teacher Education," Science Education, LIII (February, 1969), 47-52.

[38]O. L. Davis and B. R. Smoot, "Effects on the Verbal Teaching Behaviors of Beginning Secondary Teacher Candidates' Participation in a Program of Laboratory Teaching," Educational Leadership Research Supplement, IV (November, 1970), 165-169.

limitations the conclusions drawn from the study are tentative but the study as a whole appears to be significant in teacher education programs.

An evaluation of studies on the use of modeling feedback, and practice variables to influence science teacher behavior made by Koran[39] is a source of valuable information for the design and revision of teacher education programs. The research conclusions reviewed provide guidelines in the choice of course experiences involving behavior modifications in specific ways which permit more effective science teaching styles.

## Summary of Literature Reviewed

From the literature reviewed it is evident that observations of biology teacher classroom behaviors can now be done with some degree of accuracy. Several category systems for observation of teacher behaviors have been developed. One of the latest is the Biology Teacher Behavior Inventory (BTBI).

Researches show that certain types of behaviors can be identified for specific teaching and learning skills. Of primary interest in this study are the findings on teacher behavior which relate to effective teaching in the new biology

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[39]John J. Koran, "The Use of Modeling, Feedback, and Practice Variables to Influence Science Teacher Behavior," Science Education, LVI (December, 1972), 285-291.

curriculum. The data available from the studies reviewed support the hypothesis that an indirect teaching style and a supportive classroom climate result in increased subject matter achievement and the development of desirable pupil attitudes. Studies also show that change of teacher behaviors towards an indirect pattern and towards the use of motivating and reinforcing behaviors can result from in-service or pre-service courses using microteaching and feedback on teaching style as the practice variable. The findings, however, on teacher and school characteristics which may be related to teacher behavior change are not conclusive.

Although no data are available from Philippine situations the findings of the studies reviewed may be useful in evaluating the results of this study.

# CHAPTER III

# RESEARCH DESIGN AND PROCEDURES

## The Research Design and Hypotheses

The study may be categorized under a subset of teacher education research called training research. It involved a comparison of teacher behaviors between an experimental group who took an in-service biology methods course and control group over a two semester period. The research model used was patterned after the pretest-post-test control group design with randomization described by Campbell and Stanley.[1]

The following experimental hypotheses were tested:

$H_o1$: There is no significant difference in the mean values of the ratios of the following predominant categories* of teacher behaviors: (a) control-release behaviors, (b) positive-negative affectivity behaviors, (c) student centered-teacher centered content development behaviors, (d) scientific process-knowledge behaviors, and (e) facilitating communication-total teacher behaviors:
(1) between the experimental and control group before the methods course;
(2) within the control group before and after the methods course;

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[1]Donald Campbell and Julian Stanley, Experimental and Quasi-Experimental Design for Research (Chicago: Rand McNally & Co., 1963), 13-24.

*All categories are as defined in the Biology Teacher Behavior Inventory (see Appendix A).

(3) within the experimental group before and after the methods course;
(4) between the experimental and control groups after the methods course.

$H_o 2$: There is no significant difference in the mean values of the ratios of predominant verbal and non-verbal teacher behaviors interpreted as indicative of an indirect pattern of influence: (a) between the experimental and control groups before the methods course, (b) within the control group before and after the methods course, (c) within the experimental group before and after the methods course, and (d) between the experimental and control group after the methods course.

$H_o 3$: There is no relationship between change in teacher behavior towards an indirect pattern of influence following the methods course and the scores on the Teaching Situation Reaction Test.[2]

$H_o 4$: Change in teacher behavior towards an indirect pattern of influence following the methods course is not independent of the following teacher background variables: (a) teaching experience, (b) in-service science institute training, (c) educational attainment, (d) age, and (e) marital status.

$H_o 5$: Change in teacher behavior towards an indirect pattern of influence after the methods course is not independent of the following school variables: (a) school organization (public or private), (b) school type (academic or vocational), (c) school administration (sectarian or non-sectarian), (d) duration of use of BSCS materials, and (e) school facilities available.

$H_o 6$: There is no relationship between change from subject matter orientation to scientific process orientation and scores on the Processes of Science Test in biology.[3]

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[2]J. B. Hough and J. K. Duncan, "Technical Review of the Teaching Situation and Reaction Test, Sept. 15, 1966. (Mimeographed)

[3]Biological Science Curriculum Study, Processes of Science Test (N. Y.: Psychological Corporation, 1962).

## The Population

### The Area Studied

The area covered by the study is in the island of Cebu in the Central Visayas region of the Philippines (see Figure 1). The secondary schools included in the study are located in four cities (Cebu City, Mandaue City, Lapulapu City, Danao City) and ten municipalities in the province of Cebu as shown in Figure 2. All the schools are within a 60-kilometer radius from Cebu City, the provincial capital.

### The Population Sampling

The sample was taken from a population of 90 high school biology teachers from 60 secondary schools in the area studied. A summary of school characteristics in the population and in the sample taken is given in Table 1.

Out of the 60 secondary schools in the area only fifteen are public schools. The rest are either sectarian or non-sectarian private schools. Twenty-nine out of 31 sectarian schools are administered by Catholic religious orders. Of the non-Catholic schools, one is a Protestant school; the other is a Buddhist school.

Enrollments of the schools in the sample ranged from 100 to 8,000 students as of the school years 1971-72 and 1972-73.

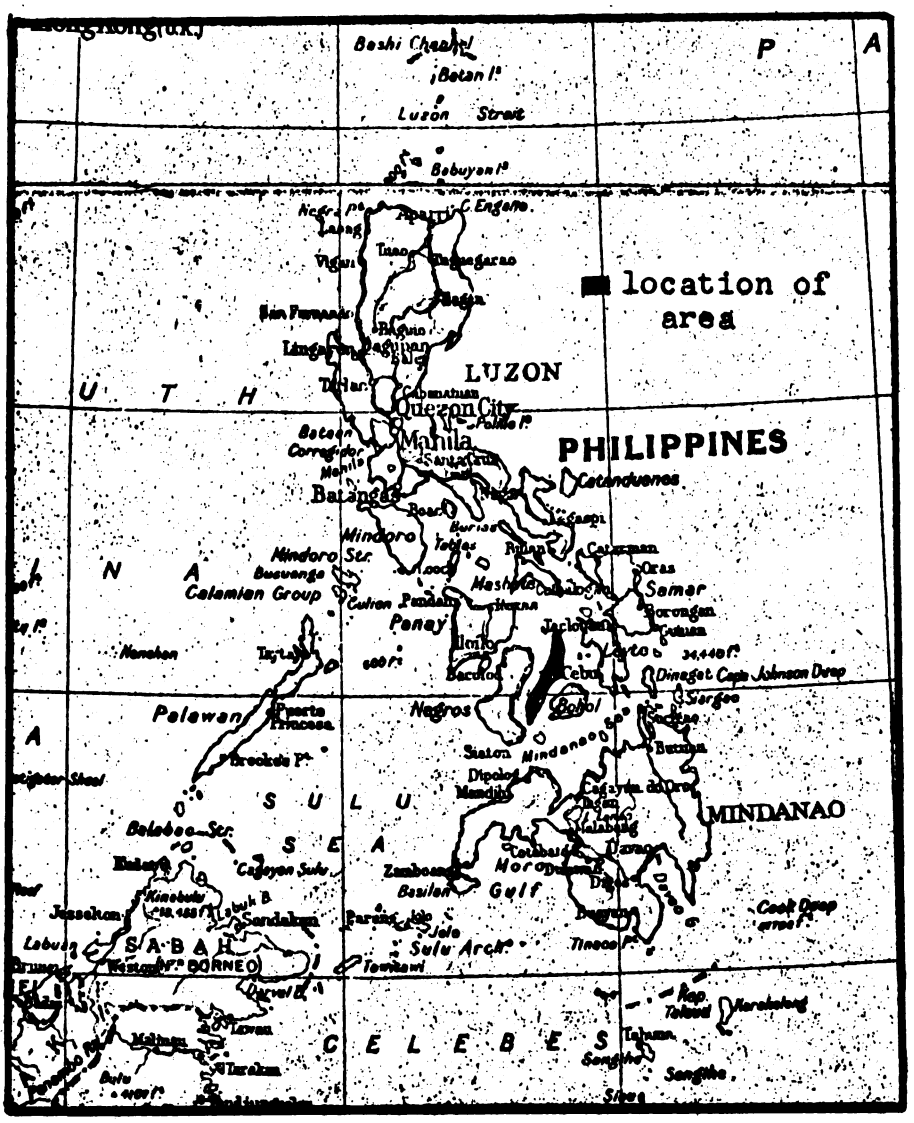


Figure 1.--Map of the Philippines showing the location of the area studied.

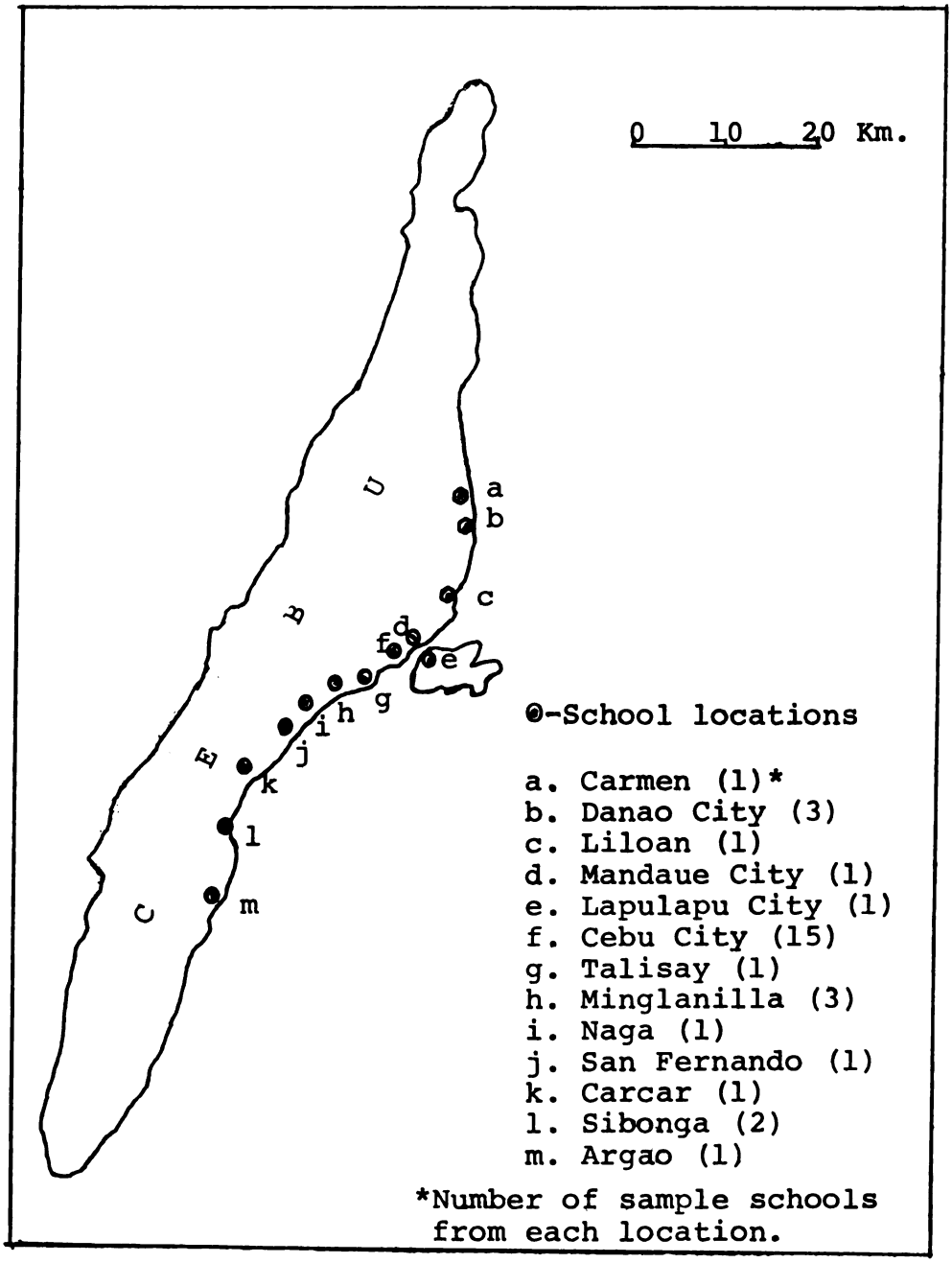


Figure 2.--Map of the Province of Cebu showing the location of schools in the area studied. (Scale 1:1,500,000)

TABLE 1

SUMMARY OF SCHOOL CHARACTERISTICS IN THE POPULATION AND SAMPLE STUDIED

| Type of School | Number in Area | Number in Sample | |
|---|---|---|---|
| | | Experimental | Control |
| Public Schools | | | |
| Academic | 6 | 1 | 1 |
| Vocational | 9 | 2 | 2 |
| Private Schools | | | |
| Non-sectarian | 18 | 6 | 5 |
| Sectarian | 31 | 10 | 9 |
| TOTAL | 60 | 19 | 17 |

Laboratory facilities ratings according to the Laboratory Facilities Checklist for BSCS Biology[4] are generally low (Table 2). The low ratings are mainly due to lack of major equipment listed in Category B of the checklist (see Appendix A) which are not required of high school laboratories by the Public and Private School Bureaus in the Philippines.

The distribution of teachers according to the type of school in the population and in the sample is summarized in Table 3. The entire population was made up of 84 female teachers and only 6 male teachers. A sample of 50 teachers,

[4]Evelyn Klinckmann, sup., Biology Teachers' Handbook (N. Y.: John Wiley & Sons, Inc., 1970), 628-630.

TABLE 2

LABORATORY FACILITIES RATINGS OF SCHOOLS IN THE SAMPLE

| Type of School | Ratings | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Experimental | | | | | | Control | | | | | |
| | A | B | C | D | E | F | A | B | C | D | E | F |
| Public Schools | | | | | | | | | | | | |
| Academic | | | | | 1 | | | | | | 1 | |
| Vocational | | | | 1 | 1 | | | | | | 1 | 1 |
| Private Schools | | | | | | | | | | | | |
| Non-sectarian | | | | 2 | 4 | | | | | 2 | 2 | 1 |
| Sectarian | | | 4 | 2 | 3 | 1 | | | 2 | 3 | 1 | 3 |
| TOTAL NUMBER OF SCHOOLS | | | 4 | 5 | 9 | 1 | | | 2 | 5 | 5 | 5 |

TABLE 3

DISTRIBUTION OF TEACHERS IN EXPERIMENTAL AND CONTROL GROUPS ACCORDING TO SCHOOL TYPE

| Type of School | Number in Area | Number in Sample | |
|---|---|---|---|
| | | Experimental | Control |
| Public Schools | | | |
| Academic | 6 | 1 | 1 |
| Vocational | 9 | 2 | 2 |
| Private Schools | | | |
| Non-sectarian | 40 | 6 | 8 |
| Sectarian | 35 | 11 | 9 |
| TOTAL | 90 | 20 | 20 |

representing 55% of the total population, was originally selected at random by picking out their names from a list with the use of a table of random numbers.[5] The sample was later increased to 60 to insure that there will be a sufficient number left for the experimental and control groups during the succeeding school terms.

Of the 60 teachers selected, five left their posts for various reasons at the end of the school year. Four of those who left were single. All were female teachers, in their early twenties, with from one to three years teaching experience.

The remaining 55 teachers from 40 high schools made up the sample. Twenty-one of these high schools were picked out at random to get 25 teachers for the experimental group. At most only two teachers were included in the experimental group from any one selected school with a biology teaching staff of more than two. The choice of the two teachers to take the biology methods course during the summer term was left to the discretion of the science department head or the school principal concerned.

Only 20 out of the 25 teachers selected for the experimental group were able to complete the course. Three could not attend because they were assigned summer teaching loads.

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[5]Gilbert Sax, Empirical Foundations of Educational Research (N. J.: Prentice-Hall, Inc., 1968), 113.

Two dropped out at the start of the course without giving specific reasons. These teachers who were automatically eliminated from the experimental group greatly increased the difference in size, age group and average years teaching experience of the two study groups. All of them were married, with a mean age of 44.5 years and an average teaching experience of 16.4 years.

In an attempt to minimize the sampling bias, the names of 6 married teachers with ages above 30 and teaching experience of more than ten years were excluded from the control group after the summer term. Two who joined a 6-week summer institute for biology teachers at a regional science teaching center and two who were not given teaching loads in biology during the 1972-73 school year were also excluded.

The Experimental and Control Groups

Teacher variables in the experimental and control groups are shown in Table 4.

The two groups were comparable with respect to mean score on the POST although the control group scored higher on the average on the TSRT. Variability of scores was higher in the control group on the POST but almost the same for the two groups on the TSRT.

About the same number of teachers in both groups claimed to be acquainted with BSCS materials at the start of the observations and to have used it entirely or in part but fewer

TABLE 4

COMPARISON OF TEACHER VARIABLES IN THE EXPERIMENTAL AND CONTROL GROUPS

| Teacher Variables | Experimental | Control |
|---|---|---|
| POST: Mean score | 22.25 | 22.60 |
| Standard deviation | 4.73 | 7.92 |
| TSRT: Mean score | 157.25 | 160.20 |
| Standard deviation | 12.23 | 11.98 |
| Mean Age | 33.55 | 36.65 |
| Mean Years Teaching Experience | 8.7 | 11.57 |
| Taking graduate courses for Masters degree (educ. or bio.) | 10 | 7 |
| Acquainted with BSCS materials | 16 | 16 |
| Using BSCS materials (entirely or in part) | 10 | 10 |
| In-service training on BSCS materials | 8 | 11 |
| Single | 13 | 5 |
| Married | 6 | 15 |
| Religious | 1 | 0 |

teachers in the experimental group had in-service training at NSDB-sponsored science institutes for biology teachers. More teachers in the experimental group, however, were pursuing graduate studies in either of the fields of education, biology, or science teaching.

Contact between the experimental and control groups during and after the methods course could not be controlled. Four schools required their teachers who attended the course

to give a report and to share their course materials with the other teachers. Two sectarian high schools whose biology teachers were part of the control group requested for a lecture-demonstration on inquiry techniques similar to those given in the microteaching sessions of the biology methods course.

## The Instruments

Observed teacher classroom behaviors were categorized with the use of the Biology Teacher Behavior Inventory (BTBI) developed by Evans and Balzer[6] in 1970 (Appendix A). The BTBI is based on actual descriptions of a sample of secondary school biology teacher behaviors observed in city and suburban areas. The inventory of teacher classroom behaviors is intended to be used in the categorization and descriptions of samples of biology teacher behaviors. Identification of specific behaviors under each category and the code numbers used in the identification of teacher behaviors were based on the Glossary of Teacher Classroom Behaviors in Evans[7] exploratory study of verbal behaviors of biology teachers and their

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[6]Thomas P. Evans and LeVon Balzer, "An Inductive Approach to the Study of Biology Teacher Behaviors," Jour. of Res. in Sc. Teaching, VII (1970), 51-52.

[7]Thomas Parker Evans, "An Exploratory Study of the Verbal and Non-Verbal Behaviors of Biology Teachers and Their Relationship to Selected Personality Traits," Ph. D, dissertation, The Ohio State Univ. (Ann Arbor, Michigan: University Microfilms, 1968), 227-245.

relationship to selected personality traits. Reported overall inter-observer agreement on the BTBI is .92 as obtained by the use of the Scott Index Inter-recorder agreement.

The Teaching Situation Reaction Test (TSRT) developed by Duncan and Hough[8] was used to compare the experimental and control groups with respect to certain teacher characteristics that may be related to change in teacher behavior towards an indirect pattern of influence. The TSRT in Appendix A is a 48 item instrument which requires the testee to respond to classroom oriented situations by ranking a set of four items representing four possible solutions for each item. Teacher characteristics that may be measured by the test relate to the

> teacher's human relations ability, openness to new experiences and feelings of comfort in using a direct or indirect style of teaching.[9]

Reported test-retest reliability of the TSRT is .84. Studies of its construct validity have demonstrated small positive relationship between factors measured by the Rokeach Dogmatic Scale, the Barret-Leonard Relationship Inventory, the Minnesota Teacher Attitude Inventory and the California Test of Mental Maturity on samples ranging from N = 51 to N = 86.[10]

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[8]Duncan and Hough, "Technical Review..." (Appendix A)

[9]John L. Carline, "In-Service Training Re-examined," Jour. of Research and Development in Education, IV (Fall, 1970), 106.

[10]Duncan and Hough, op. cit., 1-32.

Some aspects of the test appear to be related to negative control as measured by the California F-scale and positively related to empathy as measured by the Intraception Scale of the Edwards Preference Scale, according to Murray and Duncan.[11] It has also demonstrated predictive validity at significant levels (0.05) in six studies of pre-service and in-service teachers.

The classroom situations described in the TSRT are similar to those encountered in Philippine schools except for the time schedules. These were changed to suit the school calendar in the Philippines in the copies of the test administered to the teachers in the sample.

Understanding of the principles and methods of science by the experimental and control groups were compared with the use of the Processes of Science Test in Biology,[12] a 40-item test prepared by the BSCS and the Psychological Corporation (New York).

Other teacher variables that may affect teacher behavior change such as age, marital status, teaching experience, educational attainment, in-service training and duration of use of the BSCS materials were determined with a Biology Faculty Information Sheet (Appendix A).

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[11]C. Kenneth Murray and James K. Duncan, "A Study of the Construct Validity of the Teaching Situation Reaction Test" (paper read at the annual meeting of the American Educational Research Association, Chicago, Ill., February, 1968), 1-6.

[12]BSCS, Processes, 1-13.

School variables such as the type, organization, and administration of the school, enrollment and curriculum materials used were surveyed with a School Information Sheet (Appendix A). Laboratory facilities were rated according to the Laboratory Facilities Checklist for BSCS Biology shown in Appendix A.

## Procedures for Observations and Analysis

### The Class Observations

Pre-observations of high school biology classes of the experimental and control groups were made from January to April, 1972; post-observations were done from July to October, 1972.

Permission to observe biology classes in all private high schools included in the sample was obtained from the Eastern Visayas Regional Superintendent of the Bureau of Private Schools. For the public high schools permission to observe classes was obtained from the Superintendent of Trade Schools for the vocational high schools, and from the Superintendent of the Division of Cebu and from the Cebu City Division of Schools for the academic high schools. Permission was also obtained from all the principals of the high schools included in the sample.

All schools to be observed were visited once before appointments were made. Dates of class observations were set by the biology teachers concerned. Each teacher was observed

twice, once before and once after the methods course. Where technical and mechanical problems were encountered in recording the first observations, classes were observed more than once.

The purpose of the observations was not made known to the teachers and to all those from whom permission to observe classes were asked. Teachers and principals were only informed that the data gathered from the class observations were to serve as a basis for an in-service biology methods course. Assurance was given to all those concerned that the data will be treated as highly confidential and that no names of schools or teachers will be mentioned in the research report.

The Faculty Information Sheet, and the School Information Sheet, were given to the teachers at the time the first observations of their classes were made. The Teaching Situation Reaction Test and the Processes of Science Test in biology were administered at a meeting called one month before the start of the summer term for the purpose of selecting the experimental group. For those who were not able to attend the meeting the tests were administered individually. The laboratory facilities in each school were rated in the Laboratory Facilities Checklist before or after the class observations.

Classroom observations of teacher verbal behaviors were tape recorded. The recorded observations ranged from a little

over 27 minutes to almost 77 minutes for each teacher in both groups before and after the methods course except for one class observation in the control group which was recorded only for 15 minutes.* A summary of the record of all classroom observations is shown in Table 5, Appendix C.

Variations in the duration of recorded observations were due to the fact that observations were not recorded immediately at the start of the class or immediately before classes ended to exclude most routine procedures not common to the group observed (e.g., prayers, specific school announcements, etc.). Examinations given to the class, either oral or written, were also excluded from the record of observations. Preliminary observations indicated that teacher behavior patterns tended to change from direct to indirect or vice versa during one class period, depending on the nature of the class activity. Hence, it was found necessary to analyze the entire recording of a class session to maximize the accuracy of the behavior sample.

Tape recordings of the class sessions were made with a Hitachi wireless FM microphone NWM*101 clipped to the teacher and a battery-operated FM/AM Portable Radio-Cassette Tape Recorder. These were later transferred to 7-inch reel

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*One class period is 40 minutes. A regular biology class is equivalent to two class periods or 80 minutes. The 15 minute class period resulted from adverse weather conditions.

magnetic tapes together with signals from an audio tape prepared to beep every ten seconds. Ten seconds were allowed for the completion of most behaviors according to the BTBI.

Only random observations of teacher non-verbal behaviors could be made. Those behaviors which were long enough to be noticeable to a large majority of the class were either written down or photographed with an Olympus Trip 35 camera in black and white film. Photographs and recorded observations of verbal and non-verbal behaviors were usually taken at the back of the classroom where all class activities could be freely noted without the class being too conscious of it.

## Analysis and Interpretations

The audio tape recordings of teacher verbal behaviors were written to facilitate analysis and interpretation. Vertical lines were drawn to indicate the ten second intervals on the recorded behaviors. Verbal and non-verbal behaviors recorded were then identified, classified and recorded in Data Record Sheets (Appendix B).

Data from one class in the control group was excluded because these were considered atypical of biology classes. Verbal exchanges were at a whispered volume between two or more students and teacher comments were intended for only 1 or 2 students. None of the verbal teacher behaviors were audible enough to be picked up by the wireless microphone or to be heard at the back of the room.

The observed behaviors were classified according to the BTBI categories and according to the inferred intent of the behavior as verbal or non-verbal. Identifications of behaviors under specific categories and sub-categories were written in code using the number combinations in Evan's Glossary of Teacher Classroom Behaviors (Appendix D). Verbal behaviors which could not be clearly heard from the tapes were classified under Category 7 as were all other behaviors which could not be classified according to inferred intent. All teacher classroom behaviors were identified in Evan's Glossary for record purposes only. It was not the purpose of this study to prepare a list of biology teacher behaviors because of the limitations of the devices used for recording behaviors.

If two or more behaviors occurred within a ten second interval, the behavior which consumed the largest portion of the interval or the behavior reinforced by another during the interval was considered as the predominant behavior.

No detailed analysis of student behaviors could be made since the devices used for recording classroom observations were primarily for teacher behaviors. Extent of behaviors indicative of an indirect pattern of influence which were identified and classified was limited only to the categories and sub-categories of the teacher behaviors in the Biology Teacher Behavior Inventory. The informal random observations of non-verbal teacher behaviors in the absence of a video

tape recorder may have resulted in some loss of information and a consequent lessening of the degree of accuracy of the observations. The methodology of the study, however, was adapted to typical Philippine conditions where video tape recorders are not available.

The possible influence of general impressions of the teacher, the pupils or the total situation or the classroom observations constitutes another limitation to the study in spite of the awareness of the effects of this on the data obtained. No measures could be taken to minimize the "halo effect" since no student with a sufficient background in the area could be trained to do similar classroom observations so that interobserver reliability coefficient could be determined.

Totals of predominant behaviors in the following categories: (1) control, (2) release, (3) content development, and (4) affectivity (positive and negative) as well as totals of predominant subcategories of teacher centered content development such as knowledge, scientific process, and facilitating communication were determined and recorded in tabulated form. This is given in Tables 7 and 8, Appendix C, together with the total of predominant behaviors interpreted as indicative of an indirect pattern of influence and the over all totals of predominant behaviors observed for each teacher in the methods course.

Teacher behaviors categorized as "release", "positive affectivity" and "student centered content development" as well as the behaviors under the subcategories of "scientific process" and "facilitates communication" of the "teacher centered content development" category were interpreted as indicative of an indirect pattern of influence. Content development teacher behaviors under the subcategory of "knowledge" were interpreted as indicative of a subject matter emphasis while those under the subcategory of "scientific process" were interpreted as characteristic of an inquiry process oriented approach.

Ratios between totals of the following predominant teacher behaviors were computed: (1) control and release behaviors, (2) student centered and teacher centered content development behaviors, (3) behaviors indicative of positive affectivity and negative affectivity, (4) scientific process and knowledge behaviors, (5) behaviors facilitating communication and total teacher behaviors, and (6) behaviors indicative of an indirect pattern of influence and total teacher behaviors. This is shown in Tables 9 and 10, Appendix C.

Low ratios in control-release behaviors and high ratios in the following: (1) positive-negative affectivity behaviors, (2) scientific process-knowledge behaviors, (3) student centered-teacher centered content development teacher behaviors, (4) behaviors facilitating communication-total teacher behaviors, and (5) behaviors indicative of an

indirect pattern of influence-total teacher behaviors, were interpreted as characteristic of teacher behaviors which promote student behaviors associated with inquiry.

Mean ratios of these behaviors in the experimental and control groups were determined and compared to find out if there were any significant differences between the two groups before the methods course. Any change in teacher behaviors towards an indirect pattern of influence resulting from the methods course was determined by comparing the mean ratios of these behaviors before with those after the course for each group and by comparing the mean ratios after the methods course of the treatment group with those of the control group.

Two-tailed significance tests at the .01 level were made for the hypotheses formulated ($H_o1$) regarding the comparability of the two groups in the pretreatment observation. The directional hypotheses formulated relating to teacher behavior change as a result of the methods course were verified with one-tailed t-tests at the .01 level.

The existence of relationship between change in teacher behavior towards an increased use of scientific process behaviors and background in the processes of science as measured by the Processes of Science Test (POST) in biology was determined with Chi Square tests of independence between two variables. Chi square tests were also made to determine independence between change towards an indirect pattern of influence and the following teacher variables such as: dimensions

measured by the TSRT, age, marital status, educational attainment, teaching experience, previous in-service training on the BSCS materials, and school variables such as the type, organization, and administration of the school, the curriculum materials used and the laboratory facilities available. Findings were recorded in tabulated form.

## The Treatment

### The Course Program

The course was credited for three units in the Master of Arts program (science teaching and education) at the University of San Carlos during the 1972 summer term as Education 287A: Instructional Procedures and Techniques in Modern Biology. Classes were for 6 weeks from May 2 to June 6, 1966, Mondays to Fridays for two hours each day.

The course program was designed to give high school biology teachers a background in the structure and methodology of modern biology through selected classroom activities, readings, discussions and reports, microteaching experiences and self-evaluation of teaching style and teacher behavior consistent with the teaching of biology as inquiry. Stress was given to greater student participation and student-teacher interaction. Mainly, the course was experience oriented rather than theoretical (see Appendix E for the course objectives).

The course experiences were chosen to fit the needs of the individual biology teachers in their schools. It was for this reason that the teaching unit on metabolism was selected for the microteaching sessions since it appeared to fit with the various curriculum materials used in the different schools observed.

Implicit objectives of the course and explicit instructional objectives for each activity were stated in the course outline. The instructional activities were divided into four major categories: assessment of entering behavior and attitudes, establishing rapport in class and questioning techniques in inquiry discussions, the nature of modern science teaching and planning, and teaching a model unit in biology.

The section on the nature of modern science teaching was introduced with the structure of modern biology using Novak's[13] outline as a guide. Objectives for teaching inquiry processes in biology and the rationale for teaching science as inquiry were included in this section.

Experiences in formulating conceptual schemes for a biological principle and the writing of behavioral objectives for a laboratory investigation were provided. The students in the biology methods course were asked to interpret in a microteaching situation a conceptual structure of a biological principle and the teaching of science as inquiry using the

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[13]Joseph D. Novak, The Improvement of Biology Teaching (N. Y.: The Bobbs-Merrill Co., Inc., 1970), 17-30.

BSCS Invitation No. 10, "Environment and Disease,"[14] and the AIBS film on "Metabolic Diversity." Analysis of the microteaching sessions were to enable the students in the methods course to recognize and use various verbal and non-verbal behaviors and to assist them in their analysis of their own behaviors in the classroom.

Performance of the students on the methods course was evaluated on the basis of the objectives specified under each activity.

Class Organization and Management

The class was made up of 20 members divided into teams of two members each for the class activities and the microteaching sessions. Team memberships were based on the students' own choices for teammates and were retained throughout the rest of the course.

One student in a team taught the first objective of a lesson in a microteaching session, ranging from 5 to 15 minutes, to two high school pupils. The other team member acted as an observer. The observer in turn taught the succeeding objective of the lesson to the same pupils with the other team member as observer.

The microteaching sessions were tape-recorded on battery operated cassette tape recorders. Five tape recorders were

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[14]Klinckmann, ed., Biology Teachers' Handbook, 168-170.

used for the class with two teams using one tape recorder. While one team taught, the other team observed the students.

The microteaching tapes were played back immediately after the lessons and analyzed by the two teams together with the records of actual observations of pupil non-verbal behavior and the observations of the teammates. The instructor occasionally participated in the analysis before the reteaching of the lesson during the early part of the course but this was entirely up to the students towards the later weeks after they had gained familiarity with the techniques of analyzing the recorded microteaching sessions. Reteaching of the lesson was done on the same day.

Written individual comments were given by the instructor for the first two weeks on the teaching and reteaching sessions. Problems encountered were discussed on Fridays after the two teams working together had taught for the week. The students kept permanent records of their observations, the feedback and their analysis of the microteaching sessions.

## The Microteaching Unit

The unit selected for the microteaching sessions was taken from the BSCS Special Publication No. 6.[15] The unit was originally designed for 10 one-hour periods with either preservice or in-service teachers. It was intended to serve as

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[15]Glen Paterson, New Materials, 56-68.

a model for the teaching of biology as inquiry and to introduce the pupils to the nature of biological research.

Certain modifications were introduced in the unit such as the substitution of the BSCS Single Topic Inquiry Film, "Mimicry," which was not available, with the AIBS film, "Metabolic Diversity," and a change of the subject of the Invitation to Inquiry: "Environment and Disease." The foreign situations in the problem were changed to local ones familiar to the students. The procedure for Investigation No. 3, "A New Hypothesis" was altered because of the results obtained by the class in the previous investigation.

Suchman's[16] inquiry techniques and the guide questions in the discussion of the inquiry processes were used in the last two microteaching sessions.

Schedule of class activities together with the microteaching schedule is shown in a chart (Figure 3).

For the first week the microteaching session on Wednesday was an orientation with the pupils. The microteaching lessons were for the purpose of analyzing pupil entering behavior. The students were required to submit a report on the pupils' background in terms of the instructional objectives of subsequent microteaching lessons. A pretest on the unit to be taught was administered. The first microteaching session was on a Friday instead of Thursday.

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[16]J. Richard Suchman, Developing Inquiry (Chicago: Science Research Associates, Inc., 1966), 32-69.

Figure 3.--Schedule of Class Activities (May 2-June 9, 1973).

| WEEK | Mondays | Tuesdays | Wednesdays | Thursdays | Fridays |
|---|---|---|---|---|---|
| 1 | No class Labor Day | Orientation with students. Assignment of readings. | Orientation with pupils in microteaching sessions. Preparation for microteaching. | Pretest on microteaching unit for students. Discussion of objectives on assessment of entering behavior. | Pretest on microteaching unit for pupils. Microteaching session--5 min. Teams 1 & 2. Analysis and Reteaching. |
| 2 | Discussion of microteaching session and assigned readings. | Preparation for microteaching. | Microteaching session (10 minutes, Team 1 only) Analysis and Reteaching. | Microteaching session (10 minutes, Team 2 only) Analysis and Reteaching. | Discussion of microteaching sessions. Collection of written reports. |
| 3 | Film demonstration on teaching of concept. Discussion on assigned readings. | Discussion on objectives for teaching inquiry processes in biology. Preparation for microteaching. | Microteaching session (10 minutes, Team 1 only) Detailed analysis, no reteaching. | Microteaching session (10 minutes, Team 2 only) Detailed analysis, no reteaching. | Discussion of microteaching session. Collection of assignments and reports. |
| 4 | Open discussion on problems on inquiry teaching. | Discussion on planning for instruction. Preparation for microteaching. | Microteaching session (15 minutes, Team 1 only) Detailed analysis only. | Discussion of microteaching session results. Lecture-Resource person. | Microteaching session (15 minutes, Team 2 only) Detailed analysis only. |
| 5 | Discussion on background readings. | Demonstration with recording of Suchman's Inquiry Process. Preparation for microteaching. | Microteaching session using Suchman's Inquiry Techniques (15 min., Team 1) Analysis. | Microteaching session using Suchman's Inquiry Techniques (15 min Team 2) Analysis. | Discussion on problems encountered in microteaching. |
| 6 | Analysis of unit objectives and eval. questions. | Test Construction. | Administration of post test on microteaching unit. | Analysis of Test Results Item Analysis. | Statistical Analysis of Test Results. |

Each member of the two teams using one tape recorder taught one lesson objective for five minutes to two pupils and retaught the lesson to another two pupils after an analysis of the first teaching session was made.

The Pupils Taught During the Methods Course

Twenty-two first year and second year high school students who had not taken high school biology were invited to join the summer class through the teachers in the experimental group. Only nineteen were able to complete the term.

The group was originally made up of 12 boys and 10 girls, from 13 to 15 years old and coming from city and rural schools. I.Q. scores of the pupils ranged from below average to above average on the Philippine Mental Ability Test for High School Students.

Four pupils were taught by one microteaching team during each session. The pupils were rotated around the microteaching groups each meeting to give each teaching group the opportunity to come in contact with pupils of diverse backgrounds and abilities.

In summary Chapter III dealt with the research design and experimental hypotheses on teacher behavior change resulting from the in-service biology methods course. Experimental hypotheses on the relationship of change towards an indirect pattern of influence and scores on the Teaching Situation Reaction Test and on the relationship between change towards a

scientific process orientation and scores on the Processes of Science Test in biology were stated as well as hypotheses on dependence of change towards an indirect pattern of influence resulting from the in-service biology methods course on teacher background variables such as teaching experience, in-service science institute training, educational attainment, age and marital status and on selected school variables such as school type, organization, administration, duration of use of BSCS materials, and school facilities available.

The area studied, the population sampling and the characteristics of the schools and teachers in the population and sample were described. School and teacher variables in the experimental and control groups were compared. The treatment was a 6-week in-service biology methods course which provided experiences in interaction analysis, inquiry and laboratory techniques through microteaching experiences.

Observed classroom teacher behaviors were categorized with the Biology Teacher Behavior Inventory developed by Evans and Balzer in 1970. Identifications of behavior types were based on Evan's Glossary of Teacher Classroom Behaviors. Teacher characteristics that may be related to change in teacher behavior towards an indirect pattern of influence are determined with the Teaching Situation Reaction Test and the Processes of Science Test in biology. Other teacher variables such as teaching experience, in-service science institute training, educational attainment, age and marital status

were obtained with a Biology Faculty Information Sheet. School variables were determined with a School Information Sheet and a Laboratory Facilities Checklist for BSCS biology.

Observed verbal teacher behaviors are recorded with a battery-operated portable radio-cassette tape recorder and a wireless FM microphone. Non-verbal behaviors were recorded with a 35 mm. camera or written down. Duration of recorded observation for each class ranged from a little over 27 minutes to almost 77 minutes for each teacher.

Audio tape-recordings were written to facilitate analysis and interpretation. Vertical lines were drawn to indicate the 10 second intervals in the recorded behaviors. Verbal and non-verbal behaviors recorded were identified, classified and recorded in Data Record Sheets. The behavior which took up the largest portion of the 10-second interval was considered as the predominant behavior.

Totals of predominant behaviors in the following categories: (1) control, (2) release, (3) content development (student centered and teacher centered), (4) affectivity (positive and negative) as well as totals of subcategories of teacher centered content development behaviors such as: (5) knowledge, (6) scientific process, and (7) facilitate communication were determined. The sum of the totals of predominant behaviors in the following categories: (1) release, (2) positive affectivity, (3) student centered content development behaviors, and the following subcategories of

teacher centered content development behaviors: (4) scientific process, and (5) facilitate communication were interpreted as indicative of an indirect pattern of influence. Behavior totals under the subcategory "knowledge" was interpreted as indicative of a subject matter emphasis while those under the subcategory of "scientific process" were interpreted as characteristic of an inquiry process oriented approach.

Ratios between totals of the following predominant teacher behaviors were computed for each teacher in the experimental and the control groups: (1) control-release behaviors, (2) positive-negative affectivity, (3) student centered-teacher centered content development behaviors, (4) scientific process-knowledge behaviors, (5) facilitating communication-total teacher behaviors, and (6) indirect teacher behaviors-total teacher behaviors. Mean ratios of these behavior categories were computed for the experimental and control groups and compared to determine significant differences before and after the treatment. The experimental hypotheses on teacher behavior change were verified with t-tests. Chi square tests of independence between behavior change and selected teacher and school variables are used to verify the hypotheses formulated.

# CHAPTER IV

# ANALYSIS OF DATA AND DISCUSSION OF RESULTS

## The Classroom Observations

The major data gathering activity consisted of systematic classroom observations of experimental and control group teachers. The record of classroom observations of the teachers in the experimental and control groups are summarized in Tables 5 and 6 respectively, in Appendix C. Analysis of the records show that all the teachers in the experimental group were using the BSCS materials after the biology methods course compared to about 60% in both groups before the course. The shift to the use of the BSCS materials of all the teachers in the experimental group may have been a result of their exposure to the materials during the course. Although there was also an increase in the number of teachers using the BSCS materials in the control group after the methods course it was not as prevalent as in the experimental group.

There was also a distinct increase in laboratory activities in the treatment group after the course. Although no distinct pattern of topics was noted in the pre-observations,

the treatment group in the post-observations did show a topic sequence characteristic of the BSCS text used. Again it may be inferred from these observations that the change in the nature of class activities and the distribution pattern of the topics may have been an outcome of experiences provided in the methods course. As a part of their training activities, each teacher prepared a schedule of class activities for the entire year with the curriculum materials they were using. (See Appendix D for the training outline.) This experience was included because of the diversity of possible topics and the lack of laboratory activities noted in the pre-observations.

The fact that the pre- and post-observations were made during different school years and at different times during the school year did not appear to affect the findings of the study to an appreciable degree. The distribution of laboratory and non-laboratory activities was expected to be more or less the same even as topics advance in the course. The complexity of subject matter and process skills developed may increase towards the end of the course but the teacher verbal and non-verbal behaviors essential to content development were expected to be more or less similar. This was supported in the pre- and post-observations of classes in the control groups as shown in Table 6.

Appendix E shows the kinds of observed teacher behaviors as indicated in Evans' Glossary of Teacher Classroom Behaviors.[1] The variety of behaviors observed is less than that in Evan's glossary, but there are some behaviors typical of the local situations observed which were added. Almost all of the types of positive affectivity, content development, laboratory and study management behaviors were identified in the observations. Few of the routine management and goal setting behaviors were noted.

Overall fewer types of non-verbal behaviors were recorded in the observations than listed in Evans' glossary, especially in Categories 2 and 3 (Control and Release) and in Category 6b (Negative affectivity behaviors). Whether the teachers in the sample exhibit only the limited variety of the behaviors listed in these categories or whether the observations were limited by the method used or the recording devices can not be ascertained at this stage of the study. There is also the possibility that the expression of Control, Release, and Negative Affectivity behaviors may have been regulated by the teachers because of the presence of an observer in the classroom.

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[1]Thomas Parker Evans, An Exploratory Study of the Verbal and Non-Verbal Behaviors of Biology Teachers and Their Relationships to Selected Personality Traits, Ph. D. dissertation, The Ohio State University (Ann Arbor: University Microfilms, 1968), 227-245.

## Analysis of Observed Teacher Classroom Behaviors

Tables 7 and 8, in Appendix C, show the totals of predominant teacher behaviors observed in each category for the treatment and control groups. The ratios computed from the totals of each of the following behavior categories: control-release (2:3), positive affectivity-negative affectivity (6a:6b), student centered-teacher centered (5b:5a), scientific process-subject matter ($5a_3$:$5a_2$), facilitating communication-total teacher behavior ($5a_7$:total), and indirect teacher behaviors-total teacher behavior (indirect: total) are given in Table 9 for the experimental group and Table 10 for the control group in Appendix C.

Computed mean ratios for these categories are shown in Table 11. It can be seen that the mean ratios for the behavior categories enumerated increased for both the experimental and the control groups in the post observations. Mean increases appear to be higher in the experimental than in the control groups except for the ratio between behaviors facilitating communication and total teacher behavior. It appears from Tables 9 and 10 that the ratios of behaviors facilitating communication and total teacher behavior vary from topic to topic and with the methodology used (lecture, discussion, or laboratory). Very few behaviors of the category "facilitating communication" were considered predominant, since a majority of the behaviors identified in this category

TABLE 11

MEAN RATIOS OF TEACHER BEHAVIORS OBSERVED IN THE EXPERIMENTAL AND CONTROL GROUPS BEFORE AND AFTER THE BIOLOGY METHODS COURSE

| Teacher Behavior Categories | Experimental | | Control | |
|---|---|---|---|---|
| | Pre | Post | Pre | Post |
| 1. control-release | .5050 | 1.2650 | 1.0840 | 1.9960 |
| 2. positive-negative affectivity | .9900 | 1.6200 | .5400 | .9200 |
| 3. student centered-teacher centered | .3100 | 1.2300 | .3000 | .4000 |
| 4. scientific process-knowledge | .2800 | 3.8700 | .1600 | .6500 |
| 5. facilitating communi-cation-total teacher behavior | .0800 | .0700 | .1100 | .1200 |
| 6. indirect pattern of behaviors-total teacher behaviors | .3700 | .6400 | .3300 | .4100 |

consisted only of pointing to a student or calling a student by name, these behaviors very seldom occupied a major portion of a 10-second interval.

## Hypotheses Testing and Statistical Analysis of Data

Each experimental hypotheses relating to teacher behavior change as a result of the biology methods course is tested separately. Those relating to the dependence of teacher behavior change on teacher and school variables are also considered one by one. The statistical procedures and samples of computations are shown in Appendix G.

### The Hypotheses on Teacher Behavior Change

The t-test results of the experimental hypotheses tested on the difference in mean ratios of the behavior categories studied between the experimental and control groups before the methods course are summarized in Table 12.

There is no significant difference in the mean ratios of the following behaviors between the experimental and control groups before the methods course: (1) control-release behaviors ($H_o 1a_1$), (2) positive-negative affectivity ($H_o 1b_1$), (3) student centered-teacher centered content development behaviors ($H_o 1c_1$), (4) scientific process-subject matter content development behaviors ($H_o 1d_1$), (5) facilitating communication-total teacher behaviors ($H_o 1e_1$), and (6) indirect

behaviors-total teacher behaviors ($H_o 2a$). All of these hypotheses are not rejected at the .01 level of significance as shown in Table 12. The experimental and control groups are comparable with respect to the behavior categories studied before the treatment.

Data on t-test analysis summarized in Table 13 show that there are no significant differences in the mean ratios of the behavior categories studied within the control group before and after the methods course ($H_o 1a\text{-}f_2$). The t-test results do not reject the null hypotheses that there is no significant change in the mean ratios of categories of behaviors studied in those teachers who did not take the in-service biology methods course.

Table 14 shows the t-test analysis data on the null hypotheses that there is no significant difference in the mean ratios of the following behavior categories in the pre- and post-observations of the experimental group: (1) control-release behaviors ($H_o 1a_3$), (2) positive and negative affectivity behaviors ($H_o 1b_3$), (3) student centered-teacher centered content development behaviors ($H_o 1c_3$), (4) scientific process-subject matter content development behaviors ($H_o 1d_3$), (5) behaviors facilitating communication and total teacher behaviors ($H_o 1e_3$), and (6) indirect behaviors-total teacher behaviors ($H_o 2c$).

Based on the t-values obtained the null hypotheses that there is no significant difference in the mean ratios of

TABLE 12

DATA ON t-TEST ANALYSIS OF DIFFERENCE BETWEEN MEAN RATIOS OF TEACHER BEHAVIOR STUDIED IN THE EXPERIMENTAL AND CONTROL GROUPS BEFORE THE BIOLOGY METHODS COURSE

| Behavior Categories | Mean Difference | Pooled Variance | t-value | Decision |
|---|---|---|---|---|
| Control release | .5790 | 2.2972 | 1.1928 | do not reject $H_o 1a_1$ |
| Positive-negative affectivity | .4500 | 2.6300 | .8670 | do not reject $H_o 1b_1$ |
| Student centered-teacher centered | .0100 | .0599 | .1277 | do not reject $H_o 1c_1$ |
| Scientific process-knowledge | .1200 | .3022 | .6818 | do not reject $H_o 1d_1$ |
| Facilit. comm.-total behavior | .0300 | .0025 | 1.8750 | do not reject $H_o 1e_1$ |
| Indirect behavior-total behavior | .0400 | .0161 | .9847 | do not reject $H_o 2a$ |

df = 37 $\alpha = .01$

Decision: Reject $H_o$ if $-2.704 < t > 2.704$

TABLE 13

DATA ON t-TEST ANALYSIS OF DIFFERENCE BETWEEN MEAN RATIOS OF TEACHER BEHAVIORS STUDIED IN THE CONTROL GROUP BEFORE AND AFTER THE METHODS COURSE

| Behavior Categories | Mean Difference | Pooled Variance | t-value | Decision |
|---|---|---|---|---|
| Control-release | .9120 | 16.3231 | .7053 | do not reject $H_o 1a_2$ |
| Positive-negative affectivity | .3800 | 1.8315 | .8766 | do not reject $H_o 1b_2$ |
| Student centered-teacher centered | .1000 | .1007 | .9842 | do not reject $H_o 1c_2$ |
| Scientific process-knowledge | .4900 | 1.2808 | 1.3569 | do not reject $H_o 1d_2$ |
| Facilitating communication-total behaviors | .0100 | .0035 | .5208 | do not reject $H_o 1e_2$ |
| Indirect-total behaviors | .0800 | .0231 | 1.6461 | do not reject $H_o 2b$ |

df = 37 $\alpha$ = .01

Decision: Reject $H_o$ if $-2.705 < t > 2.705$

TABLE 14

DATA ON t-TEST ANALYSIS OF DIFFERENCE BETWEEN MEAN RATIOS OF TEACHER BEHAVIORS STUDIED IN THE EXPERIMENTAL GROUP BEFORE AND AFTER THE METHODS COURSE

| Behavior Categories | Mean Difference | Pooled Variance | t-value | Decision |
|---|---|---|---|---|
| Control-release | .7600 | 1.1322 | 2.2659 | do not reject $H_o 1a_3$ |
| Positive-negative affectivity | .6300 | 4.4471 | .9448 | do not reject $H_o 1b_3$ |
| Student centered-teacher centered | .9200 | .7682 | 3.3201 | accept $H_o 1c_3$ |
| Scientific process-knowledge | 3.5900 | 16.3250 | 2.8097 | accept $H_o 1d_3$ |
| Facilitating communication-total behaviors | .0100 | .0021 | .6839 | do not reject $H_o 1e_3$ |
| Indirect-total behaviors | .2700 | .0283 | 5.0751 | accept $H_o 2c$ |

df = 38 $\alpha = .01$

Decision: Reject $H_o$ if $t > 2.423$

of control-release behaviors ($H_o 1a_3$) positive-negative affectivity behaviors ($H_o 1b_3$) and behaviors facilitating communication-total teacher behaviors ($H_o 1e_3$) in the experimental group before and after the methods course were not rejected at the .01 level of significance. There is, however, a significant increase in the mean ratios of student centered-teacher centered content development behaviors ($H_o 1e_3$), scientific process-knowledge content development behaviors ($H_o 1d_3$), and in the indirect behaviors-total teacher behavior ratio ($H_o 2c$) after the biology methods course.

Summarized in Table 15 is the t-test analysis data on the null hypotheses ($H_o 1a\text{-}e_4$, $H_o 2d$) that there is no significant difference in the mean ratios of the behavior categories studied between the experimental and control groups after the biology methods course. The null hypotheses that there are no significant differences in the mean ratios of control-release behaviors ($H_o 1a_4$) and positive-negative affectivity behaviors ($H_o 1b_4$) between the experimental and control groups were not rejected at the .01 level. There are significant differences in the mean ratios of the following behavior categories between the experimental and control groups after the biology methods course: (1) student centered-teacher centered content development behaviors ($H_o 1c_4$), (2) scientific process-knowledge content development behaviors ($H_o 1d_4$), (3) behaviors facilitating communication-total teacher behaviors ($H_o 1e_4$),

TABLE 15

DATA ON t-TEST ANALYSIS OF DIFFERENCE BETWEEN MEAN RATIOS OF TEACHER BEHAVIORS STUDIED IN THE EXPERIMENTAL AND CONTROL GROUPS AFTER THE METHODS COURSE

| Behavior Categories | Difference | Variance | t-value | Decision |
|---|---|---|---|---|
| Control-release | .7310 | 12.2708 | .6599 | do not reject $H_o 1a_4$ |
| Positive-negative affectivity | .7000 | 3.6695 | 1.1556 | do not reject $H_o 1b_4$ |
| Student centered-teacher centered | .8300 | .8078 | 2.9204 | reject $H_o 1c_4$ |
| Scientific process-knowledge | 3.2200 | 17.2774 | 2.4497 | reject $H_o 1d_4$ |
| Facilitating communication-total behavior | .0500 | .0031 | 2.8409 | reject $H_o 1e_4$ |
| Indirect-total behavior | .2300 | .0351 | 3.8851 | reject $H_o 2d$ |

df = 38 $\alpha = .01$

Decision: Reject $H_o$ if $t > 2.423$

and (4) behaviors indicative of an indirect pattern of influence-total teacher behaviors ($H_o$2d).

The increase in the mean ratios of student centered-teacher centered content development behaviors, scientific process-knowledge content development behaviors and behaviors indicative of an indirect pattern of influence-total teacher behaviors was significant. There was no significant increase in the mean ratio of behaviors facilitating communication-total teacher behaviors in the experimental group nor in the control group after the biology methods course yet, the difference between the two groups after the methods course is distinct. This difference may be traced to the fact that the mean ratio in this behavior category decreased slightly in the experimental group but increased slightly in the control group in the post-observations.

These findings agree with the findings of previous studies reviewed (Raack, Schmidt, Carline)[2] that teacher behaviors can be modified in a predicted pattern through an in-service program and that teacher behaviors can change towards an indirect pattern of influence through self-awareness of teaching styles, microteaching experiences and familiarity

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[2]Marilyn Loeffler Raack, The Effect of An In-service Education Program on Teacher Behavior. Ed. D. Dissertation, Univ. of Calif., L. A., 1967 (microfilm); Frederick B. Schmidt, The Influence of a Summer Institute in Inquiry Centered Sc. Ed. Upon the Teaching Strategies of Elem. Teachers in Two Disciplines. Ph. D. Dissertation, Univ. of Oklahoma, 1969 (microfilm); John Carline, "In-service Training-Re-examined," Jour. of Res. & Dev. in Ed., IV (Fall, 1970), 103-115.

with interaction analysis (Roush and Kennedy, Bruce, Bondi, Druger).[3]

The change towards an indirect pattern of influence after the biology methods course is significant because no previous empirical data have been obtained to show that the Filipino teacher can adapt such a pattern of influence in the classroom considering the claims to his "authoritarian" cultural background. The findings in this study do not agree with the report of Carbonell[4] that the choice of method in the classroom is determined by the cultural background of the Filipino teacher and the students, granting that the cultural background claimed is true of the region studied.

No difference was observed in the use of behaviors categorized as control, release, positive and negative affectivity and behaviors facilitating communication. It appears that the biology methods course did not result in an increase of behaviors which stimulate, support and reinforce

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[3]R. E. Roush and V. J. Kennedy, "Changing Teacher Behavior with Interaction Analysis," Education, XCI (Fall, 1971), 220-222; Matthew H. Bruce, "Teacher Education in Science," Rev. of Ed. Research, XXXIX (October, 1969), 415-419; Joseph C. Bondi, "The Effect of Interaction Analysis Feedback on the Verbal Behavior of Student Teachers," Ed. Leadership Research Supplement (May, 1969), 794; and Marvin C. Druger, "An Approach to a Science Methods Course," Science Education, LIII (December, 1969), 381-382.

[4]Guadalupe A. Carbonell, "Functional Relationships of the Filipino Cultural Values and Methods of College Teaching," St. Louis Univ. Research Journal, III (March-June, 1972), 31-37.

inquiry in the classroom. This seems to agree with Parakh's[5] observation of teacher pupil interaction in BSCS Yellow Version classes that very little time is spent by the biology teacher on motivational aspects such as praising, encouraging, and accepting student ideas and reinforcement behaviors.

### The Hypotheses on Independence Between Teacher Behavior Change and Teacher and School Variables

Table 16 shows the findings on the Chi Square Tests of independence of change towards an indirect pattern of influence on scores in the Teaching Situation Reaction Test (TSRT), on teacher background variables and on school variables and of change towards a scientific process orientation on scores in the Processes of Science Test (POST) in biology. The data show that the probability of the existence of a relationship between change in teacher behavior towards an indirect pattern of influence and scores on the TSRT ($H_o 3$) is less than 50%.

It appears that previous training in in-service science institutes ($H_o 4b$) is related to some degree ($.750 < p > .900$) to teacher behavior change towards an indirect pattern of influence as a result of the biology methods course. Although these in-service programs have been mainly on competence in the content of modern biology, this content background may

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[5]Jal S. Parakh, "A Study of Teacher Pupil Interaction in BSCS Yellow Version Classes," The American Biology Teacher, XXX (December, 1968), 848.

TABLE 16

CHI SQUARE TESTS OF INDEPENDENCE ON TEACHER BEHAVIOR CHANGE AND SELECTED TEACHER AND SCHOOL VARIABLES

| Behavior Change | Variable | $X^2$ value | p value* |
|---|---|---|---|
| | TSRT Scores ($H_o$ 3) | .3554 | .250 < p > .500 |
| | Teaching Exp. ($H_o$ 4a) | .5867 | .500 < p > .750 |
| Indirect pattern of influence | In-service Science instit. training ($H_o$ 4b) | 1.6467 | .750 < p > .900 |
| | Educational attainment ($H_o$ 4c) | 1.6039 | .750 < p > .900 |
| | Age ($H_o$ 4d) | .5861 | .500 < p > .750 |
| | Marital status ($H_o$ 4e) | .5861 | .500 < p > .750 |
| | School organization public or private ($H_o$ 5a) | .0653 | .100 < p > .250 |
| | School type: acad. or vocat. ($H_o$ 5b) | .0927 | .100 < p > .250 |
| | School administ. sectarian or non-sectarian ($H_o$ 5c) | .2987 | .250 < p > .500 |
| | Duration of use of BSCS materials ($H_o$ 5d) | 1.2500 | .500 < p > .750 |
| | School facilities ratings ($H_o$ 5e) | 10.7692 | .995 < p |
| Scientific process | POST Scores ($H_o$ 6) | 2.9570 | .900 < p > .950 |

df = 1

*William H. Beyer, ed., Handbook of Tables for Probability and Statistics (Cleveland, Ohio: The Chemical Rubber Co., 1966), 90.

have facilitated the use of the inquiry processes in the classroom. This relationship, however, may also be an interaction with other teacher variables as well.

Educational attainment appears to be related to change towards an indirect pattern of influence ($H_o$4c) to the same degree ($.750 < p > .900$) as previous in-service training in science institutes. Teachers with graduate units either in science or in education tended to change towards an indirect pattern of influence more than the teachers who had none.

There is a probability (more than 50%) that teacher behavior change towards an indirect pattern of influence is not independent of teaching experience ($H_o$4a), age ($H_o$4d) and marital status ($H_o$4e) although this probability is too low to be considered statistically significant. It appears that the less the number of years of teaching experience, the greater is the probability of changing towards an indirect pattern of influence in teacher behavior. The younger and single teachers, likewise, appeared to change towards an indirect pattern of influence more than the older and married teachers after the methods course.

Research studies cited by Butts and Raun[6] have reported that teaching experience is not related to teacher behavior change especially after the first few years. No data are

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[6]David P. Butts and Chester E. Raun, "A Study of Teacher Change," Science Education, LIII (January, 1969), 3-8.

available on the relationship between teaching experience, age of marital status and teacher behavior change in a Philippine setting, however, these are the teacher variables which are frequently used as criteria for selection of teachers for in-service training programs.

Teacher behavior change towards an indirect pattern of influence appears to be independent ($P > .500$) of the school organization, or whether the school is a public or a private school ($H_o 5a$); the school type, or whether the school is academic or vocational ($H_o 5b$); or school administration, or whether the school is sectarian or non-sectarian ($H_o 5c$). There are no data available on the relationship of these school variables to teacher behavior change. However, like the teacher variables selected in this study, these are school variables that have been used for categorization of teachers for in-service programs.

There appears to be no independence ($.500 < p > .750$) between teacher behavior change towards an indirect pattern of influence and previous use of the BSCS materials in the schools. Familiarity with the structure and content of the BSCS program must have increased the laboratory activity and facilitated the shift towards a more indirect pattern of influence.

In the Chi Square Tests of independence of teacher behavior change and selected school and teacher variables summarized in Table 16, only the experimental hypothesis on the

independence of teacher behavior change towards an indirect pattern of influence and school facilities ratings had a probability of more than 95%. It is interesting to note that of the teacher and school variables expected to be related to change towards an indirect pattern of influence only the school facilities available appeared to have a definite relationship to this change. This may be traced to the fact that if laboratory facilities are not available laboratory activity can not be carried out. Consequently, student participation is at a minimum and the teacher may have to resort to being direct. In general, the schools in the sample rated E and F are those with no rooms equipped for laboratory work, or if there is one, it is shared with all the other science classes and may not be available for biology classes when needed.

The increase in the use of scientific process behaviors is not independent of the teacher's background in the science processes as measured by the POST in biology ($.900 < p > .950$, $H_o 6$). This increase may also be related to the previous use of the BSCS materials. All the teachers in the experimental group were using the BSCS materials entirely or in part after the methods course compared to only a little over 50% in the control group. The increase in the use of scientific process behaviors after the methods course agrees

with the findings of Balzer:[7] that BSCS teachers are evidently higher in scientific process behaviors than non-BSCS teachers.

[7]Abe LeVon Balzer, "Teacher Behaviors and Student Inquiry in Biology," The American Biology Teacher, XXXII (January, 1970), 26.

# CHAPTER V

# SUMMARY, CONCLUSIONS, AND IMPLICATIONS FOR FURTHER STUDY

## Summary

The study was an assessment of the effect of a 6-week in-service biology methods course on teacher behavior change towards an indirect pattern of influence related to inquiry learning and the relationship between this change to selected school and teacher variables commonly used as criteria for selection of teachers in in-service programs.

The hypotheses investigated predicted an increase in the use of teacher behaviors which stimulate, support or reinforce inquiry in the classroom and a change towards an indirect pattern of influence as described by Flanders. It was also predicted that there would be an increase in the use of "scientific process" behaviors and that this change would be independent of the teacher's background in the processes of science as measured by the Processes of Science Test in biology.

Teacher behavior change towards an indirect pattern of influence was predicted to be dependent on teacher characteristics such as those measured by the Teaching Situation Reaction Test, previous in-service training in summer

institutes, teaching experience, educational background, age and marital status and on school variables such as the type, organization and administration of the school, the duration of use of the BSCS materials in the schools, and the school facilities available.

A sample of 40 secondary school biology teachers was selected at random from sixty secondary schools within a 60-kilometer radius from the City of Cebu, Philippines. One half of the sample was assigned to the experimental group and the other half was assigned to the control group. The experimental group took a 6-week in-service biology methods course aimed at developing teacher behaviors which promote inquiry learning during the 1972 summer term at the University of San Carlos. The course provided experiences in interaction analysis, inquiry and laboratory techniques through microteaching situations and in skills essential to the teaching of the BSCS materials such as planning, the formulation of behavioral objectives in the teaching of biological concepts and principles and evaluation techniques.

The data consisted of class observations of each teacher in the sample. Each teacher was observed twice during a two semester period, once during the second semester of the school year 1971-72 and once during the first semester of the school year 1972-73. Verbal behaviors were recorded with a battery-operated wireless microphone and a radio cassette tape

recorder. Non-verbal behaviors were observed only at random and recorded with a 35 mm. camera or in writing.

The observed behaviors were classified according to the Biology Teacher Behavior Inventory categories and according to the inferred intent as verbal and non-verbal. Totals of behaviors which predominate in 10-second intervals were determined and ratios of the following behavior categories were determined: (1) control-release behaviors, (2) positive-negative affectivity, (3) student centered-teacher centered content development behaviors, (4) scientific process-knowledge content development behaviors, (5) behaviors which facilitate communication-total teacher behaviors, and (6) indirect behaviors-total teacher behaviors. Totals of behaviors in the categories of release, positive affectivity, student centered, scientific process and facilitating communication were interpreted as constituting an indirect patterm of influence. Behavior totals under the subcategory of "knowledge" were interpreted as indicative of a subject matter emphasis while those under the subcategory of "scientific process" were interpreted as characteristic of an inquiry process oriented approach. A decrease in mean ratio of control-release behaviors and increase in the mean ratios of positive-negative affectivity, student centered-teacher centered, scientific process-knowledge, facilitate communication-total teacher behavior, and indirect behaviors-total teacher behavior were predicted outcomes of the treatment.

The significance of the difference between the mean ratios of the behavior categories studied in the experimental and control groups before and after the methods course were determined by using a two-tailed t-test at the .01 level of probability. One-tailed t-tests were used to determine the significance of the difference between the mean ratios of the behavior categories studied in the experimental groups before and after the methods course and in the experimental and control groups after the methods course. Hypotheses on the dependence of teacher behavior change towards an indirect pattern of influence on teacher and school variables were tested with Chi Square Tests of Independence.

Six experimental hypotheses were formulated in null form for the study. The results of the tests of the original hypotheses were:

1. There were significant gains in the mean ratios of student centered-teacher centered content development behaviors and scientific process-knowledge behaviors between the experimental and control groups after the treatment but no significant differences were observed in the mean ratios of the following behavior categories: control-release and positive-negative affectivity behaviors. Although there was a significant difference in the mean ratio of facilitate communication-total teacher behaviors this difference was not a gain resulting from the treatment but rather a decrease in the mean ratio of this behavior category in the experimental group

following the treatment. The mean ratios of all the behavior categories studied in the two groups were comparable before the treatment. No significant differences in the mean ratios were noted within the control group before and after the treatment. In the experimental group, however, significant increases in mean ratios before and after the treatment were noted in the student centered-teacher centered content development behaviors and scientific process-knowledge behaviors.

2. There was a significant increase in the mean ratio of verbal and non-verbal teacher behaviors indicative of an indirect pattern of influence to total teacher behaviors between the experimental and control groups after the treatment. There was no significant difference in the mean ratio of this behavior category to total teacher behaviors between the experimental and control groups before the treatment or within the control group before and after the treatment. A significant increase, however, was noted within the experimental group before and after the treatment.

3. The probability that change in teacher behavior towards an indirect pattern of influence is dependent on the scores on the Teaching Situation Reaction Test is less than 50%.

4. The probability that change towards an indirect pattern of influence is not independent of teaching experience is less than 75%. There is a higher probability that this change is

not independent of previous training in in-service institutes or educational background (.750 < p > .900). The probability that change towards an indirect pattern of influence is not independent of age or marital status is higher than 50% but less than 75%.

5. The probability that change towards an indirect pattern of influence is not independent of school organization, school type or school administration is very low (.100 < p > .250, .250 < p > .500). There is a higher probability that this change is not independent of the previous use of the BSCS materials in the schools (.500 < p > .750). The findings showed a very high probability (p > .995) that change towards an indirect pattern of influence is not independent of school facilities available.

6. The probability that teacher behavior change towards an indirect pattern of influence is not independent of the scores on the Process of Science Test in biology is higher than 90%.

Incidentally, the study also showed that the types of behaviors exhibited by the biology teachers in the area studied are fewer than those in Evans' Glossary of Teacher Classroom Behaviors. The types of laboratory and study management behaviors as well as the content development behaviors were very much similar to those in Evans' list. There were, however, a number of behaviors found only in the local situations studied, especially verbal behaviors intended to facilitate communication using the vernacular.

All of the teachers in the experimental group were using the BSCS materials after the treatment compared to only 50% in the control group. More laboratory activity was also noted in the classrooms of the experimental group after the treatment.

## Conclusions

Biology teacher classroom behavior was modified along the predicted pattern after the in-service biology methods course was provided experience in interaction analysis, inquiry and laboratory techniques and other skills essential to the teaching of the BSCS materials.

Teacher behavior was changed towards an increase in the use of student centered content development behaviors in relation to teacher centered behaviors and of scientific process behaviors in relation to knowledge behaviors characteristic of a subject matter emphasis following the methods course, but not in other behavior categories which may stimulate, support or reinforce inquiry such as "release", in relation to "control" behaviors, "positive affectivity" in relation to "negative affectivity" behaviors, and behaviors which "facilitate communication" in relation to "total" teacher behaviors.

Teacher classroom behavior was modified towards an indirect pattern of influence as defined by Flanders. Modification of teacher behavior towards an indirect pattern of influence was possible in spite of claims that the Filipino

teacher's classroom behavior is influenced by his "authoritarian" background.

The Teaching Situation Reaction Test (TSRT) is a low predictor for teacher behavior change towards an indirect pattern of influence.

Teacher characteristics such as teaching experience, previous training in in-service institutes, educational background, age, or marital status are fair indicators of teacher behavior change towards an indirect pattern of influence.

Teacher behavior change towards an indirect pattern of influence is independent of school characteristics such as type, organization, and administration although it is not independent of the previous use of the BSCS materials in the school. There is definitely no independence between teacher behavior change towards an indirect pattern of influence and school facilities available.

Change towards a scientific process orientation as a result of an in-service course may be well predicted by the Processes of Science Test in biology.

## Recommendations and Implications for Further Study

The in-service course in this study might be revised to include more intensive practice on the use of behaviors which stimulate, support, or reinforce inquiry in the classroom especially behaviors under the categories of "release",

"positive affectivity" and "facilitate communication".

A special study on behaviors which facilitate communication in the classroom might be worthwhile because of language problems in Philippine schools. Although the medium of instruction is English, pupils communicate with each other in a local vernacular. Data on the extent to which the use of the vernacular may stimulate, support or reinforce inquiry is important in structuring a methods course such as the one used in this study.

Whether the behavior changes observed are permanent or only temporary needs to be studied further. A follow-up study on the effect of teacher behavior changes observed on student learning and desired student attitudes towards science should be made. Studies on in-service courses of this nature in the other fields of science are also needed to test the findings of the study across different types of subject matter taught.

There are no data available which provide a basis for testing the hypothesis that an indirect pattern of influence promotes inquiry learning in Filipino students. There are also no research studies available on the advantages of inquiry learning and under what conditions these advantages "accrue". Cortes[1] pointed out the need of research studies in inquiry learning in the Philippines to identify the

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[1]Josefina R. Cortes, "Research in Science Teaching in the Philippines." Science Review (January-February, 1972), 43.

conditions under which it occurs, and the learning tasks and pupil behaviors which characterize it. The data on pupil achievement in the microteaching unit taught in the in-service biology methods course in this study might serve as a pilot study on inquiry learning as an outcome of instruction in biology in Philippine high schools.

The findings of this study indicate that there is a potential for the use of the Teaching Situation Reaction Test as a predictor for teacher behavior change towards a pattern of influence identified with inquiry learning as a result of an in-service methods course. The instrument might also be of use as a predictor for behavior change in methods courses in the pre-service program. An item analysis of the test results might be done to determine the validity and reliability of the Philippine adaptation of the test. Used together with the Processes of Science Test in biology as a predictor for change towards the use of scientific process behaviors the TSRT might be a useful tool in teacher preparation programs.

The findings of this study further indicate that the present practice of using such teacher characteristics as teaching experience, educational attainment, age, and marital status as part of the major criteria in the selection of teachers for government sponsored in-service programs should be reviewed in the light of other teacher and school variables that may affect the desired objectives of such programs.

School organization, type, and administration do not appear to be useful criteria for choice of teachers in in-service programs intended to modify teacher behaviors.

The dependence of teacher behavior change towards an indirect pattern of influence in the classroom on laboratory facilities available warrants the inclusion of a study on planning of the science laboratory facilities in the biology methods course. This was not considered in the experimental biology methods course in this study.

The study as a whole has revealed some significant aspects on the nature of behavior changes that can result from an in-service methods course such as the one used in this study. These findings have a bearing on the direction of in-service as well as pre-service teacher education programs which will enable the teachers to teach the BSCS materials with optimum effectiveness.

The findings on the effects of a biology methods course on the verbal and non-verbal behaviors of secondary school biology teachers in this study may lead to further investigations of this nature and to studies related to student learning in inquiry and student attitudes towards science. Research on science teaching in the Philippines is only in its initial stages. The problems confronting the science teacher in achieving the desired goals of modern science teaching pose a challenge for those committed to the improvement of science education for national development.

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# APPENDICES

# APPENDIX A

# THE INSTRUMENTS

# BIOLOGY TEACHER BEHAVIOR INVENTORY

(Evans & Balzer, 1970)

| Categories and Subcategories | Subdivision | Definitions |
|---|---|---|

1. Management: Those behaviors that regulate the routine "housekeeping" activities which are used in the operation of the biological science classroom. In addition, this category includes those behaviors in which the teacher makes assignments, since those behaviors comprise an aspect of management in the learning situation.

   a. Routine Management: Those behaviors of the teacher associated with the routine management of any classroom. Behaviors involved in the control of the physical environment and the execution of administrative details are illustrative of this subcategory.

   b. Laboratory Management: Those behaviors of the teacher associated with preparation for, maintenance and supervision of, or clean-up from biological science laboratory, demonstration, or classroom activities.

   c. Study Management: Those behaviors of the teacher which specify assignments or provide for directed study.

2. Control: Those behaviors that intend to make the classroom activities more orderly or formal. They tend to structure, regulate or otherwise keep student behavior and attention within limits, i.e., teacher behaviors that intend to have students follow a recommended course of action.

3. Release: Those teacher behaviors that intend to make student behavior less formal and orderly. They tend to allow greater student control of attention and discipline, i.e., those teacher behaviors that increase informality and permissiveness in the classroom.

4. Goal Setting: Those behaviors which explicitly deal with the stating, explaining, implying, or clarifying of the purposes or goals for a given individual or classroom activity.

| Categories and Subcategories | Subdivision | Definitions |
|---|---|---|

5. Content Development: Those behaviors dealing primarily with subject matter in the science classroom. These behaviors are based upon efforts to achieve objectives related to content whether they are cognitive, psychomotor or affective.

   a. Teacher Centered: The classroom is teacher centered when the attention of most students is on the teacher, or the teacher is attempting to obtain the attention of most students in the classroom. In addition, behaviors comprising teacher assertiveness in relation to individual students or groups of students are teacher centered even though the remainder of the students may be involved in student centered activities.

      (1) Procedures: Those behaviors of the teacher concerned with instruction in procedural aspects of the content. Illustrative are behaviors involved in laboratory procedures and procedures in problem solving.

      (2) Knowledge: Those behaviors of the teacher which pertain to giving and receiving information at low cognitive levels. The principal concern is that of knowledge of specific aspects of content such as facts, definitions, and terminology as contrasted with interpretation, extrapolation, application,analysis, synthesis, observation, and evaluation.

      (3) Scientific Process: Those behaviors of the teacher which pertain to such cognitive processes as observation, interpretation, extrapolation, application, analysis, synthesis, and evaluation as contrasted with knowledge of relatively specific information such as facts, definitions, and terminology.

      (4) Tentativeness of Knowledge: Those behaviors in which the teacher states or distinctly implies a state of change regarding scientific knowledge.

      (5) Generalizations: Those behaviors which are of considerable scope or breadth as contrasted with specificity and depth of other content considerations being undertaken by the teacher. Operationally, these behaviors may be explicitly described by the teacher or may be identified by the observer on the basis of his acquaintance with teacher behavior and the content under consideration.

| Categories and Subcategories | Subdivision | Definitions |
|---|---|---|

(6) Articulation of content: Those behaviors through which the teacher attempts to establish continuity across topical areas or time. Articulation and integration of topical areas may be within biology and between biology and other areas of knowledge. When generalizations or summarizations are used as means of articulation and integration of content, the behaviors are classified on the basis of the latter intent.

(7) Facilitates Communication: Those behaviors in which the teacher attempts to make clear and distinct the nature of communication. These can be distinguished from explanations and illustrations of content as such in that the latter pertain to examples and elaborations given to aid understanding of the nature of the content. Hand motions and voice pitch intended to draw attention to content are seen as facilitating communication. However, when such nonverbal behaviors illustrate content, they must be categorized as such, not as facilitation of communication.

b. Student Centered: Those behaviors dealing primarily with subject matter other than those covered in teacher centered content development.

6. Affectivity: Those behaviors that intend to elicit and reinforce, positively or negatively, contributions to the teaching learning process by an individual or group of students.

a. Positive Affectivity: Those behaviors that elicit and reinforce, in a positive manner, contributions by an individual or group of students to the teaching-learning process. These behaviors take the form of teacher recognition, encouragement, and/or praise; they are based on the positive aspects of teacher motivation and evaluation.

b. Negative Affectivity: Those behaviors that elicit, correct and reinforce, in a negative manner contributions by an individual or group of students to the teaching-learning process. These behaviors take the form of corrective feedback, criticism, reprimands, accusations, admonition and/or willful disregard; they are based on the negative aspects of teacher motivation and evaluation.

| Categories and Subcategories | Subdivisions | Definitions |
|---|---|---|
| 7. Undecided: Those behaviors whose intent cannot be inferred and categorized into the other categories in the system. | | |
| N. B. The numbers in parenthesis ( ) indicate subdivisions that can either be teacher centered or student centered content development. | | |

# TEACHING SITUATION REACTION TEST

Revised September, 1966

DIRECTIONS: The case example that follows has been planned to measure your ability to work through some of the problems of handling a classroom group. You will be given certain information about the classroom group and the working situation. You will then be asked to respond to a number of questions. This will be repeated through a series of problem situations. The case study has been designed so that you can respond regardless of your teaching subject field. You do not need technical subject matter knowledge to take this test.

You are asked to indicate your first, second, third, and fourth choice under each question by inserting respectively the numbers 1,2,3,4, in the spaces provided on the answer sheets under (a) (b) (c) and (d). The most desirable choice should be labelled 1, and the least desirable 4. For example, if your first choice was response (c), your second choice was response (a), your third choice was response (b), and your fourth choice was response (d), you would record your responses on the answer sheet as follows:

| (a) | (b) | (c) | (d) |
|---|---|---|---|
| 2 | 3 | 1 | 4 |

Please do not write on the test booklet

THE SITUATION:

You have been employed by a school system which is engaged in a series of experimental studies. One of these studies involves an experimental class designed to improve the pupils's general adjustment to their environment. A heterogeneous group (physically, mentally, socially) of twenty-five thirteen and fourteen year old youngsters have signed up for this class.

The class is scheduled to meet the last period of the day on Tuesday and Thursday during the first half of the next school year. Arrangements have been made so that the class might take trips and students might have an opportunity to meet informally with the teacher after class.

Around the first of March your principal calls you in to tell you that, if you are interested, you have been chosen to teach the experimental class. You were asked because of your background in adolescent psychology and your interest in helping youngsters with minor problems of adjustment typical of the young adolescent.

Your principal has given you pretty much of a "free hand" to develop the content of the course and the activities in which the student will be engaged. A good supply of instructional materials, books on the adolescents, and descriptions of similar programs in other schools has been made available to you. There will be no direct supervision of your work, but an evaluation by students and yourself will be requested at the middle and close of the semester. Studies will also be made of the gain in personal adjustment evidenced by your students. You know the names of the students who have signed up for your course. An experienced teacher-counselor has been asked by the principal to help you when and if you ask for help. The teacher-counselor knows well each of the youngsters who have signed up for your class.

THE GROUP:

Some of the youngsters who have signed up for the course know each other very well, having gone through school together. Three do not know anyone else in the group. Others are only casually acquainted. Members of the group have a variety of interest and abilities and they represent many levels of competence and come from a variety of socio-economic backgrounds. The quality of their personal adjustments varies, but none is seriously maladjusted.

A. You have about six weeks plus the summer vacation to plan for your class.

1. When you begin planning the course you would:

(a) Ask your teacher-counselor what he thinks should be in the course.

(b) Examine the materials available to you and determine how they might be used by members of the class.

(c) Read through the copies of publications describing other school programs of a similar nature and draw ideas from them.

(d) Interview a randomly selected group of the young people signed up for the course and set your own tentative objectives based on these interviews.

2. During early April an important local civic group comes out against teaching sex education in the schools. Your planning had included some sex education. At this point in your planning you would:

(a) Continue planning as you have been.

(b) Ask the principal if you should include any sex education in your course.

(c) Remove the lessons dealing with sex education.

(d) Find ways to get the sex education material across without causing an issue.

3. About three weeks before your class is scheduled to meet for the first time, your principal asks you to come in and talk with him about the course. You would hope that your principal would:

(a) Say that if there was anything that he could do to be of help that you should feel free to call on him.

(b) Indicate to you what he would hope the course would accomplish during the semester.

(c) Encourage you to talk about the purposes of your course as you see them after several weeks of planning.

(d) Make specific suggestions to help you in your planning, and encourage you to drop in for further suggestions if you need help.

4. The weekend before the course is to start it would be natural for you to feel:

   (a) Concern that your planning has been inappropriate.

   (b) Anxious to get started and prove your ability to handle this rather difficult assignment.

   (c) Hopeful that the course will be of real value to the students.

   (d) Confident knowing you have done the best you could under the circumstances.

B. You will have your first meeting with the group tomorrow.

5. It will be important that you have planned for:

   (a) Students to get well acquainted with each other.

   (b) Explaining your grading system.

   (c) Activities to catch student interest.

   (d) Explaining your complete program for the semester.

6. The teacher-counselor drops by your room and asks if he can be of help. You would ask him for:

   (a) His opinion about what you have planned for tomorrow.

   (b) Suggestions to help you make a good impression.

   (c) Suggestions as to what student reaction might be on the first day.

   (d) Nothing until you had an opportunity to meet with the group.

7. The more important personal information to gather at the first meeting would be:

   (a) Interests of the different students.

   (b) Parent or guardian, home address and phone number.

   (c) What the students would like to do in the course.

   (d) Why they are taking the course.

8. Of the things you would do the evening before meeting the class, the most essential would be to:

   (a) Become familiar with the notes for such presentations as you might make.

   (b) Become familiar with students' names and any information you have about them from their files.

   (c) Become familiar with the sequence and nature of any activities you may have planned.

   (d) Be sure any materials you were to use were available and in good condition.

9. Your greatest concern on this night before the first meeting would be:

   (a) How to appear poised and at ease.

   (b) How to gain control of the group.

   (c) How to handle problem pupils.

   (d) How to get your program moving rapidly and well.

C. On meeting the group the first day a number of students come in from three to five minutes late. Following this, as you get your program underway the students get restless.

10. With the students that come in late you would:

   (a) Simply acknowledge their presence and noticeably mark them present in the record book.

   (b) Inform them politely about the time at which the class starts.

   (c) Ask them politely why they were unable to get to class on time.

   (d) Make clear to the class as a whole and the late students in particular the standards you will maintain with regard to tardiness.

11. You would handle the restlessness of the group by:

   (a) Presenting your program more dynamically.

   (b) Asking students why they were restless.

(c) Speaking to the group firmly about paying attention.

(d) Picking out one or two of the worst offenders and reprimanding them.

12. You would tell the group your name and:

(a) The rules of conduct for your class.

(b) Your expectations for the class.

(c) Some of your personal adjustment problems at their age.

(d) Some of your interests and hobbies.

13. You would, by your general behavior and manner, try to present yourself as:

(a) Firm and serious but fair.

(b) Efficient, orderly and business-like.

(c) Friendly, sympathetic and understanding.

(d) Understanding, friendly and firm.

14. You would prepare for the next meeting by:

(a) Discussing with pupils what they would like to do and deciding on one or two ideas.

(b) Telling them what pages to read.

(c) Giving students a choice of two ideas and determining in which the majority is interested.

(d) Discussing your plans for the next meeting with them.

D. You have met with your class four times and have made some observations. Two boys seem particularly dirty and you have found they come from a lower class, slum area. One girl seems to be withdrawn. The students do not pay any attention to her. She is a pleasant-looking well-dressed girl. There are four or five youngsters, apparently very good friends (both boys and girls) who do most of the talking and take most of the initiative. Students seem to continually interrupt each other and you.

15. In the interests of the two boys from the slum area you would:

    (a) Find an opportunity to discuss the matter of cleanliness with the class.

    (b) Speak to the boys about their need to be clean in a conference with them.

    (c) Inaugurate a cleanliness competition with a prize to that half of the class with the best record, putting one boy in each half.

    (d) Speak to the boys about their need to be clean and arrange facilities at school where they could clean up.

16. In the interests of the apparently withdrawn girl you would:

    (a) Talk to her informally over a period of time to see if you could determine her difficulty.

    (b) Call on her regularly for contributions to the discussion.

    (c) Discover a skill she has and have her demonstrate for the class.

    (d) Have a conference with her and tell her to become involved with the class discussion and speak up.

17. To improve the relationship of the group to the apparently withdrawn girl you would:

    (a) Determine who, if anyone, is friendly with her and arrange to have them work together on occasion.

    (b) Take the girl aside and help her see how she can establish better relations with her classmates.

    (c) Arrange to have her work with the group of boys and girls who take most of the initiative.

    (d) Allow her to work out her own problem.

18. With regard to the four or five youngsters who do most of the talking and take the initiative you would tend to believe:

(a) They are brighter than most of the other students.

(b) They are the leaders of the class.

(c) There is considerable variation in student's ability to participate in class.

(d) They are a little too cocky and think they know more than the others.

19. With regard to the tendency of class members to interrupt while others are talking you would:

(a) Tell the class politely but firmly that interruptions are impolite and should not continue.

(b) Discuss the matter with the class, determining why this happens and what should be done about it.

(c) Organize a system of hand raising and set rules for students participation in discussion.

(d) Set rules for student participation in discussion and firmly but fairly reprimand each person who breaks the rules.

20. One of the important problems facing you now is to do something which:

(a) Will insure that no one is rejected or disliked.

(b) Will result in everybody's being liked.

(c) Will encourage each person's acceptance of the others.

(d) Will guarantee that no one's feelings get hurt.

E. At the beginning of the eighth class session (fourth week) Johnny comes into class holding on to his arm and very nearly crying. The tears are welled up in his eyes and he looks away from the others. You notice that Peter, the largest and strongest boy in the class, looks at Johnny occasionally with a sneering smile. You do not feel that you can let this pass, so you arrange to meet with Johnny and Peter separately after class.

21. You would tend to believe:

(a) That Johnny probably did something for which this was just, but maybe severe, payment.

(b) That Peter is something of a bully.

(c) That Johnny was hit on the arm by Peter.

(d) That Johnny felt badly and Peter was quite aware of it.

22. When you meet with Johnny you would:

(a) Ask him if Peter hit him and why.

(b) Engage him in conversation and lead slowly into the difficulty he had that afternoon.

(c) Tell him you were aware that he had some difficulty and offer your help to him.

(d) let him guide the discussion and reveal what he would about the incident.

23. When you meet with Peter you would:

(a) Tell him that Johnny was upset this afternoon and you had noticed that he (Peter) was looking strange--proceed from there.

(b) Make him aware that you know he had trouble with Johnny and proceed from there.

(c) Make him aware that he is bigger and stronger than the other boys and that he is a bully if he picks on smaller boys.

(d) Ask him if he and Johnny had had difficulty.

24. When young people get into conflict in school it would be best to:

(a) Let them resolve it themselves.

(b) Help them to establish a friendly relationship.

(c) Find the cause of the trouble and work to eliminate it.

(d) Control the school situation so that the conflicts are less likely to arise.

F. In general your program has been moving along satisfactorily. After the eighth meeting you have a feeling that the students are beginning to lose interest. A number of students seem to be sitting through class without really getting involved. Others seem to stay interested and active. The teacher-counselor asks to see you informally over coffee.

25. When you meet with the teacher-counselor you would:

(a) Not talk about your class or its present lack of involvement.

(b) Discuss your concern with him and listen for suggestions he might have.

(c) Speak about how satisfactory the early meetings have been.

(d) Allow the teacher-counselor to orient the discussion.

26. Your planning for the next (ninth) session would include:

(a) Some new ideas that you had not tried.

(b) Some clarification of the importance of students doing well in their work.

(c) A request for ideas from students as to how to make the class more interesting.

(d) Ways to get more students actively doing something in class.

27. During the ninth session you would:

(a) Behave much as you had in earlier sessions.

(b) Put some stress on the importance of everybody paying attention in class.

(c) By careful observation determine which students seem disinterested.

(d) Speak pointedly to those who were not paying attention.

28. You would tend to believe the loss of interest due to:

    (a) A rather natural reaction in an elective experimental course.

    (b) Failure of students to realize that they must contribute much to a course of this kind.

    (c) A rather natural group reaction to the experience of working together on personal adjustment problems.

    (d) Your own failure in developing good human relationships in the class and stimulating the students.

G. Before the mid term (eighteenth) meeting of the class you take time out to think about the experiences you have had. The class has been good some days and poor other days. You have had no word from your principal about how your work has been. The teacher-counselor has seemed satisfied but not very much impressed with what you are doing. You have heard nothing about the young people who are being studied. You are asked to meet with the parents to discuss the experimental class in an informal way.

29. You would be most concerned about:

    (a) The failure of the principal and teacher-counselor to discuss the progress of the students before your meeting with the parents.

    (b) What you should say to the parents.

    (c) Your apparent failure to impress your teacher-counselor.

    (d) What the studies of the young people are showing.

30. You would resolve to:

    (a) Discuss your progress with the teacher-counselor.

    (b) Ask for an appointment with the principal to find out how he feels about your work.

    (c) Plan to work harder with your group.

    (d) Not let the present state of affairs worry you.

31. When talking with the parents you would:

(a) Encourage them to ask questions about the program.

(b) Tell them what the program has consisted of so far.

(c) Tell them you don't know how well the program is going.

(d) Impress upon them the importance of student participation in class activities.

32. In this case you would feel that parents:

(a) Ought to be told how their children are doing in this class.

(b) Ought not to become involved in such an experimental program.

(c) Are entitled to an opportunity to question you.

(d) Ought to be referred to those in charge of the experiment.

33. At your next class meeting:

(a) You would tell students what you told their parents.

(b) You would not initiate any discussion about your visit with the parents.

(c) You would discuss briefly the parents' interest in the class.

(d) You would tell the students that you expected more cooperation from them now that their parents were involved.

H. The nineteenth and twentieth class sessions are very unsatisfactory. You leave class at the end of the twentieth session with doubts in your mind as to whether students are gaining in personal and social adjustment. You can see problems with the structure and organization of the class and believe that if these would be corrected or if you had done some things differently over the past few weeks that you would not have a problem with the class.

34. At this point you would:

(a) Decide to go to class the next day and ask your students how they feel about the progress of the course.

(b) Think through the problem carefully and start planning revisions for the course next year.

(c) Try to help yourself accept the fact that life is often filled with disappointments and redouble your efforts to make your class better in the future by spending more time in preparation and encouraging your students to work harder.

(d) Mention your concern at the next meeting of your class and encourage students to talk with you after class about the progress of the course.

35. You would feel much better regarding the accuracy of your estimate about what is wrong with the class if you:

(a) Were sure that some of the students were not being difficult on purpose to test your authority as a new teacher.

(b) Knew more about the expectations of your students and to what extent they felt their expectations were being met.

(c) Could have a colleague in whom you could confide and in whom you could trust, come in and observe your class and talk with you.

(d) Were sure you understood your own needs for success and the extent to which these needs influence your feelings.

36. After the twentieth session, it would be natural for you to feel that:

(a) You would like to relax and think about the situation over the weekend.

(b) You wished students accepted the fact that things which are taught them in schools are usually good for them even though they may not like what they are learning all of the time.

(c) Things seldom go well all the time for everybody and that they couldn't be expected to always go well for you.

(d) It must have been wonderful to teach in the good old days when students were in school because they wanted to learn.

37. In an attempt to analyze the source of the problem you are having with your class you would:

    (a) Have a conference with several of the brighter and more interested students to see if they could give you any insight into the problem.

    (b) Take part of a class session to share your concerns with the class, get their reactions, and using this information, rethink the problem.

    (c) Ask the teacher-counselor to come in and observe the class several times and talk with you about his observations.

    (d) Consult the records of the students to see if you could find any clues there.

I. At your twenty-fourth meeting you wish to make plans for a series of visits to different community health and welfare agencies. You want to be sure that the youngsters learn from the experiences and conduct themselves properly while traveling to and from and visiting in the agencies.

38. In order to assure that all youngsters learned from their first trip you would:

    (a) Assign particular things for all of them to look for and listen to.

    (b) Ask each to write a brief commentary on the most important things they saw and heard.

    (c) Encourage them to ask questions while they were there.

    (d) Present them with a check sheet of items to be seen and heard and ask them to check off those that they saw or heard.

39. In preparation for the first trip you would:

    (a) Tell them as much as you could about the agency to which they were going.

    (b) Tell them you were sure it would be interesting and fun and let them see and hear for themselves.

    (c) Ask them what they thought they could expect and encourage guided discussions about their expectations.

    (d) Tell them about the most interesting things they would see and hear.

40. To insure that the group conducted themselves properly you would:

    (a) Set out rules of conduct for them.

    (b) Ask them to behave as young ladies and gentlemen representing their school.

    (c) Ask them what rules of conduct they would propose and develop a code with the group.

    (d) Assure them that if they did not behave properly they would not go on trips in the future.

41. On the trips you would:

    (a) Divide them into small groups with a leader responsible for each group and arrange their itinerary and meetings after you get to the agency.

    (b) Ask the youngsters to get your permission first and on this basis allow them to pursue their own interests.

    (c) Let the agency people take responsibility for deciding where they could go and when.

    (d) Keep them all together as a manageable group.

J. At the close of the thirtieth class session Bob, one of the most able boys, summarizes a class discussion on boy-girl relationships with, "Well, we've talked around the subject but we never get down to the important questions." The agreement of a number of the class members is evident.

42. You would tend to believe:

    (a) The class members are too young to be dealing with important questions in this area.

    (b) You had allowed just a little too much freedom in the discussions of boy-girl relationships.

    (c) This simply reflects a natural desire on the part of students to introduce some excitement into the class sessions.

    (d) The class could handle important questions in this area with your guidance and support.

43. Before the thirty-first session you would:

(a) Clarify the significance and implications of Bob's statement in your own mind.

(b) Determine what you will and will not allow to be discussed in class in this area.

(c) Consult the principal and get direction from him.

(d) Discuss the situation with the teacher-counselor with a view of getting ideas for handling the next session.

44. During the thirty-first session you would:

(a) Propose a list of carefully selected questions you believe the students have in mind and begin discussions on the most manageable of these.

(b) Repeat Bob's comment and draw from the class a list of what they thought should be discussed.

(c) Suggest that some questions are not appropriate for discussion in school and that some of these fall in the area of boy-girl relationship..

(d) Ask Bob to pick up where he left off and guide him and other class members as they clarify the directions further discussion should take.

K. Your class has at last developed into a fairly cohesive unit. The discussions are more animated and everyone participates to some degree. Disagreements on ideas begin to appear and the students give evidence of intense feelings on a number of issues. George has been particularly outspoken. He has very radical ideas that seem to provoke the other students to disagree but you know that the ideas he expresses have some support from some adolescent psychologists that you consider to be the "lunatic fringe." George seldom gives in on a point.

45. You would believe that these conditions are likely to:

(a) Ultimately strengthen the group.

(b) Do little but make it uncomfortable until George learns his lesson.

(c) Destroy the group unity unless you intervene.

(d) Make it difficult for progress to be made for some students until they learn to accept George.

46. With regard to George you would.

(a) Refer him to the teacher-counselor.

(b) Point out to George that he is intolerant of the views of other class members.

(c) Encourage him to express his ideas in ways that would not irritate other students.

(d) Politely but firmly keep him from expressing such ideas.

47. With regard to the other students you would:

(a) encourage them in their effort to stand up to George.

(b) Help them to understand what George is doing to them and why.

(c) Help them to get onto topics and ideas where George could not disagree with them so forcefully.

(d) Get into the discussion on their side and show George that he is wrong.

48. With regard to your concern for George as a person, you would feel that:

(a) He is developing undemocratic traits by behaving as he does, and you would hope to help him change.

(b) He does not understand how to behave in a democratic setting and may need help.

(c) He probably has never learned certain social skills necessary for democratic group behavior and the possibilities of developing such skills should be shown him.

(d) He will learn sooner or later that in a democracy some ideas are undesirable because they tend to destroy the group.

# BIOLOGY FACULTY INFORMATION SHEET

1. Position_____ School_____

2. Age_____ 3. Sex_____ 4. Civil Status _____

5. If part time, please indicate fraction of full time given to this school _____

6. Degree or Degrees Obtained | Name of Institution | Year

| | | |
|---|---|---|
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |

7. Major field _____ 8. Minor field _____

9. In-service Courses, Seminars or Workshops Attended | Sponsoring Agency | Date

| | | |
|---|---|---|
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |

10. Number of Years Teaching Experience _____

11. Present Teaching Load

| Subject | Time | Number of Students |
|---|---|---|
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |

12. Regularly Assigned Duties other than Classroom Instruction (Indicate if these duties are seasonal, e.g., college day activities, graduation exercises, etc.)

| Nature of Activity | Hours per Week |
|---|---|
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |
| _____ | _____ |

SCHOOL INFORMATION SHEET

Name of School _____

Address _____

School Organization (public or private) _____

Religious or Nonsectarian (if private) _____

Religious Order administering (if religious) _____

Total School Enrollment (1971-72)_____

Number of Biology Classes _____ Average Class Size _____

Number of Biology Teachers _____

Biology Textbook Used _____

Laboratory Manual Used _____

School Principal _____

## LABORATORY FACILITIES CHECK LIST

| Facility | Point of Value | | | | |
|---|---|---|---|---|---|
| Category A | 16 | 12 | 8 | 4 | Your School |
| **Fixed Laboratory Installations (maximum possible score 144)** | | | | | |
| Demonstration Table | 1 | | | | |
| Work counter (peripheral) feet | 120 | 60 | 30 | 15 | |
| Sinks/Utilities | 4 | 3 | 2 | 1 | |
| Shelf-storage - sq. ft. | 450 | 300 | 200 | 100 | |
| Preparation Room | large | med. | small | | |
| Life alcove | large | med. | small | | |
| Work Project Area | large | med. | small | | |
| Science Library--min. 59 vols | large | med. | small | | |
| Display cases (in walls) | 2 | 1 | | | |
| Subtotal Points | | | | | |
| **Budget Considerations (maximum possible score 48)** | | | | | |
| Funds for perishables, glassware, chemicals, specimens | ₱2000/yr. | 1500/yr. | 1000/yr. | 500/yr. | |
| Funds available during year as needed | Yes | | | | |
| Capital outlay funds | ₱2000/yr. | 1500/yr. | 1000/yr. | 500/yr. | |
| Subtotal Points | | | | | |

| Category B | 12 | 9 | 6 | 3 | Your School |
|---|---|---|---|---|---|
| **Major Equipment (Maximum possible score 84)** | | | | | |
| Refrigerator | 1 | | | | |
| Gas range/oven | 1 | | | | |
| Incubator | 2 | 1 | | | |
| Balances (.01-g sensitivity) | 4 | 3 | 2 | 1 | |
| Pressure cooker | 2 | 1 | | | |
| Centrifuge | 2 | 1 | | | |
| Power supply units | 2 | 1 | | | |
| Subtotal Points | | | | | |

| Category C | 4 | 3 | 2 | 1 | Your School |
|---|---|---|---|---|---|
| Small Equipment and Supplies (maximum possible score 52) | | | | | |
| Thermometers (centigrade) | 15 | 10 | 5 | 2 | |
| Filter flasks | 2 | 1 | | | |
| Bunsen burners | 8 | 4 | 2 | 1 | |
| Aquaria | 4 | 3 | 2 | 1 | |
| Terraria | 4 | 3 | 2 | 1 | |
| Dissecting sets | 30 | 20 | 10 | 2 | |
| Laboratory specimens for dissection (pref. fresh) | many | adeq. | few | sparse | |
| Laboratory organisms (going cultures) | 5 | 4 | 3 | 2 | |
| Chemical reagents | many | adeq. | few | sparse | |
| Pippettes (calibrated in 3 sizes) | 36 | 24 | 15 | 6 | |
| Glassware, misc. | many | adeq. | few | sparse | |
| Collecting equipment (nets, vials, buckets, etc.) | many | adeq. | few | sparse | |
| Animal cages | 8 | 6 | 4 | 2 | |
| Subtotal points | | | | | |
| Demonstration Aids (maximum possible score 12) (Preserved specimen sets (not for dissecting) | many | adeq. | few | sparse | |
| Models and charts | many | adeq. | few | sparse | |
| Prepared slides, microscopic | many | adeq. | few | sparse | |
| Subtotal points | | | | | |

All Facilities

(Maximum possible score 388)
Your school-total Score _____

Table — Rating Scale

| Rating | Points | Per Cent of Optimal |
|---|---|---|
| A | 330-388 | 85-100 |
| B | 273-329 | 70-84 |
| C | 215-272 | 55-69 |
| D | 155-214 | 40-54 |
| E | 97-154 | 25-39 |
| F | 0-96 | 0-24 |

# APPENDIX B

## DATA RECORD SHEET SAMPLE

# SAMPLE OF TRANSCRIPT OF TAPE RECORDING OF A CLASS OBSERVATION WITH INTERPRETATIONS IN CODE

Teacher's name _____ Date _____

School _____ Class time _____

Topic: Ex. 61--A Garden of "Microorganisms" (BSCS Text)

## Post-lab Discussion

|...probably. But some species $5a_2n$ are microscopic. $5b$ (ans)

Now what is the meaning of the word if it is enclosed in

parenthesis? I mean, | with quotation $5a_2n$ marks? $5b$ (ans) Yes,

Mata? $5a_7d$ | $5b$ (ans) A species name? $5b$ (ans) Yes. Who has another $5a_2n$

idea? ② | Gloria? $5a_7d$ (ans) Did you hear, Suzette? $(2z)5b$ By means of $6a$ $5a_2b$

microorganism? $(5a_7d)$ Now | you have a little idea. ③ Remember? $(2z\ 3y)$ Who

has another idea? $5a_2n$ Dolores? $5a_7d$ | $5b$ (ans) Very $(6a_5)$ | special. Well,

who has a better idea? $5a_2n$ Now | does it mean that we have these

things when it is enclosed in quotation marks? $5a_2n$ $(5a_7j)$ | That this $5a_7n$ is

an expression? Well, it looks like a dot but that one $(5a_2s)$ in-

side, | it is really a dot being printed. $5a_7n$ No, $(5a_7j)$ that's a real

dot because here are the quotation marks. Now what | do you

understand is the meaning of this when it is printed here:

④ (2z 3y) A Garden of "Microorganisms", Juanito? | ⑤ (ans) So they are not all microorganisms. So that what | we are going to study in this Chapter are not all microorganisms. | What organisms do you know that are microorgan isms? What are they?

. . .

## SAMPLE OF DATA RECORD SHEET

Sample of a 3 min. observation.

Duration of observation _____ Teacher's Name _____

Pre-observation

| Verbal | Non-verbal | Predominant |
|---|---|---|
| $5a_2n$ 5b | | $5a_2n$ |
| $5a_2n$ 5b $5a_7d$ | | $5a_2n$ |
| (1) #5b $5a_2n$ 6a | $6a_5$ 3a* 3b* | 5b |
| (2) $5a_7d$ 5b | $5a_7d$ 2z* | 5b |
| 5b 6a $5a_2b$ | $5a_7d$ | 6a |
| (3) $5a_2n$ $5a_7d$ | 2z* 3y | $5a_2n$ |
| 5b | $6a_5$ | 5b |
| $5a_2n$ | | $5a_2n$ |
| $5a_2n$ | $5a_7j$ | $5a_2n$ |
| $5a_7n$ | $5a_2s$ | $5a_7n$ |
| $5a_7n$ | $5a_7j$ | $5a_7n$ |
| (4) $5a_2n$ $5a_7d$ | 2z* 3y | $5a_2n$ |
| (5) 5b $5a_7n$ $5a_2d$ | $6a_5$ 3b* | 5b |
| $5a_2d$ | | $5a_2d$ |
| $5a_6f$ | 2z | $5a_6f$ |
| 5b $5a_6f$ $5a_7d$ | | 5b |
| $5a_2d$ | | $5a_2d$ |
| $5a_6f$ | 2z | $5a_6f$ |

#Numbers preceding verbal behavior categories recorded refer to the number sequence of photographs taken.

*Non-verbal behaviors with asterisks are those recorded in pictures.

SAMPLE OF DATA RECORD SHEET--Continued

Sample of Behavior Totals of a 30' 30" Observation

Total predominant teacher behaviors: 173

Totals of behavior categories:

2 (control). . . . . 1

3 (release). . . . . 4

6a (positive affectivity). . . . . 3

6n (negative affectivity . . . . . 0

5b (student centered). . . . . 78

5a (teacher centered). . . . . .87

$5a_2$ (knowledge) . . . . . .16

$5a_3$ (scientific process). . . . . 39

$5a_7$ (facilitate communication). . . 25

Total behaviors indicative of an indirect pattern of influence: 149

Behavior ratios:

$2:3 = \frac{1}{4} = .75$

$6a:6b = \frac{1}{0} = 0$

$5b:5a = \frac{78}{87} = .896$ or .90

$5a_3:5a_2 = \frac{39}{16} = 2.437$ or 2.44

$5a_7$:total behaviors $= \frac{25}{173} = .144$ or .14

Indirect:total behaviors: $\frac{149}{173} = .86$

# APPENDIX C

## SUMMARY OF RECORD OF CLASSROOM OBSERVATIONS

TABLE 5

SUMMARY OF RECORD OF CLASSROOM OBSERVATIONS OF TEACHERS IN THE EXPERIMENTAL GROUP BEFORE AND AFTER THE METHODS COURSE

| Teacher Number | Date Observed | Duration of Recorded Observation | Topic | Method Used | Curriculum Materials Used |
|---|---|---|---|---|---|
| 1 | 2/21/72 | 40' | Stimulus Response Behavior | Lec-disc. | Non-BSCS |
| | 7/28/72 | 65' | Population | Lablec-disc. | BSCS |
| 2 | 1/11/72 | 60' 10" | Diversity in Plants | Prelabdisc-lab. | BSCS |
| | 7/21/72 | 60' | Interrelations of Producers & Consumers | Postlab-disc. | BSCS |
| 3 | 2/28/72 | 60' | Anatomy of Stem | Lec-disc. | Non-BSCS |
| | 8/8/72 | 48' | Communities and Ecosystems | Lec-disc. | Part BSCS |
| 4 | 2/3/72 | 51' | Stimulus Response Behavior | Lec-disc. | Non-BSCS |
| | 7/24/72 | 57' 50" | Observing Living Things | Postlab-disc. | BSCS |
| 5 | 2/15/72 | 72' | Asexual, Sexual Reproduction | Lec-disc. | Non-BSCS |
| | 8/15/72 | 70' 10" | Structure of Flowering Plant | Labpostlab-disc. | BSCS |
| 6 | 2/1/72 | 34' 50" | Nearctic, Palearctic Realms | Lec-lab. | Part BSCS |
| | 8/22/72 | 69' 50" | Classes of Vertebrates | Lec-lab. | Part BSCS |
| 7 | 1/13/72 | 33' 40" | Cell Physiology | Lec. | BSCS |
| | 8/1/72 | 62' | Population Growth | Postlab-disc. | BSCS |
| 8 | 2/22/72 | 56' 50" | Asexual, Sexual Reproduction | Prelabdisc-lab. | Part BSCS |
| | 8/15/72 | 70' 20" | Use of Microscope | Prelabdisc-lab. | Part BSCS |
| 9 | 2/21/72 | 31' 10" | Sexual Reproduction | Lec-disc. | Non-BSCS |
| | 7/27/72 | 70' | Use of Microscope | Postlabdisc-lab. | BSCS |

continued

TABLE 5--Continued

| Teacher Number | Date Observed | Duration of Recorded Observation | Topic | Method Used | Curriculum Materials Used |
|---|---|---|---|---|---|
| 10 | 2/15/72 | 30' 30" | A Garden of Microorganisms | Postlab-disc. | BSCS |
| | 8/31/72 | 55' 10" | Diversity in the Plant Kingdom | Postlab-disc. | BSCS |
| 11 | 1/24/72 | 40' 10" | Plant Physiology | Lec-demonst. | BSCS |
| | 9/8/72 | 48' | Invertebrates | Postlab-disc. | BSCS |
| 12 | 3/14/72 | 27' 20" | Embryology | Lec-disc. | Part BSCS |
| | 8/25/72 | 36' | Animal Classification | Lec-demonst. | BSCS |
| 13 | 3/17/72 | 60' 50" | Physiology of Digestion | Lec-disc. | BSCS |
| | 8/1/72 | 62' | Biotic Community | Postlab-disc. | BSCS |
| 14 | 12/7/71 | 30' | Parts of Flower | Postlab-disc. | BSCS |
| | 8/7/72 | 47' 20" | Communities and Ecosystems | Lec-disc. | BSCS |
| 15 | 2/9/72 | 45' 30" | Circulatory System | Lec-disc. | Non-BSCS |
| | 7/27/72 | 37' | Communities and Ecosystems | Lec-disc. | BSCS |
| 16 | 2/28/72 | 56' 50" | Struc. & Function of Leaf | Lec-demonst. | Non-BSCS |
| | 8/5/72 | 62' 40" | Population Growth | Prelabdisc-lab. | BSCS |
| 17 | 12/13/71 | 27' 10" | Skeletal System | Lec-disc. | Non-BSCS |
| | 8/17/72 | 69' 33" | Population Growth | Prelabdisc-lab. | BSCS |
| 18 | 2/9/72 | 45' 10" | Anatomy of Stem | Prelabdisc-lab. | Part BSCS |
| | 8/7/72 | 76' | Biotic Community | Postlab-disc. | BSCS |
| 19 | 3/15/72 | 59' 10" | Sensory Organs | Lec-disc. | Non-BSCS |
| | 8/15/72 | 65' 30" | Animal Classification | Lec-demonst. | Part BSCS |
| 20 | 3/15/72 | 56' 10" | Anatomy & Physiology of Frog | Postlab-disc. | BSCS |
| | 8/29/72 | 63' | Diversity in the Plant Kingdom | Postlab-disc. | BSCS |

TABLE 6

SUMMARY OF RECORD OF CLASSROOM OBSERVATIONS OF TEACHERS IN THE CONTROL GROUP BEFORE AND AFTER THE METHODS COURSE

| Teacher Number | Date Observed | Duration of Recorded Observation | Topic | Method Used | Curriculum Materials Used |
|---|---|---|---|---|---|
| 1 | 1/7/72 | 33' 40" | Plasmolysis of Cells | Prelabdisc-lab. | BSCS |
| | 8/10/72 | 51' | Biotic Community | Lec-disc. | BSCS |
| 2 | 2/1/72 | 37' 25" | Palearctic, Oriental Realms | Lec-lab. | Part BSCS |
| | 8/27/72 | 25' 40" | Classes of Vertebrates | Lecdisc-lab. | Part BSCS |
| 3 | 2/22/72 | 59' 50" | Nervous System | Lec-disc. | BSCS |
| | 7/31/72 | 52' 40" | Communities and Ecosystems | Lec-disc. | BSCS |
| 4 | 3/8/72 | 55' 30" | Structure and Func. of Leaf | Lec.(1 pd. only) | Non-BSCS |
| | 8/16/72 | 41' 30" | Levels of Classification | Lec-disc. | Non-BSCS |
| 5 | 1/12/72 | 30' 20" | Energy in Cell | Lec-disc. | BSCS |
| | 8/2/72 | 46' 50" | An Experiment: The Germination of Seeds | Postlab-disc. | BSCS |
| 6 | 1/27/72 | 57' 40" | Circulatory System | Lec. | BSCS |
| | 8/4/72 | 45' 10" | Levels of Classification | Lec-disc. | BSCS |
| 7 | 1/28/72 | 51' | Meiosis | Lec. | Part BSCS |
| | 8/8/72 | 59' 40" | Structure of Flowering Plant | Prelabdisc-lab. | BSCS |
| 8 | 3/7/72 | 48' 20" | Sensory Organs | Lec-demonst. | Part BSCS |
| | 8/5/72 | 51' 30" | Observing Living Things & Classification | Lec-disc. | Part BSCS |
| 9 | 2/24/72 | 40' | Excretory System | Lec-lab. | Non-BSCS |
| | 8/8/72 | 53' 30" | Bryophytes & Pteridophytes | Lec-demonst. | Non-BSCS |
| 10 | 2/23/72 | 44' 50" | Digestive System | Lec. | Non-BSCS |
| | 9/6/72 | 31' | Germination of Seeds | Lec-demonst. | Non-BSCS |

continued

TABLE 6--Continued

| Teacher Number | Date Observed | Duration of Recorded Observation | Topic | Method Used | Curriculum Materials Used |
|---|---|---|---|---|---|
| 11 | 1/20/72 | 29' 10" | Cell Structure | Lec. | Part BSCS |
| | 7/25/72 | 42' | Communities and Ecosystems | Lec-disc. | BSCS |
| 12 | 3/6/72 | 49' | Anatomy and Physiology of Frog | Prelab-disc. | BSCS |
| | 9/7/72 | 41' 30" | Parasitism | Lec-disc. | BSCS |
| 13 | 1/17/72 | 15' | Structure of Fish | Lec. | Non-BSCS |
| | 9/6/72 | 26' | Leaf Structure | Lec-disc. | Non-BSCS |
| 14 | 3/14/72 | 58' | Conservation | Lec. | Non-BSCS |
| | 8/30/72 | 56' 30" | Population | Prelabdisc-lab. | Part BSCS |
| 15 | 3/14/72 | 45' 50" | Vegetative Propagation | Lec-demonst. | Part BSCS |
| | 9/7/72 | 50' 40" | Animal Characteristics | Lab-disc. | Part BSCS |
| 16 | 2/1/72 | 46' 30" | Palearctic & Oriental Realms | Lec-lab. | Part BSCS |
| | 8/22/72 | 49' 40" | Classes of Vertebrates | Lecdemonst-lab. | Part BSCS |
| 17 | 12/13/71 | 28' | Skeletal System | Lec. | Non-BSCS |
| | 8/17/72 | 37' 50" | Population Growth | Prelabdisc-lab. | BSCS |
| 18 | 2/16/72 | 75' | Anatomy of Frog | Lab. (1 pd. only) | BSCS |
| | 8/8/72 | 52' 50" | Population Growth | Prelabdisc-lab. | BSCS |
| 19 | 4/11/72 | 32' 50" | Vegetative Propagation | Lec. | Non-BSCS |
| | 8/16/72 | 46' 40" | Chemical Substance Stored in Seeds | Lec-demonst. | Non-BSCS |
| 20 | 12/13/71 | 21' 10" | Population Density, Ecosystem | Lec. | Part BSCS |
| | 8/17/72 | 42' | Population Growth | Postlab-disc. | BSCS |

TABLE 7

TOTAL NUMBER OF PREDOMINANT TEACHER BEHAVIORS OBSERVED BEFORE AND AFTER THE BIOLOGY METHODS COURSE IN THE EXPERIMENTAL GROUP

| Teacher Number | Behavior Categories 2 | 3 | 6a | 6b | 5b | 5a | $5a_3$ | $5a_2$ | $5a_7$ | Indirect | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 1 | 0 | 5 | 2 | 24 | 222 | 23 | 141 | 37 | 89 | 250 |
| | 4 | 3 | 6 | 1 | 78 | 367 | 44 | 141 | 56 | 187 | 389 |
| 2 | 18 | 16 | 0 | 7 | 106 | 238 | 11 | 24 | 9 | 142 | 360 |
| | 7 | 13 | 4 | 9 | 87 | 266 | 87 | 27 | 43 | 234 | 360 |
| 3 | 0 | 5 | 0 | 0 | 62 | 261 | 17 | 163 | 41 | 125 | 328 |
| | 1 | 4 | 1 | 0 | 50 | 213 | 18 | 154 | 30 | 108 | 337 |
| 4 | 1 | 6 | 0 | 1 | 45 | 244 | 11 | 200 | 27 | 89 | 302 |
| | 6 | 5 | 8 | 0 | 100 | 206 | 118 | 5 | 48 | 279 | 347 |
| 5 | 2 | 2 | 0 | 2 | 75 | 145 | 1 | 117 | 18 | 96 | 433 |
| | 9 | 3 | 1 | 0 | 310 | 93 | 51 | 8 | 12 | 377 | 431 |
| 6 | 0 | 0 | 1 | 0 | 27 | 109 | 5 | 80 | 14 | 47 | 209 |
| | 3 | 1 | 0 | 0 | 277 | 99 | 12 | 58 | 10 | 300 | 419 |
| 7 | 0 | 4 | 0 | 0 | 38 | 151 | 31 | 92 | 13 | 86 | 202 |
| | 1 | 5 | 1 | 0 | 259 | 91 | 19 | 27 | 12 | 294 | 371 |
| 8 | 3 | 4 | 6 | 2 | 94 | 202 | 13 | 135 | 20 | 137 | 330 |
| | 1 | 2 | 1 | 0 | 294 | 106 | 0 | 60 | 2 | 299 | 422 |
| 9 | 0 | 6 | 2 | 1 | 29 | 128 | 0 | 98 | 25 | 62 | 187 |
| | 0 | 4 | 3 | 4 | 287 | 119 | 32 | 11 | 37 | 363 | 420 |
| 10 | 1 | 4 | 3 | 0 | 78 | 87 | 39 | 16 | 25 | 149 | 173 |
| | 1 | 19 | 14 | 2 | 93 | 158 | 99 | 13 | 24 | 249 | 331 |

continued

TABLE 7--Continued

| Teacher Number | Behavior Categories 2 | 3 | 6a | 6b | 5b | 5a | $5a_3$ | $5a_2$ | $5a_7$ | Indirect | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 1 | 4 | 5 | 1 | 69 | 150 | 46 | 57 | 24 | 148 | 245 |
| | 10 | 8 | 4 | 3 | 136 | 136 | 17 | 76 | 14 | 179 | 314 |
| 12 | 1 | 8 | 4 | 0 | 29 | 104 | 11 | 68 | 21 | 73 | 164 |
| | 8 | 13 | 5 | 1 | 46 | 133 | 14 | 64 | 30 | 108 | 218 |
| 13 | 0 | 4 | 1 | 0 | 99 | 238 | 17 | 187 | 19 | 140 | 365 |
| | 0 | 5 | 3 | 1 | 92 | 266 | 116 | 90 | 52 | 268 | 372 |
| 14 | 0 | 2 | 0 | 0 | 27 | 147 | 7 | 63 | 12 | 48 | 180 |
| | 2 | 7 | 4 | 0 | 59 | 201 | 23 | 135 | 31 | 124 | 284 |
| 15 | 0 | 3 | 0 | 0 | 37 | 216 | 0 | 206 | 9 | 49 | 273 |
| | 2 | 3 | 4 | 0 | 66 | 140 | 7 | 95 | 31 | 111 | 222 |
| 16 | 8 | 2 | 4 | 3 | 53 | 277 | 7 | 266 | 13 | 79 | 342 |
| | 28 | 7 | 11 | 2 | 71 | 168 | 79 | 7 | 3 | 171 | 476 |
| 17 | 3 | 4 | 2 | 0 | 16 | 135 | 1 | 119 | 9 | 32 | 163 |
| | 14 | 4 | 3 | 4 | 375 | 100 | 52 | 10 | 2 | 436 | 510 |
| 18 | 2 | 3 | 6 | 0 | 61 | 161 | 39 | 59 | 9 | 118 | 271 |
| | 0 | 19 | 4 | 2 | 116 | 290 | 150 | 50 | 41 | 330 | 456 |
| 19 | 0 | 2 | 6 | 1 | 76 | 253 | 8 | 195 | 40 | 132 | 355 |
| | 29 | 6 | 0 | 2 | 112 | 93 | 0 | 34 | 11 | 129 | 321 |
| 20 | 0 | 2 | 0 | 4 | 73 | 251 | 102 | 66 | 43 | 129 | 337 |
| | 1 | 15 | 8 | 0 | 93 | 242 | 159 | 27 | 20 | 295 | 378 |

TABLE 8

TOTAL NUMBER OF PREDOMINANT TEACHER BEHAVIORS OBSERVED BEFORE AND AFTER THE BIOLOGY METHODS COURSE IN THE CONTROL GROUP

| Teacher Number | Behavior Categories | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2 | 3 | 6a | 6b | 5b | 5a | $5a_3$ | $5a_2$ | $5a_7$ | Indirect | Total |
| 1 | 4 | 0 | 1 | 0 | 100 | 69 | 3 | 21 | 4 | 108 | 202 |
| | 1 | 0 | 2 | 0 | 31 | 251 | 5 | 189 | 52 | 90 | 306 |
| 2 | 2 | 1 | 1 | 2 | 25 | 174 | 0 | 122 | 36 | 63 | 222 |
| | 3 | 1 | 1 | 1 | 30 | 110 | 9 | 59 | 27 | 68 | 154 |
| 3 | 4 | 3 | 4 | 0 | 71 | 252 | 2 | 188 | 59 | 139 | 359 |
| | 2 | 3 | 1 | 2 | 97 | 206 | 33 | 118 | 48 | 182 | 317 |
| 4 | 3 | 5 | 3 | 3 | 40 | 272 | 14 | 187 | 51 | 113 | 334 |
| | 1 | 0 | 0 | 1 | 37 | 199 | 8 | 148 | 36 | 37 | 249 |
| 5 | 0 | 5 | 1 | 0 | 14 | 129 | 0 | 101 | 14 | 34 | 152 |
| | 4 | 16 | 3 | 3 | 73 | 167 | 62 | 9 | 51 | 205 | 281 |
| 6 | 0 | 6 | 0 | 4 | 55 | 281 | 0 | 229 | 38 | 99 | 346 |
| | 1 | 8 | 3 | 1 | 22 | 214 | 31 | 119 | 48 | 112 | 271 |
| 7 | 0 | 4 | 1 | 0 | 48 | 240 | 15 | 184 | 9 | 77 | 306 |
| | 6 | 3 | 0 | 4 | 101 | 180 | 8 | 240 | 13 | 125 | 321 |
| 8 | 2 | 2 | 0 | 0 | 40 | 241 | 14 | 176 | 31 | 87 | 290 |
| | 1 | 5 | 3 | 1 | 58 | 233 | 27 | 108 | 67 | 160 | 309 |
| 9 | 0 | 3 | 0 | 1 | 36 | 186 | 3 | 141 | 22 | 64 | 240 |
| | 7 | 7 | 0 | 5 | 102 | 166 | 13 | 88 | 31 | 153 | 317 |
| 10 | 0 | 3 | 2 | 0 | 67 | 196 | 0 | 148 | 42 | 114 | 269 |
| | 1 | 0 | 2 | 0 | 89 | 83 | 13 | 36 | 27 | 131 | 186 |

continued

TABLE 8--Continued

| Teacher Number | Behavior Categories 2 | 3 | 6a | 6b | 5b | 5a | $5a_3$ | $5a_2$ | $5a_7$ | Indirect | Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 11 | 0 | 6 | 0 | 0 | 36 | 124 | 7 | 93 | 15 | 64 | 175 |
| | 0 | 5 | 2 | 0 | 40 | 197 | 5 | 160 | 29 | 81 | 252 |
| 12 | 3 | 1 | 1 | 1 | 76 | 166 | 9 | 4 | 17 | 106 | 294 |
| | 2 | 5 | 0 | 4 | 6 | 219 | 0 | 174 | 31 | 42 | 249 |
| 13 | 0 | 0 | 0 | 0 | 14 | 74 | 0 | 63 | 11 | 25 | 90 |
| | 0 | 0 | 0 | 0 | 1 | 156 | 1 | 152 | 3 | 5 | 163 |
| 14 | 0 | 3 | 6 | 1 | 44 | 289 | 0 | 180 | 55 | 108 | 348 |
| | 5 | 2 | 1 | 3 | 181 | 139 | 50 | 13 | 36 | 270 | 339 |
| 15 | 14 | 2 | 1 | 0 | 73 | 157 | 17 | 70 | 6 | 99 | 275 |
| | 48 | 2 | 2 | 1 | 70 | 163 | 23 | 70 | 4 | 91 | 329 |
| 16 | 4 | 2 | 3 | 7 | 30 | 173 | 3 | 114 | 38 | 76 | 249 |
| | 2 | 8 | 3 | 1 | 16 | 277 | 37 | 151 | 64 | 128 | 328 |
| 17 | 2 | 3 | 4 | 3 | 31 | 121 | 2 | 78 | 40 | 80 | 168 |
| | 16 | 9 | 12 | 3 | 50 | 129 | 1 | 80 | 33 | 105 | 227 |
| 18 | 150 | 12 | 0 | 0 | 17 | 11 | 9 | 0 | 0 | 38 | 666 |
| | 3 | 1 | 0 | 2 | 123 | 173 | 0 | 106 | 15 | 139 | 317 |
| 19 | 0 | 2 | 0 | 0 | 35 | 131 | 1 | 111 | 11 | 49 | 197 |
| | 0 | 1 | 1 | 2 | 95 | 163 | 8 | 108 | 28 | 135 | 280 |
| 20 | 3 | 1 | 1 | 0 | 22 | 75 | 4 | 51 | 15 | 43 | 127 |
| | 3 | 4 | 0 | 11 | 20 | 203 | 6 | 164 | 24 | 54 | 252 |

TABLE 9

COMPUTED RATIOS OF CATEGORIES OF TEACHER CLASSROOM BEHAVIORS OBSERVED IN THE EXPERIMENTAL GROUP BEFORE AND AFTER THE BIOLOGY METHODS COURSE

| Teacher Number | Behavior Categories 2:3 | 6a:6b | 5b:5a | $5a_3$:$5a_2$ | $5a_7$:Total | Indirect:Total |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 2.50 | 0.11 | 0.16 | 0.15 | 0.36 |
| | 1.33 | 6.00 | 0.21 | 0.31 | 0.14 | 0.48 |
| 2 | 1.13 | 0.00 | 0.45 | 0.46 | 0.03 | 0.39 |
| | 0.54 | 0.44 | 0.33 | 3.22 | 0.12 | 0.68 |
| 3 | 0.00 | 0.00 | 0.23 | 0.10 | 0.13 | 0.41 |
| | 0.25 | 0.00 | 0.23 | 0.12 | 0.09 | 0.32 |
| 4 | 0.17 | 0.00 | 0.10 | 0.05 | 0.09 | 0.29 |
| | 1.20 | 0.00 | 0.49 | 23.60 | 0.14 | 0.80 |
| 5 | 1.00 | 0.00 | 0.52 | 0.01 | 0.04 | 0.22 |
| | 3.00 | 0.00 | 3.33 | 6.38 | 0.03 | 0.87 |
| 6 | 0.00 | 0.00 | 0.25 | 0.06 | 0.07 | 0.22 |
| | 3.00 | 0.00 | 2.79 | 0.21 | 0.02 | 0.72 |
| 7 | 0.00 | 0.00 | 0.25 | 0.35 | 0.06 | 0.43 |
| | 0.20 | 0.00 | 2.85 | 0.70 | 0.03 | 0.79 |
| 8 | 0.75 | 3.00 | 0.47 | 0.10 | 0.06 | 0.42 |
| | 0.50 | 0.00 | 2.77 | 0.00 | 0.005 | 0.71 |
| 9 | 0.00 | 2.00 | 0.23 | 0.00 | 0.13 | 0.33 |
| | 0.00 | 0.75 | 2.41 | 2.91 | 0.09 | 0.86 |
| 10 | 0.75 | 0.00 | 0.90 | 2.44 | 0.14 | 0.86 |
| | 0.05 | 7.00 | 0.59 | 7.62 | 0.07 | 0.75 |

continued

TABLE 9--Continued

| Teacher Number | Behavior Categories 2:3 | 6a:6b | 5b:5a | $5a_3$:$5a_2$ | $5a_7$:Total | Indirect:Total |
|---|---|---|---|---|---|---|
| 11 | 0.75 | 5.00 | 0.46 | 1.24 | 0.10 | 0.60 |
| | 1.25 | 1.33 | 1.00 | 0.22 | 0.04 | 0.57 |
| 12 | 0.13 | 0.00 | 0.28 | 0.16 | 0.13 | 0.45 |
| | 0.62 | 5.00 | 0.35 | 0.22 | 0.14 | 0.50 |
| 13 | 0.00 | 0.00 | 0.42 | 0.09 | 0.05 | 0.38 |
| | 0.00 | 3.00 | 0.35 | 1.23 | 0.14 | 0.72 |
| 14 | 0.00 | 0.00 | 0.18 | 0.11 | 0.07 | 0.27 |
| | 0.29 | 0.00 | 0.29 | 0.17 | 0.11 | 0.44 |
| 15 | 0.00 | 0.00 | 0.17 | 0.00 | 0.03 | 0.14 |
| | 0.67 | 0.00 | 0.47 | 0.07 | 0.14 | 0.50 |
| 16 | 4.00 | 1.33 | 0.19 | 0.03 | 0.04 | 0.23 |
| | 4.00 | 5.50 | 0.42 | 11.29 | 0.01 | 0.36 |
| 17 | 0.75 | 0.00 | 0.12 | 0.01 | 0.06 | 0.20 |
| | 3.50 | 1.33 | 3.75 | 5.20 | 0.004 | 0.85 |
| 18 | 0.67 | 0.00 | 0.38 | 0.66 | 0.03 | 0.44 |
| | 0.00 | 2.00 | 0.40 | 3.00 | 0.09 | 0.72 |
| 19 | 0.00 | 6.00 | 0.30 | 0.04 | 0.11 | 0.37 |
| | 4.83 | 0.00 | 1.20 | 0.00 | 0.03 | 0.40 |
| 20 | 0.00 | 0.00 | 0.29 | 1.54 | 0.13 | 0.38 |
| | 0.07 | 0.00 | 0.38 | 5.89 | 0.05 | 0.78 |

TABLE 10

COMPUTED RATIOS OF CATEGORIES OF TEACHER CLASSROOM BEHAVIORS OBSERVED IN THE CONTROL GROUP BEFORE AND AFTER THE BIOLOGY METHODS GROUP

| Teacher Number | Behavior Categories 2:3 | 6a:6b | 5b:5a | $5a_3$:$5a_2$ | $5a_7$:Total | Indirect:Total |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 1.45 | 0.14 | 0.02 | 0.53 |
| | 0.00 | 0.00 | 0.12 | 0.13 | 0.17 | 0.29 |
| 2 | 2.00 | 0.50 | 0.14 | 0.00 | 0.16 | 0.28 |
| | 3.00 | 1.00 | 0.27 | 0.15 | 0.18 | 0.44 |
| 3 | 1.33 | 0.00 | 0.28 | 0.01 | 0.16 | 0.39 |
| | 0.67 | 0.50 | 0.47 | 0.28 | 0.15 | 0.57 |
| 4 | 0.60 | 1.00 | 0.15 | 0.07 | 0.15 | 0.34 |
| | 0.00 | 0.00 | 0.19 | 0.05 | 0.14 | 0.15 |
| 5 | 0.00 | 0.00 | 0.11 | 0.00 | 0.09 | 0.22 |
| | 0.25 | 1.00 | 0.44 | 6.88 | 0.18 | 0.73 |
| 6 | 0.00 | 0.00 | 0.20 | 0.00 | 0.11 | 0.29 |
| | 0.13 | 3.00 | 0.10 | 0.26 | 0.18 | 0.41 |
| 7 | 0.00 | 0.00 | 0.20 | 0.08 | 0.03 | 0.25 |
| | 2.00 | 0.00 | 0.56 | 0.03 | 0.04 | 0.39 |
| 8 | 1.00 | 0.00 | 0.17 | 0.08 | 0.11 | 0.30 |
| | 0.20 | 3.00 | 0.25 | 0.25 | 0.22 | 0.52 |
| 9 | 0.00 | 0.00 | 0.19 | 0.02 | 0.09 | 0.26 |
| | 1.00 | 0.00 | 0.61 | 0.15 | 0.10 | 0.48 |
| 10 | 0.00 | 0.00 | 0.34 | 0.00 | 0.16 | 0.42 |
| | 0.00 | 0.00 | 1.07 | 0.36 | 0.15 | 0.70 |

continued

TABLE 10--Continued

| Teacher Number | Behavior Categories 2:3 | 6a:6b | 5b:5a | $5a_3$:$5a_2$ | $5a_7$:Total | Indirect:Total |
|---|---|---|---|---|---|---|
| 11 | 0.00 | 0.00 | 0.28 | 0.07 | 0.09 | 0.37 |
| | 0.00 | 0.00 | 0.20 | 0.03 | 0.12 | 0.32 |
| 12 | 3.00 | 1.00 | 0.46 | 2.25 | 0.06 | 0.36 |
| | 0.40 | 0.00 | 0.15 | 0.00 | 0.12 | 0.17 |
| 13 | 0.00 | 0.00 | 0.19 | 0.00 | 0.12 | 0.27 |
| | 0.00 | 0.00 | 0.01 | 0.01 | 0.02 | 0.03 |
| 14 | 0.00 | 6.00 | 0.15 | 0.00 | 0.16 | 0.31 |
| | 2.50 | 0.33 | 1.30 | 3.84 | 0.11 | 0.80 |
| 15 | 7.00 | 0.00 | 0.40 | 0.24 | 0.02 | 0.36 |
| | 24.00 | 2.00 | 0.43 | 0.33 | 0.01 | 0.28 |
| 16 | 2.00 | 0.43 | 0.17 | 0.03 | 0.15 | 0.31 |
| | 0.25 | 3.00 | 0.06 | 0.25 | 0.19 | 0.39 |
| 17 | 0.67 | 1.33 | 0.26 | 0.03 | 0.24 | 0.48 |
| | 1.77 | 4.00 | 0.39 | 0.01 | 0.15 | 0.46 |
| 18 | - | 0.00 | - | - | - | - |
| | 3.00 | 0.00 | 0.71 | 0.00 | 0.05 | 0.44 |
| 19 | 0.00 | 0.00 | 0.27 | 0.01 | 0.06 | 0.25 |
| | 0.00 | 0.50 | 0.58 | 0.07 | 0.10 | 0.48 |
| 20 | 3.00 | 0.00 | 0.29 | 0.08 | 0.12 | 0.34 |
| | 0.75 | 0.00 | 0.10 | 0.04 | 0.10 | 0.21 |

# APPENDIX D

## THE BIOLOGY METHODS COURSE OUTLINE AND OBJECTIVES

Course No. Education 287 A

Course Title: INSTRUCTIONAL PROCEDURES AND TECHNIQUES IN MODERN BIOLOGY

3 units, 1 semester

3 hours a week during semestral terms
2 hours a day, from Mondays to Fridays, during summer terms

The course is intended to give biology teachers a background in the structure and methodology of modern biology through selected classroom activities, readings and discussions, microteaching experiences and self-evaluations of teaching style and teacher behavior consistent with the teaching of biology as inquiry. Stress is given to greater student participation and student -teacher interaction. The course will mainly be experience oriented rather than theoretical. As much as possible, course experiences will be made to suit the needs of the individual biology teachers in their schools.

Instructor: Mrs. Araceli G. Almase, Assistant Professor

Secondary Department, College of Education & formerly of the College of Liberal Arts, University of San Carlos

Assistant Instructor: A BSCS (Biological Science Curriculum study) high school biology teacher.

Ed. 287A

Major Objectives of the Course:

The course is designed to give biology teachers the following:

1. A better understanding of the nature of science and science teaching as inquiry;

2. A knowledge of the use of methods of analyzing teacher behavior and behavior patterns which promote inquiry learning;

3. A knowledge of pupil characteristics identified with inquiry behaviors;

4. Develop a laboratory oriented teaching style based on practice in microteaching situations of strategies which promote individual student participation and help students develop competencies related to inquiry in biology.

Instructional Activities:

(Tentative Schedule Given is for the Summer Term)

Week One

I. Assessment of Entering Behavior and Attitudes:

The student should be able to:

A. Analyze his entering behavior through his performance on the following:

   1. The BSCS Processes of Science Test (POST)
   2. The Teaching Situation Reaction Test (TSRT)
   3. The Science Impact Survey Test
   4. Survey on Educational Goals

B. Analyze his present teaching behavior (if tapes and recorded observations of previous class taught are available) according to the:

   1. Biology Teachers Behavior Inventory
   2. Parakh's Interaction Analysis for Biology Classes
   3. Categories of Questions Asked (Bingman, ed., 1969)

C. Identify strengths and weaknesses of his entering behavior in terms of course objectives.

D. Analyze pupils' entering behavior in terms of instructional objectives of subsequent microteaching lessons.

II. Establishing Rapport in Class and Questioning Strateties

The student should be able to:

A. Demonstrate through a study of recordings of inquiry lessons (Suchman, 1966) and other materials:

1. Rapport with the pupils in a microteaching situation.
2. Facility in questioning strategies consistent with inquiry in biology using the model strategies for Laboratory Activities in the Biology Teachers Handbook, 1970, Chap. V, and mimeographed handouts.
3. Verbal and non-verbal behaviors which promote pupil behavior associated with inquiry.

B. Analyze his teaching behavior and teaching style and utilize these in reteaching the activity.

Week Two and Three

III. The Nature of Modern Science Teaching

A. The Structure of Modern Biology

The student should be able to demonstrate his understanding of the structure of modern biology by:

1. Making an outline of his own of the major generalizations in biology using Novak's outline as a guide (Novak, The Improvement of Biology Teaching, 1970).
2. Formulating a conceptual scheme for a selected biological principle.

B. Objectives for Teaching Inquiry Processes in Biology

The student should:

1. Examine and criticize behavioral objectives in selected BSCS Laboratory Teaching Blocks.
2. Write behavioral objectives for one laboratory investigation in the BSCS lab. manual based on the Table of Objectives for Teaching Enquiry Processes in Biology (Biology Teacher's Handbook, 1970).

3. Evaluate the behavioral objectives examined and written in terms of complexity of behavior expected using Gagne's Classes of Behavior in DeCecco, The Psychology of Learning and Instruction, 1968; Bloom's Taxonomy of Educational Objectives, 1956 and other suggested readings.

C. Teaching Science As Inquiry, Rationale

The student should be able to:

1. Interpret in a microteaching situation the conceptual structure of biological principles and the teaching of science as inquiry using the Invitations to Inquiry in the Biology Teacher's Handbook and the BSCS inquiry slides.
2. Demonstrate the importance of the laboratory and discussion techniques in biology teaching through evaluations of pupil learning.
3. Evaluate the effectiveness of the teaching session in terms of inquiry techniques (inquiry into inquiry teaching).

Week Four, Five and Six

IV. Planning and Teaching a Model Teaching Block or Unit

A. The Laboratory Teaching Block or Teaching Unit

The student should be able to:

1. Demonstrate familiarity with the objectives of the BSCS Lab. Teaching Blocks by defending his choice or rejection of a laboratory block (using the BSCS Lab. Blocks Guide for the Selection of a Specific Laboratory Block, Chap. IV).
2. Plan a schedule for the use of a laboratory block or the laboratory activities of a teaching unit in biology (in case student prefers a unit instead of a block) which is applicable to his own school situation.
3. Prepare sample lessons for criticism and evaluation.
4. Present two sample lessons in a microteaching situation (Presentations will be recorded; verbal behavior in a tape recorder and non-verbal behavior, in written form).

5. Evaluate teaching in critique sessions with peers and the instructor following microteaching activity.

   The evaluation might involve:

   a. Biological themes and concepts
   b. Inquiry techniques
   c. Instructional objectives as related to teaching activities and evaluations in terms of inquiry learning.
   d. Observations about materials and learners.
   e. Instructional procedures.

      (1) Ordering and securing supplies.
      (2) Daily and long range planning.
      (3) Scheduling of laboratory activities.
      (4) Preparation and use of AV materials.
      (5) Performance of some necessary laboratory skills and techniques

   f. Student learning in terms of stated objectives of the block or unit, and the specific lesson.

B. Testing and Evaluation

   The student should be able to:

   1. Analyze the sample biological activities taught for testing purposes according to the guide Part IV, Evaluation, BSCS Special Pub. No. 6).
   2. Develop a test on the activities and analyze questions with respect to:

      a. What the question is trying to measure.
      b. What the objective is behind the question.
      c. What the question measures.
      d. Whether the material is worth measuring.

   3. Discuss principles for preparing different types of tests.
   4. Discuss grading policies in their respective school systems.

# APPENDIX E

## GLOSSARY OF TEACHER CLASSROOM BEHAVIORS

# GLOSSARY OF TEACHER CLASSROOM BEHAVIORS

The following glossary is a modification of Evans[1] definitions of behaviors in the categories and sub-categories of the Biology Teacher Behavior Inventory. Numbers preceded by a single asterisk (*) are behaviors defined by Evans which were observed in the study. Those preceded by a double asterisk (**) are behaviors observed in this study which were not defined in Evans' glossary.

1. Management

   *a. Routine management

      *(1) Erases and/or washes chalkboard
      *(2) Calls roll (verbal and non-verbal)
       (3) Opens or closes windows and/or doors
      *(4) Passes out papers or gives papers to student to pass out
      *(5) Takes up papers or gives papers to student to pass out
       (6) Adjusts lighting
      *(7) Looks for or readies materials or papers
      *(8) Pulls down movie screen
           **a. Puts up or rolls charts
           **b. Uses overhead projector
       (9) Takes care of administrative details (signs notes, talks to visitors, prepares absence slips, and admits tardy students)

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[1] Thomas Parker Evans, An Exploratory Study of the Verbal and Non-verbal Behaviors of Biology Teachers and Their Relationship to Selected Personality Traits, Ph. D. dissertation, The Ohio State University (Ann Arbor, Michigan: University Microfilms, 1968), 227-245.

*(10) Moves and reorganizes furnitures
(11) Shuffles paper during school announcement
(12) Sends student on errand
(13) Announces or explains school events
(14) Gives several grades on request
(15) Washes hands
(16) Sharpens pencil
(17) Mentions that exams or papers are available for those interested
(18) Asks for lost articles
*(19) Waits for class to arrive or for bell to ring
(20) Watches time

*b. Laboratory management

*(1) Looks for or readies supplies or equipment
*(2) Asks students to clean up or to turn off equipment
*(3) Tells students how to get information, gives sources of information
*(4) Shows, provides, or directs pupils to materials, supplies, and equipment
*(5) Reads instruction
*(6) Asks student needs of materials
*(7) Aids individual students with specific techniques
*(8) Shouts instructions to entire class while class works
*(9) Observes or supervises laboratory activities
**(10) Checks materials assigned to be brought by pupils to class
**(11) Checks pupils' data notebooks

c. Study management

(1) Asks student about make-up test or assignment
(2) Gives make-up test to individual student
*(3) Gives, explains, repeats, implies or reminds students of assignment
(4) Assigns reading (aloud or directed study)
*(5) Refers students to specific page in textbook
**a. Refers students to record of observations
(6) Gives assignment and time for directed study; also observes or directs study
*(7) Asks students to make a diagram on the chalkboard
*(8) Tells students to make copies of the diagrams on the chalkboard
*(9) Assigns or reminds students of quiz or exam
**(10) Calls attention to displays
**a. Calls attention to diagrams on the blackboard, specimens, or materials

2. Control

a. Looks up from work
*b. Silence
*c. Stops walking
d. Indicates inability to hear due to classroom noise
e. Postpones student question or statement
*f. Shows or places finger to lips
g. Points student to his seat
h. Holds out hands to request student to wait
i. Turns and stares
j. Taps pencil
k. Raises eyebrows or uses eyes to gain attention
*l. Stands with hands on hips (and stares in silence) arms behind
    *(1) Stands with arms behind back or with hands clasped together in front
m. Holds up hand(s)
n. Rubs brow or grabs head
o. Walks to front of room or to door as the bell rings
*p. Walks from seat to seat to inspect work
q. Records in grade book while student reports
*r. Scans room to see who is not working
s. Uses sarcasm to control students
t. Stares at individual student (eye contact)
u. Adjusts apparatus for student without being asked
v. Asks student to report after class
w. Comments on appropriateness of combing hair in public
x. Watches carefully the interchange between two students
y. Studies or stares at student giving a report
*z. Maintains or returns to authoritarian position (behind desk or demonstration table, at door or in front of room)
*aa. Walks back and forth behind students
bb. Waves to get attention
cc. Cautions student on his behavior
dd. Moves toward students who are noisy
ee. Refers to handout about term paper
ff. Gives instruction for handout
*gg. Gives instruction regarding written work
*hh. Tells students to draw
*ii. Tells students to proceed with work
*jj. Asks or states:
    *(1) "Take your seats."
    (2) "The bell has rung."
    (3) "You are too noisy."
    (4) "Time is running out."

*(5) "Five more minutes."
(6) "Some people are still talking."
(7) "Get busy."
(8) "Give me your attention."
(9) "Let's keep it quiet."
(10) "Sit down."
(11) "Get rid of those things, will ya?"
(12) "Too much competition."
*(13) "Put away your books."
*(14) "Come on."
(15) "Shut up."
(16) "If you don't be quiet...."
*(17) "I just want the answer..." (you just give me the answer)
(18) "Get into your groups."
(19) "Start your homework."
(20) "Get the microviewers."
*(21) "Work on this for ... min."
*(22) "Attention class."
*(23) "Pay attention."
*(24) "One at a time."
(25) "I really didn"t expect Bill to cooperate."
*(26) "Hurry up."
(27) "Will you cooperate?"
(28) "What's the trouble here?"
(29) "You must participate."
(30) "Taste this."
(31) "Quit messing around."
(32) "Some are not paying attention."
(33) "Get back where you belong."
(34) "You're going to ruin it."
(35) "What are you doing now, David?"
(36) "Quiet"
*(37) "Move back!"
(38) "What's your problem?"
*(39) "Finished?"
(40) "Tom where are you supposed to be?"
(41) "Are you in this class? Well, take part."
(42) "If everybody would accept his own responsibility..."
*(43) "You should already know this."

**kk. Tells students to repeat work or answers of other students

3. Release

*a. Laughs, smiles, jokes, or teases
*b. Removes formal barriers and shortens formal distance (moving from behind desk when talking informall, etc.)
c. Chats informally with students

d. Ignores or tolerates student noise
e. Gives students a choice of things to do
*f. Encourages student talk and participation
g. Allows and encourages discussion among students
h. Ignores control
i. Uses humor
j. Accepts student joke
k. Offers own materials for student use
l. Draws cartoon or joke on board or overboard
m. Encourages students to select their own committee and committee officials
n. Stops talking to receive student statement
*o. Moves around room talking informally and giving aid when students ask for it
*p. Asks for student help
*q. Accepts student's correction or criticism
*r. Asks for volunteers
*s. Corrects own mistake or apologizes for error or omission made earlier
*t. Admits lack of knowledge or undertaking in certain area
u. Lays hand on student
v. Approaches student who is talking
*w. Sits on desk
x. Uses sarcasm concerning self
*y. Leans towards class as he talks
**(1) Leans towards class to listen
*z. Raises hand during student discussion
aa. Uses sarcasm as joke, laughing
*bb. Uses a sweeping motion with hands to elicit response
*cc. Asks one student to give another assistance
*dd. States or asks:
*(1) "Any questions?"
*(2) "Are you sure?"
*(3) "Everyone understand?" **(Do you understand?)
(4) "Are you with us?"
(5) "Other questions?"
(6) "Do you see that?"
*(7) "How many think...?"
(8) "Want the same kind of a problem or a harder one?"
*(9) "How many understand?"
*(10) "How many are lost?"
**(11) "Is there any observation not recorded on the board?"

4. Goal setting

*a. States the purpose of a particular class activity
*b. Reviews the major objectives of a given exercise

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**Not in Evans Glossary of Teacher Classroom Behaviors.

*c. Rephrases the objectives of an exercise
*d. Justifies an area of study
e. Points out the results of studying certain areas of information
f. Refers to a concept as the most important in the work
g. Asks about the significance of a certain fact
*h. Emphasizes the importance of a topic
i. Places emphasis on certain topics of a student report, statement or question
j. Marvels at man's accomplishments
k. Notes that photosynthesis is not an accomplishment of man
l. Refers to man's starvation
m. Asks question about the effect of human actions, decisions...
n. Asks questions about man in general
o. Refers to human life as a natural resource
p. Relates content to local community situation
q. Relates content to current events
r. Relates content to government
s. Relates content to lives of students in class, home...

5. Content Development

*a. Teacher Centered (see subdivisions below)
*b. Student Centered
    *(1) Procedures
        *(a) Tells students how to proceed with work
        (b) Shows samples of assignment done and explains it
        *(c) Nods, answers or gives assent to student procedures
        *(d) Refers to materials and the instructions on the use thereof
        *(e) Gives or shows instructions to individual groups or class
        (f) Stops the classwork and calls attention to specific procedures
        *(g) Gives or shows instructions for individual laboratory work
        *(h) Asks group about their procedures
        *(i) Tells students how to do work and how not to do it
        *(j) Gives or shows students the procedures for solving a problem
    *(2) Knowledge
        *(a) Presents or asks content in chronological order
        *(b) States facts, gives factual answer or reply or asks factual questions

*(c) Gives explanation of phenomenon, process, or detail
*(d) Introduces subject
(e) Presents problem and gives results as facts
*(f) Gives answer to question student missed
**(1) Gives answer to student question
*(g) Gives detailed information
(h) Gives exceptions to a law and examples thereof
*(i) Gives vocabulary list
(j) Gives symbols and explains meaning thereof or asks meaning of symbols
(k) States equality of given terms
*(l) Refers to text presentation of terms
*(m) Explains illustration
*(n) Asks for a term
**(1) Asks for definition or meaning of term
*(o) Asks for name of process, structure, etc.
*(p) Asks for identification of object
*(q) Asks content question and gives answer
*(r) Extends factual knowledge from given information
*(s) Writes, draws, diagrams content on blackboard
*(t) Listens while student reads

(3) Scientific process

*(a) Asks for prediction of results from a given procedure or situation
(b) Asks how certain information could be obtained experimentally
*(c) Asks for an interpretation or an explanation of data
(d) Reminds students to keep eyes open
*(e) Asks student what usually happens under given conditions
(f) Asks questions about possible ways of getting information in biology
(g) Distinguishes hypotheses from facts observed
*(h) Asks a question a second time but gives different variables
(i) Asks: "Can you think of a simpler way?"
*(j) Asks critical question on scientific method
*(k) Presents hypothetical situation
(l) Reads a question pertaining to the explanation of a result of experimentation

(m) Discusses the traits of a scientist
*(n) Asks how problem was solved.
(o) Asks: "What about that?" "Could that happen?"
(p) Asks sequence of specific questions that forces correct conclusion.
*(q) Asks for the possible results of a problem
*(r) Asks for elaboration or extension of content from the known
**(1) Asks for examples
*(s) Asks: "How do you know?"
*(t) Asks students what they think about given content statements: Asks questions requiring judgment, evaluation
*(u) Asks students to think of exceptions
*(v) Makes a statement for student evaluation
*(w) Asks students why they took a particular position
*(x) Asks a question requiring inference(s) from present or previous information
*(y) Asks deductive thought questions
*(z) Asks inductive thought questions
(aa) Extends student question and relates it to laboratory to follow but does not answer question
*(bb) Presents problems or problem situations for students to think through
*(cc) Reads problem statements **(or discussion questions)
*(dd) Participates in or involves student in gathering, processing and analyzing
*(ee) Aids students in making scientifically useful and accurate observations
*(ff) Aids students in working out problem-solving and experimentation skills
*(gg) Asks and discusses basis of meaning of terminology
(hh) Asks questions requiring value judgments by students
*(ii) Asks for delineation or statement of problem

*(4) Tentativeness of Knowledge

*(a) Makes statement emphasizing incompleteness of knowledge in given area of content
*(b) Makes statement regarding tentativeness of knowledge or notes tentativeness of scientific knowledge

*(c) Makes explanation with phraseology which implies tentativeness of information

*(5) Generalizations

*(a) Reviews content in general terms or asks review questions
*(b) Uses generalizations to summarize
*(c) Reviews sequence of previous study, class-work content
(d) Refers to organization of the chapter under consideration
(e) Explains an entire process as the reverse of another in summary
(f) Poses a review problem requiring inference
*(g) Summarizes by asking a broad question
(h) Asks a mathematical summary question
**(i) Asks for general conclusions

*(6) Articulation of Content

*(a) Cites economic example in illustrating a principle
*(b) Asks economic questions
*(c) Introduces new topic as pertaining to the uses of previous information
*(d) Relates content of laboratory work to paper work already done
(e) Relates one area of content in biology to another area of content in biology
*(f) Calls attention to a previous discussion, previous work, or previous information
*(g) Asks a background information question
(h) Poses a problem requiring use of previous information
*(i) Refers to previous experiences and knowledge of students
(j) Relates content to earlier questions or consideration
*(k) States plans for tomorrow

(7) Facilitates Communication

*(a) Motions student with hands after asking question
*(b) Motions to chalkboard, overhead projector screen, models, specimens, charts, or other aids
**(1) Shows specimens, models or other aids

*(c) Asks students to speak loudly
*(d) Recognizes student intent to make contribution or ask question (points to student, nods, says "yes", calls student by name, etc.)
*(e) Writes or records student answer on chalkboard or overhead projector
*(f) Repeats or confirms student statement
*(g) Asks: "Does that answer your question?"
*(h) Points out differences in questions asked
*(i) Repeats, rereads, restates teacher or student question, answer, problem or statement
*(j) Makes hand motion for emphasis
*(k) Makes statement emphatically (raises voice, motions with hands)
*(l) Gives pronounciation of terms **(or meaning of terms)
*(m) Asks for answers to questions
*(n) Clarifies the framework of a question
(o) Articulates sources of communication
**(p) Asks for term in the dialect
**(q) Gives student permission to speak in the dialect

*6. Affectivity

*a. Positive Affectivity

*(1) Smiles at correct answer
*(2) Smiles while listening to student contributions
*(3) Smiles approval at student action
*(4) Writes honor roll students on board and calls attention to them
*(5) Nods head in affirmative
(6) Uses hand to draw out responses
(7) Pats student(s)
(8) Reassures student(s)
*(9) Thanks student for correction or correct answer
*(10) Makes obvious use of a kind of voice
*(11) Speaks as if he were very interested in the topic
*(12) Thanks student for his contribution
*(13) Points out value of a student's contribution
*(14) Gives credit to student concerning his actions
*(15) Responds in a kind tone of voice to incorrect answer and gives a second chance

(16) Recognizes skill of student in certain areas
*(17) States or asks (Associated non-verbal behaviors are extremely important here):

(a) "That's a boy"
*(b) "That;s better."
(c) "Go ahead and out the fish" (encouragement)
*(d) "This is pretty easy, isn't it?"
(e) "Nice to work with symbols, isn't it?"
*(f) "Fine."
*(g) "Good!"
(h) "Keep it up ... good ..."
*(i) "Very good!"
**(j) "That's a good finding."
**(k) "Alright"
**(l) "No?" (a vernacular expression that is almost equivalent to the English expression, "Is it not?")

b. Negative Affectivity

(1) Admonishes a student for not picking up a fish **(for not having a laboratory manual or data notebook)
(2) Uses sarcasm to motivate a student to action
*(3) Makes a face at an incorrect answer
(4) Jokes at the expense of the student(s)
(5) Moves hands in a pushing-away-motion when incorrect response is given
(6) Identifies student with a poor technique **(Identifies student with incorrect conclusions)
*(7) Uses a harsh tone of voice when correcting a student's response
(8) Raises eyes and shakes head no
(9) Ignores student comments and questions
(10) Does not recognize a student with his hand raised
(11) Points out two students who disagree
(12) Hits table with a hand at incorrect student procedure
(13) Gives a sarcastic answer to irrelevant question
(14) Makes a sarcastic statement concerning student's ability, perfection, coordination
(15) Frowns at student who has an accident **(Who gives the wrong answer)
*(16) Remains expressionless at student replies
**(17) Waits impatiently for student answer

**(18) Does something else while student is reciting
(19) Shakes head in the negative and clicks tongue
*(20) Glares at student who answers incorrectly
*(21) Avoids eye contact while talking to students or with students
(22) Shakes head in disgust
(23) States or asks (Associated non-verbal behaviors are extremely important here):

*(a) "That's wrong."
(b) "If you don"t know this, you will be in trouble."
(c) "You're doing the wrong assignment!"
(d) "That is poor technique."
*(e) "You are just guessing, work on the problem."
(f) "You don't need a slide."
(g) "This will probably bore you but ..."
(h) "I don't believe you ..."
*(i) "No."
(j) "Either do this or not."
(k) "Whew ... finally got that one out (wiped brow).
(l) "Start over" **(You do it again!)
(m) "You people aren't labeling properly."
(n) "Who took the equipment?" (accuses students)
*(o) "Did you see?" ... "No, you couldn't."
(p) "Forget it."
*(q) "Not yet."
(r) "Y.O.U. need a piece of paper."
(s) "I give up!"
**(t) "Those of you who don't have anything you watch out."
**(u) "You are not smart."

# APPENDIX F

## STATISTICAL PROCEDURES AND SAMPLE COMPUTATIONS

## STATISTICAL PROCEDURES AND SAMPLE COMPUTATIONS

The formulation of the problem, the procedures for construction of the decision model for the tests of hypotheses and the sampling used in this study is based on Armore's[1] discussion of tests of hypotheses and statistical decision making with two sample tests.

Two-tailed tests were made to examine significant differences between the mean ratios of the behavior categories between the experimental and control groups before the treatment and within the control group before and after the treatment. One-tailed tests were made to examine significant differences within the experimental group and between the experimental and control groups before and after the methods course. In all cases the basic test was the Student's t.

Sample calculations for the t-tests are as follows:

Two-tailed test:

(a) Test statistic: (mean ratio of control-release behaviors before and after the treatment)

$$\bar{X}_1 - \bar{X}_2 = .5050 - 1.0840 = .5790$$

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[1]Sidney J. Armore, Introduction to Statistical Analysis and Inference for Psychology and Education (New York: John Wiley and Sons, Inc., 1966), 343-344, 387-388.

(b) Test Variable

$$s^2 = \frac{15.9211 - 69.0751}{(20 + 19) - 2} = 2.2972$$

$$t = \frac{.5790}{\sqrt{2.2972\ (\frac{1}{20} + \frac{1}{19})}}$$

$$= \frac{.5790}{\sqrt{(2.2972)\ ).1026)}} = \frac{.5790}{\sqrt{.23569272}}$$

$$= \frac{.5790}{.4854} = 1.1928$$

(c) $n = 40$, $\alpha = .01$, $-2.704 < t > 2.704$*

One-tailed test:

(a) Test Statistic: (mean ratios of indirect teacher behavior-total teacher behaviors before and after the treatment)

$$\bar{X}_1 - \bar{X}_2 = .6400 - .4100 = .2300$$

(b) Test Variable:

$$s^2 = \frac{.5955 + .7374}{(20 + 20) - 2}$$

$$= \frac{1.3329}{38} = .0351$$

$$t = \frac{.2300}{\sqrt{.0351(.1)}} = \frac{.2300}{\sqrt{.00351}}$$

$$= \frac{.2300}{.0592} = 3.8851$$

(c) $\alpha = .01$, $t > 2.423$.

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*t values from Table on Student t-Distribution, William Beyer, Ed., Handbook of Tables for Probability and Statistics (Cleveland, Ohio: The Chemical Rubber Co., 1966), 82.

Chi Square tests of dependence of teacher behavior change towards an indirect pattern of influence on school and teacher variables selected were computed as in the following sample:

(1) Contingency Table:

| Post Scores | Scientific Process Ratio: Above Mean | Below Mean | Total |
|---|---|---|---|
| Above mean | 6 (4.2) | 6 (7.8) | 12 |
| Below mean | 1 (2.8) | 7 (5.2) | 8 |
| Total | 7 | 13 | 20 |

(2) $$X^2 = \frac{(6 - 5.2)^2}{4.2} + \frac{(6 - 7.8)^2}{7.8} + \frac{(1 - 2.8)^2}{2.8} + \frac{(7 - 5.2)^2}{5.2}$$

$$= 2.9570$$

(3) $n = 20$, $df = 1$, $.900 < p > .950$.*

*p values from Table on Chi-Square Distribution, William Byer, Ed., Handbook of Tables for Probability and Statistics (Cleveland, Ohio: The Chemical Rubber Co., 1966), 90.