1992

A study of teachers' instructional planning as revealed by an analysis of objectives, strategies and indicators of student achievement

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Order Number 9226631

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Davis, Barbara Sewell, Ed.D.

The College of William and Mary, 1992

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A STUDY OF TEACHERS' INSTRUCTIONAL PLANNING AS REVEALED BY AN ANALYSIS OF OBJECTIVES, STRATEGIES AND INDICATORS OF STUDENT ACHIEVEMENT

A Dissertation
Presented to
The Faculty of the School of Education
The College of William and Mary in Virginia

In Partial Fulfillment
Of the Requirements for the Degree
Doctor of Education

By
Barbara Sewell Davis
April, 1992

A STUDY OF TEACHERS' INSTRUCTIONAL PLANNING
AS REVEALED BY AN ANALYSIS OF
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DEDICATION

This study is dedicated to my family.

ACKNOWLEDGEMENTS

To Dr. Robert J. Hanny, I extend my sincere appreciation for the generous assistance and support which he provided during my graduate studies and as advisor for this study.

To Dr. Roger Ries, I express my appreciation for his assistance in the classroom and his service on my committee.

To Dr. Ronald Giese, I offer my thanks for his help on my committee.

Chapter I

INTRODUCTION

Justification for Study

While this study uses subjects who are science teachers and data collected from science curriculum planning, the major focus is on the instructional planning process which should be used by all teachers. The intent is to focus on the planning process, not the content.

The goals and objectives of any school curricula are intended to identify student outcomes; however, student outcomes are influenced by the teacher's delivery of the prescribed program. The teacher has tremendous influence on what curriculum is really taught through a day - to - day curriculum decision process. The goals and objectives explicit in any school division's curricula are subject to implementation which is influenced by the personal goals and theories of education which the teachers embrace. (Tyler, 1949; Shavelson & Stern, 1981; Buchmann, 1983). Student outcomes will depend on the exposure they have had to the prescribed curriculum: a product not only of the teacher's content background, but of the effective practices used by the teacher during the instructional process (Taba, 1962; Goodlad, 1984). The curriculum consists not only of objectives which identify content to be taught, but also the strategies and activities which can be used effectively to implement the curriculum (Dewey, 1902, Bobbitt, 1924; Tyler, 1949; Taba, 1962). Therefore, the curriculum is what individual teachers make it. Coffman (1983) suggests, "What goes on in the school depends on the teacher in the classroom--- on the way he accepts and implements the ideas of the experts or adds his own creative touch based on his own unique experience with a

particular group of pupils. The teacher, then, is a key person in any program of curriculum development" (p.3).

There has been diminishing confidence in the ability of schools to adequately educate students in the understandings and habits of mind which are necessary for students to become independent learners, to prepare them for the work force, and to allow this nation to compete in the global market.. The National Commission on Excellence in Education (1983) report, *A Nation At Risk*, stated concerns about public education. The commission noted a concern expressed by Paul Hurd, Educational Researcher, that " We are raising a nation of Americans that is technologically and scientifically illiterate" (p.10). However, the Commission reports that the educational problem is more extensive. The report goes further to state, "Some worry that schools may emphasize such rudiments as reading and computation at the expense of other essential skills such as comprehension, analysis, solving problems, and drawing conclusions" (p.10). The Commission recommends that "New instructional materials should reflect the most current applications of technology in appropriate curriculum areas, the best scholarship in each discipline, and research in learning and teaching" (p.29).

In 1989, the American Association for the Advancement of Science (AAAS) published *Science for All Americans, A Project Report on Literacy Goals in Science, Mathematics, and Technology.* This report presented recommendations prepared by a special committee, The National Council on Science and Technology Education, for the reform of education in science, mathematics, and technology. The report refers to "A cascade of recent studies which made it abundantly clear that by both national standards and world norms, U.S. education is failing to adequately educate too many students - and hence failing the nation" (p.3).

The 1988 Educational Testing Service report, *A World of Differences, An International Assessment of Mathematics and Science*, reported that in average science

performance students from the United States scored well below the mean. In reporting the context of the assessment, Lapointe, Mead and Phillips (1988) suggested that the United States had successfully strengthened the basic skills all of students whether they were from affluent families or from minority and economically disadvantaged families. However, assessments consistently revealed weakness by United States students in higher-order thinking skills in all subjects (p.78).

Robert Yager (1981) reported that Philip Handler, president of the National Academy of Sciences, expressed concern over the loss of confidence by the public in the value of scientific endeavors.

Carl Glickman (1987) reveals in a study of 15 schools, that findings show that change efforts in education are chiefly brought about by teachers, lead teachers, assistant principals or supervisors rather than the principal of a school. Furthermore, he states that, " Instructional improvement is a constant cycle of decisions, discoveries, and further decisions..." (p.122). One may conclude that teachers are a key factor in implementing educational change.

Other studies noted in the review of literature link teachers' judgments and decisions in planning to the interactive phase of teaching and the consequences in the classroom (Shavelson & Stern, 1981; Haigh, 1981; Buchmann, 1983). Studies which focused on teachers and their testing practices tended to fall into general categories such as achievement assessment practices, the nature of such testing as it is actually conducted and used in the schools (Dorr-Bremme, Herman, & Dougherty, 1983); teachers' competency in classroom testing, measurement preparation, and testing practices (Newman & Stallings, 1982); and, classroom testing and associated problems within the context of the school (Nagy & Morehead, 1989). No studies were found which matched teachers' planned outcomes (objectives) of instruction directly to indicators of achievement.

Research on teachers' behaviors, judgments and decisions shows that the instructional events in the classroom are affected by certain antecedent conditions, the complex environment in which teaching occurs, the teachers' goals and beliefs about teaching, the teachers' level of understanding about the subject matter, and the teachers' own cognitive processes and decision - making abilities (Shavelson and Stern, 1981; Shulman, 1986; Haigh, 1981). Furthermore, Shavelson (1981) suggests that "... research on instructional planning balances multiple goals such as maintaining a flow of activity, reducing management problems, teaching concepts and skills, and maintaining a social organization. In reaching a balance, some teachers emphasize, say, subject matter while others emphasize, say, behavior management" (p. 491).

Teachers' subject matter knowledge can be characterized by Shulman's (1986) constructs of *pedagogical content* knowledge and *curricular knowledge.* "Pedagogical knowledge refers to how particular topics, principles, strategies and the like in specific subject areas comprehended or typically misconstrued, are learned and likely to be forgotten. Curricular knowledge is familiarity with the ways in which particular knowledge is organized and packaged for instruction, in texts, programs, media, workbooks, other forms of practice, and the like" (p.26).

In a study of teachers' ways of thinking about teaching, Buchmann (1983) revealed differences in the characteristics of self-oriented and role -oriented teachers which influence the activity within a classroom. That study showed that teachers who revealed themselves as self-oriented demonstrated characteristics which were not reflective of the overriding considerations of the teaching profession. Those teachers saw events in the classroom and their own behaviors as inevitable or natural, and thereby failed to consider change as an alternative to their behavior. They failed to accept responsibility if they saw that the needs of some students were not being met by their method of teaching. Self- oriented teachers justified their work by personal preferences and habitual ways of working. Role - oriented teachers revealed

characteristics more focused on helping students learn. The role - oriented teachers' beliefs emphasized the curriculum and the student's learning as removed from the teachers' personal preferences and established habits. Role - oriented teachers were more likely to ask questions, see alternatives, and correlate the reality of the classroom with what might be possible. The implications of these findings reflect the influence that teachers' beliefs have on their decisions when planning and selecting appropriate strategies and help explain why there is such diversity of outcomes.

Although most school systems have identified curricular content to be covered in specific courses, teachers are frequently required to develop daily plans reflecting the objective(s) and outlining the procedure(s) for implementing the plan. This planning should reflect linkage between the written objectives, strategies/ activities used for implementing the objectives, and the evaluation of students. Specifically, those written objectives should be designed to identify a desired behavior which moves students from their entry level of understanding to achievement of the behavior identified by the objective. Hilda Taba (1962) suggests that "Providing for cumulative progression of learning naturally requires that curriculum experiences be planned so that there is an increasing complexity of material to deal with accompanied by a requirement for increasingly more mature mental reactions" (p.297). Appropriate strategies should assist the teacher in implementing the objectives and should also assist students in learning. Tyler (1949) states that a student must be provided experiences which give him the opportunity to practice the types of behaviors implied by objectives.

Planning provides a broad outline of what is likely to happen during teaching and serves as a guide to smooth transitions between activities. Clark and Peterson (1986) have shown that once teaching begins, a teacher's planning becomes less important and interactive decision making becomes more important. Their findings suggest that prior planning provides teachers with a feeling of confidence and reduces

uncertainty. Furthermore, teachers who have appropriately planned should be more likely to respond in appropriate ways to unexpected events during the interactive phase of teaching. Research conducted by Haigh (1981), shows that teachers felt that planning provided security in their lessons. That security stemmed from "...their knowledge that at any point they would know what they might or should do next" (p.16). Furthermore, the preparation of plans helped teachers to feel more comfortable during discussion lessons which the teachers characterized as having a high level of complexity and uncertainty.

Appropriate assessment of objectives, skills, and desired behaviors should be considered as part of a teachers' planning. Important studies by Taylor (1970) and Morine - Dershimer and Vallence (1976) showed that little attention is given to evaluation during planning stages even though important instructional decisions are made by classroom teachers based on assessment of students' achievement. Stiggins (1987) reported that "Recent studies of school assessment suggest that teachers rely at least as much on observation and judgment in evaluating student achievement as they do on paper and pencil assessment strategies" (p. 33).

Certain generally held assumptions about what science teachers should do are important to the justification of this study. Because of the nature of science teaching, much of a student's time should be spent in laboratory activities or in field studies. These learning situations are most appropriately assessed by observation and teacher judgment, and effective assessment depends on some method of recording those observations and judgments. Student outcomes in the process of learning should encompass a number of categories (e.g.information which can be tested by paper and pencil tests, skills which must be demonstrated, and specific behaviors which must be exhibited). Evidence shows that while appropriate student achievement (learning) is multidimensional, the most common way of assessing student learning remains paper and pencil tests (Dorr - Bremme, et al., 1983; Newman et al., 1983). Appropriate

assessment of certain skills, behaviors and student products requires methods other than typical paper and pencil tests (Stiggins, 1991; Newman et al., 1983).

White and Tisher (1986) reported that the results of studies of student understanding of scientific concepts and rules undertaken during the 1970s reflected disparities between the capabilities of students as identified by Piagetian developmental guidelines and the stated objectives of their science courses. Analyses of classroom tests also revealed that teachers gave too much weight to recall of facts and routine problem solving, thereby assuming learning was occurring when, in fact, little understanding of science was demonstrated. Presently, many types of indicators of student achievement are being developed, employing a variety of methods more appropriate for science instruction.

Laboratory work has long been recognized as a vital part of science instruction. White and Tisher (1986) suggested that the value of laboratory work is accepted as a means of demonstrating concepts, stimulating interest in science, supporting information given in lectures, providing experience for the development of theory , and training students in problem solving. Evaluation of laboratory work should include cognitive and performance outcomes. Opportunities for the development of the scientific values (i.e., respect for data and verification of results) should be evident in a teacher's planning and should be reflected in the indicators of student achievement which are used. Wolfe (1990) refers to the appropriateness of evaluation procedures meaning that evaluation should require the student to perform the behavior specified in the objective.

The Virginia State Department of Education Guidelines for Science recommend that fifty percent of instructional time be spent in laboratory activities. The value of the laboratory component of science teaching is well established whether one adheres to science laboratory experiences as a means of developing problem-solving abilities, or as a means of checking alternative ideas and demonstrating concepts. A teacher's own

goals and beliefs about science teaching will influence greatly the value placed on the laboratory component, and consequently may dictate the way the laboratory component is used in instruction. The planning, strategic use, and assessment of these laboratory experiences should be linked carefully to the development of conceptual understanding of the course content.

Theoretical Rationale

It is generally accepted that course objectives should be organized in a hierarchical scheme which identifies a logical path for information processing, strategy selection and valid testing. Thus, a teacher's plans should reveal a conceptual pattern beginning with low - level information processing and developing to some stage of high - level information processing for course content. Objectives should also reflect the development of requisite skills. The strategies and activities selected should be those which evoke developmentally appropriate behaviors which signal that learning is taking place. Assessment should effectively determine if the specific content or concept has been learned or if the appropriate values and skill(s) have been acquired. Assessment should include a variety of achievement indicators such as paper - and - pencil tests, performance or skill profiles, and laboratory practicals. Course objectives and assessment instruments should reflect a blend of content and science process. Linkages between the development of objectives, selection of instructional strategies, and assessment modes should exist.

Statement of the Problem

The purpose of this study was to describe teachers' instructional planning as revealed in the analysis of curriculum objectives, strategies and activities (including pre and post lab instruction), and assessments of student achievement, skills and behaviors.

The research questions which were answered follow:

1) Given a specified unit in biology, was there congruence among teachers' planning as revealed in the objectives and types of assessment within the same school system, and among teachers in other school systems using the same textbook?

2) To what degree were objectives reflective of low - level and high - level behaviors as determined by the use of a table of specifications?

3) What instructional strategies/activities were being used to implement the levels of content and type of behavior identified in the objectives?

4) To what degree did the indicators of student achievement reflect the low - level and high - level behaviors described in the objectives as determined by the use of a table of specifications?

5) Were the indicators of student achievement valid for reflecting the levels of behavior noted in the objectives?

6) To what degree were indicators of student achievement other than classroom tests being used; additionally, what types of indicators were used for assessing student laboratory work?

Design of the Study

Subjects

The population from which the sample was drawn for this study was level I biology teachers in secondary schools in Virginia public school systems. Thirteen school systems in the state of Virginia were asked to participate in the study. Of the thirteen contacted, four declined to participate for various reasons. The geographic locations of the school systems selected were: the eastern shore; and the southeast, and southwestern parts of the state.

The sample was 20 volunteers from these school systems. The volunteers were teachers who met certain requirements: certification by the State Department of Education, inclusion of a unit on cells in their instructional program, use of the same textbook within their school system, and instruction of a general biology course (i.e.,

Level I Biology as classified by the Virginia State Department of Education code). The average number of years of teaching for all volunteers was 14.6. The average number of years teaching Biology was 12.1.

Methods

The superintendents of thirteen Virginia school systems were contacted to participate in this study. Four of these declined for various reasons. Each remaining superintendent was asked to designate a contact person to assist with this study. In the school systems which participated, the contact persons designated varied, however, they included a principal, science department chairpersons, science supervisors, science coordinators, science specialists, and a research specialist. These contacts solicited volunteers, disseminated information, and coded the consent forms for those teachers requesting confidentiality. In some instances they also assisted with collecting, copying and returning the teachers' materials.

For the purpose of this study, a unit on cells common to most, if not all level I biology, was identified as the basis of content for which daily plans were refined. Teacher participants were asked to refine existing daily lesson plans for that unit to reflect accurately the daily objectives, and to identify the strategies/activities they had selected to implement those objectives. They were also asked to submit the indicators of student achievement, such as classroom tests, performance assessments, and laboratory practicals used while teaching the unit. Teachers removed their names from all plans and tests to assure confidentiality.

These daily plans and the assessment instruments were analyzed based on the six questions noted in the section "Statement of the Problem".

Definitions

The terms which clarify the purposes of this study are set forth below:

Daily Lesson Plan -- A concise and functional plan of action which describes the objectives of a lesson and identifies intended implementation strategies/activities.

Planning -- The problem solving process by which teachers make decisions about the principles, concepts, and facts which constitute their objectives, identify strategies and activities for use in implementing those objectives, and plan the indicators of student achievement most suitable for measuring student success for each objective.

Objectives -- Statements representing changes intended in student behaviors as a result of educational experiences. (Bloom, 1956)

Activities -- The things students are expected to do, except for reading or listening, which assist them in learning or in responding to curricular content (Brophy & Alleman, 1991, p. 9).

Strategies -- The methods selected by teachers for presenting information and demonstrating procedures.

Classroom Tests -- Tests constructed by the teachers or selected from commercial sources to assess students' academic achievement of specific course objectives.

Performance Assessment -- Measurement based on observation and professional judgmental rating of achievement (Stiggins, 1987, p.33).

Laboratory Practical -- Laboratory assessment in which students are asked to devise a plan of action to investigate a problem, select appropriate materials, conduct their plan, collect and record data, draw conclusions and explain their reasoning.

Table of Specifications -- A two dimensional table showing the relationship between hierarchical categories of student behaviors and the student behaviors as described in the objectives (Bloom, Hastings & Madaus, 1971).

Standards of Learning -- Learner objectives as identified by the Science Education Service, Virginia Department of Education (Standards of Learning Objectives for Virginia Public Schools, Commonwealth Of Virginia, Department of Education, 1988).

Low Level / High Level Objectives -- The hierarchical arrangement of objectives from simple behaviors to complex behaviors.

Inquiry -- The taxonomy of student behaviors which are observed at some time when inquiry is proceeding, but it is not claimed that all behaviors will be observed in the order in which they appear here: observing and measuring; seeing a problem and seeking ways to solve it; interpreting data and formulating generalizations; and, building, testing, and revising theoretical models (Klopfer, 1976, pp. 568-572).

Limitations of the Study

Interpretation and discussion of the results of this study should be made in light of the following limitations:

This study reflects the teachers' own descriptions of their instructional planning and did not attempt to demonstrate what they actually taught.

No classroom observations were made, therefore, the degree of student involvement and formality of instruction is unknown.

The use of volunteers complicated the interpretation of the results of this study. Subjects could not be identified through random selection.

The school systems were not randomly selected, however, the results were compiled from teachers in six school systems representative of the Commonwealth of Virginia.

While these limitations appear to be serious threats to the study, the fact remains that to conduct a study where these limitations did not exist would be impossible in a naturalistic setting.

Ethical Safeguards and Considerations

This study was approved by the School of Education Review of Human Subjects Committee at the College of William and Mary.

Each participating school district was provided with a reasonable explanation of the study with confidentiality being assured for both the school district and the individual teacher.

Information on the study was disseminated through contact persons designated by the Superintendent of each school system.

The consent form allowed each teacher to be assigned a code by the contact person and thereby remain anonymous. Once volunteers were located, the contact person disseminated the remaining information pertaining to the study.

All names were removed from the materials submitted either by the contact person or by those individual teachers who elected to sign their consent form rather than to use a code. Therefore, even those teachers who elected to sign a consent form regained anonymity upon submitting plans without their name. Those plans were mailed to the researcher in pre - addressed envelopes with no return address noted. With the exception of two school systems which had only one volunteer, it was not possible to match teachers with the materials.

Within the researcher's local school system, all functions related to the study were handled by the senior specialist in the Department of Research who served as the contact person. All consent forms from the volunteers were retained by the specialist instead of being sent to the researcher. The identity of the researcher was withheld. All correspondence to teachers was made through the specialist and all materials from teachers were sent to that person. The specialist insured that names were removed from all materials before forwarding to the researcher.

No school system was referred to by name in the study.

All participating school systems were offered the opportunity to obtain a copy of the findings of the study upon written request by the superintendent or his/her designee.

Chapter II

Review of Literature

A review of the literature and research related to this study is presented in this chapter. Included are literature and research providing the rationale for linking planning, strategies and assessment; and, current research.

Rationale

John Dewey (1902) wrote in his book, *The Child and the Curriculum and The School and Society*,

> " Development does not mean just getting something out of the mind. It is a development of experience and into experience that is really wanted. And this is impossible save as just that educative medium is provided which will enable the powers and interests that have been selected as valuable to function. They (students) must operate, and how they operate will depend almost entirely upon the stimuli which surrounds them and the material upon which they exercise themselves. The problem of direction is thus the problem of selecting appropriate stimuli for instincts and impulses which it is desired to employ in the gaining of new experience" (p.18).

Because learning is the goal of formal education, various components and processes have been identified which are requisite to occur within schools. Those components and processes have been the target of studies for many years resulting in verifiable information on what teachers should do to enhance student learning.

The multiple functions of effective teaching have been the subject of research studies. Herbert Walberg's (1984) synthesis of research of nearly 3000 studies

identifies specific interventions which improve students' educational achievement. David Berliner's (1984) review of research identified factors influenced by teachers which affect student behavior, attitudes, and achievement. These teaching functions, however, represent only one facet of the educational process by which teachers engage students in learning.

Content of the curriculum remains under scrutiny nationally as the knowledge base in most subjects increases at phenomenal rates. Many school divisions have established that a curriculum which can be identified by objectives is necessary. The idea being that objectives serve as guidelines for teachers to ensure that all students within a particular school division are exposed to a common core of knowledge in a particular subject. In situations where a common curriculum has not been defined, teachers have the latitude to develop their own objectives. This requires that teachers apply their individual judgment as to the appropriate body of information for children to learn. This often leads to use of a single textbook as the source of planning. What is identified by the publishers of that particular text as the core of information becomes the content of teachers' plans. Whether there is a prescribed curriculum for teachers to follow, or the curriculum is developed by teachers through individual efforts, selection of instructional strategies and activities to be used in implementing the curriculum is left to a teacher's judgment. In addition, the method of assessing the achievement of the curriculum goals is often tied to selection of commercially prepared tests or classroom tests which are prepared by the teacher. Therefore, teachers' influence on what their students learn is profound. Teachers are the key to implementation of any program.

Planning

John Dewey (1902) wrote of the varying aspects of a subject: one for the subject purist (i.e., scientist) and one for the teacher of the subject. Of the teacher's concern with a subject, Dewey wrote, " Hence, what concerns him, as teacher, is the ways in which that subject may become part of experience; what there is in the child's present that is

usable in reference to it; how such elements are to be used; how his own knowledge of the subject matter may assist in interpreting the child's needs and doings, and determine the medium in which the child should be placed in order that his growth may be properly directed" (p.23). Clearly Dewey felt that that a teacher must make connections between content to be taught and the strategies/activities used to teach a given lesson. Those connections today would be influenced by variables such as that teacher's beliefs and practices, knowledge of content, knowledge of current research findings, and understanding of proper evaluation techniques.

Bobbitt (1924) suggests that connections between objectives and activities are important. "The first step in curriculum - making is to decide what specific educational results are to be produced" (p.32). His list of objectives for natural science reflects the same categories suggested by science educators today such as content knowledge, experimentation, ability to perform certain mental activities, and certain skills (p.141-143). He also states that "Understanding is not a thing which can be imposed. It grows up out of practical experiences" (p.41). He elaborates on the pupil activities and experiences which are necessary for developing interests, appreciations, attitudes, and habits consistent with diversified observation, proportioned vision (rather than specialized), powers of practical judgment and a wealth of information. These areas are consistent with categories noted in most science reform projects in the 1980s-1990s. Once the general goals of education are established, Bobbitt suggests that objectives serve for "...planning the general outlines of the routes" (p.5).

Ralph Tyler (1949) refers to work by Thorndike in the early 1900's in which Thorndike formulated a theory of learning which suggested connections between specific stimuli and specific responses. By that theory, learning is specific rather than general and objectives should be specific, numerous, and reflecting specific habits. Tyler notes that at the same time Judd and Freeman formed a theory of learning called generalization. Their theory views objectives in general terms. Based on these contrasting theories Tyler

concludes, "It is thus clear that one's theory of learning has considerable importance in determining how specifically objectives are to be stated and what kind of statements can be viewed as educational objectives" (p.43).

Tyler also developed a two - dimensional chart to be used in curriculum planning. The chart indicated the relationship between content aspects of objectives and the various behaviors showing that a course should aim at more than simply acquiring information. Plotting course objectives on the two-dimensional chart provided a view of the content aspects of the objectives as well as the kinds of behavior changes which were desired. Planning of this type provides a view of where additional objectives may be required and provides specifications which indicate the particular situations necessary with each objective. Tyler states, " By defining these desired educational results as clearly as possible, the curriculum - maker has the most useful set of criteria for selecting content, for suggesting learning activities, for deciding on the kind of teaching procedure to follow, in fact to carry on all the further steps of curriculum planning" (p.62).

In 1956, a committee of educators prepared and published the Taxonomy *of Educational Objectives*, a book which described a method of classifying educational goals. The results of this work are popularly referred to as "Blooms Taxonomy" of educational objectives. The authors' intent was to provide a method of "...specifying objectives so that it becomes easier to plan learning experiences and prepare evaluation devices" (Bloom, editor, 1956 p.2). This work clearly relates a connection between planning, selection of strategies for implementation, and evaluation. In addition, the classification scheme recognizes a hierarchical development of intended behaviors of students from simple to complex. In their book, *Models of Teaching*, Bruce Joyce and Marsha Weil (1986) describe a similar model by which teachers can see relationships between objectives and student performance as developed by Robert Gagne. Gagne's analysis of the key variables in learning identified as "Conditions of Learning", form a hierarchy. He suggests that certain hierarchical performances by the student are required

and it is the learners' activity which results in learning. These works by Bloom and Gagne imply a relationship between the desired student behavior as identified in objectives, and the activity selected to engage students in learning specific behaviors. Identification of the specific behaviors expected of students suggests the necessity for correlating evaluation instruments and techniques which indicate student achievement of of those behaviors. Links between teachers' planning, strategy/activity selection and selection of indicators of student achievement were established by both authors.

In a review of research on teachers' thoughts, judgments, decisions and behavior, Shavelson and Stern (1981) report on major findings about teacher planning by Clark and Yinger in 1979 and Mintz in 1979. Those findings reveal that teachers do not follow a model of defining objectives, planning activities which move the students with certain entry skills and knowledge to achieve those objectives, followed by evaluation of the effectiveness of their instruction in achieving those objectives. Rather, teachers focus on activities which maintain the flow of activity in the interactive phase of teaching. They respond to indicators that the activity is not going as planned and therefore are able to control the complexities of the classroom environment. These findings are of particular interest when the conditions of teaching are described.

Shavelson and Stern (1981) report on a number of conditions which influence teachers' instructional planning and interactive teaching. Antecedent conditions such as information about students, the nature of the instructional task, the school and classroom environments, teacher characteristics, and the teachers' cognitive processes and decision-making abilities influence the decisions teachers make. These conditions are clarified by findings in Shavelson's review. The types of information about students which appeared in the majority of studies reviewed were: students general ability or achievement, sex, class participation, self-concept, social competence, independence, classroom behavior, and work habits. The task, as identified by Shavelson and Stern from studies by Morine - Dershimer, 1978-1979b, Morine -Dershimer & Vallance,

1976, Peterson et al., 1978, and Zahorik, 1975, consists of content, materials and activities. Furthermore, findings by Joyce, 1978-1979 and Morine-Dershimer, 1978-1979b indicate that much of teachers' planning is focused on creating tasks and much of interactive teaching is focused on smooth implementation of those tasks. The task then serves as a plan and directs the teachers' behavior in the classroom. However, additional findings by Joyce, 1978-1979, Morine-Dershimer, 1978-1979b, and Yinger,1977, show that when something goes wrong in the interactive phase of instruction, the teacher then must decide on an alternative plan of action. The original plan have may be altered to accommodate the unexpected situation. Teachers' responses to unexpected situations within the classroom may be further influenced by the school environment. If school administrators stress classroom management as a major evaluative criteria in judging teacher performance, even teachers who are knowledgeable and interested in their subject may plan tasks which are more teacher -controlled to reduce the possibility of apparent confusion in their classes.

Findings by Shavelson, Cadwell and Izu relative to teacher characteristics suggest that when teachers have relevant information available for making decisions they will use that information in decision-making. However, in the absence of appropriate information, a teacher's own beliefs will be the basis for decision making. In addition, Shavelson and Stern (1981) suggest that teachers make instructional decisions based on the instructional model of their choice.

Although the interactive phase of teaching is subject to the effect of unexpected events in the classroom, much of what a teacher does is the result of the teachers own thoughts and beliefs. Individuals may not be aware of the influence of their own beliefs in planning and implementing a lesson. Shavelson and Stern (1981) refer to a study in 1979 by Clark, Wildfong & Yinger in which teachers were found not to consider their own teaching style when evaluating activities, and findings by McNair, 1978-1979, in which teachers were surprised by their own behaviors.

The findings from this review of research by Shavelson and Stern (1981) suggest that teachers' decisions about what they must do in planning for instruction and in the interactive phase of teaching are influenced by a number of factors. Moving students through the hierarchical development of content and skills suggested by Bloom et al. and Gagne requires a plan which connects objectives and activities. Planning provides a broad outline of what should happen during teaching and tends to guide transitions between activities therefore increasing the chances that the desired goals of instruction will be met in spite of unexpected interruptions.

Neil Haigh's (1981) research on teacher thinking focused on providing a "holistic account of the activity of teaching". The findings related to teachers thoughts during pre-lesson planning suggest that teachers share a viewpoint on the need for planning. "Common to all teachers was the view that plans were necessary for their security in lessons - security that in its most simple terms rested on their knowledge that at any given point in the lesson they would know what hey might or should do next" (p.16). Teachers revealed that through planning they were more likely to be able to contemplate a lesson, identify possible problems associated with the lesson and identify possible solutions to those problems. Once a lesson is underway, teachers opportunities to plan in a calm and rational way are limited by the complex nature of the classroom environment and the competing demands on the teacher from unexpected events. In the absence of well thought out plans a teacher's effectiveness in facilitating students' learning is compromised.

Haigh suggests that the teachers view of planning corresponds to that of Yinger, 1979, (as stated by Haigh) that planning is most appropriately viewed as a problem solving activity that moves through a succession of stages in a cyclical rather than linear pattern. A significant finding of his study suggests that individualizing instruction may require teachers to retain more information than can actually be handled in the known limitations of memory. Therefore, modifications of plans to accommodate individual

differences among students may be most appropriate during a lesson when the actual responses of children occur. Without benefit of prior planning, modifications of this sort would tend to be chaotic.

Clark and Peterson (1986) report in the 1986 *Handbook of Research on Teaching* that planning reduces uncertainty about teacher-student interactions and provides teachers with a feeling of confidence . Teachers who are well planned are more likely to respond in appropriate ways to unexpected events during the interactive phase of teaching. Consequently, those factors shown to have an impact on student achievement (e.g., time on task, student involvement, reinforcement) are more likely to be noted.

Objectives

Benjamin Bloom refers to objectives as "Statements representing behaviors intended in student behaviors as a result of educational experiences" (Bloom, 1956, p.12). John De Cecco (1968) refers to work by Robert Mager which points to the need for explicit statements of instructional objectives. Mager suggests that explicit statements of the terminal performance expected of students helps a teacher plan the steps which students must take in order to achieve the performance. He suggests that a teacher can only provide for the responses needed to accomplish a final response if the characteristics of the final response have been adequately described. Additional work by Mager provided empirical results showing that students benefit from knowing at the start the specific objectives they must obtain.

De Cecco also points to separate works by Ralph Tyler and Robert Gagne in which they established three reasons supporting explicit statements of instructional objectives. First, explicit statements of objectives provide guidance in the planning of instructional procedures. Second, they are useful in performance assessment. Third, they provide direction for the students so that they can direct their efforts.

In 1962, Hilda Taba referred to certain basic ideas and principles relative to knowledge. Taba refers to the 1947 yearbook of the *National Society for the Study of*

Education in which it was suggested that teaching should be organized around broad principles with facts serving as the means to an end in gaining an understanding of concepts and principles. These same ideas and principles are repeated in the 1989 report , *Science for All Americans, A Project Report on Literacy Goals in Science, Mathematics, and Technology* from the American Association for the Advancement of Science. Furthermore, Taba (1962) points out that problem solving must involve skills such as the ability to define problems to investigate and to plan a method of inquiry. These skills are suggested to be inherent in science curricula. In a collection of works related to various aspects of curriculum Louis Rubin (1977) includes a chapter on science by Alfred Collette. Collette points to certain strengths related to a science discipline which suggest that students should be involved in discovery and problem - solving activities in order to develop certain intellectual and cognitive skills.

Hilda Taba suggests, "Only certain objectives can be implemented by the nature of curriculum content, its selection and organization. Others can be implemented only by the nature and organization of learning experiences. Thinking, for example, is one of the latter objectives (p.9).

Strategies / Activities

Hilda Taba (1962) discusses the relationship between objectives and corresponding learning experiences. She states, " While newer curriculum patterns extended vastly the concept of desirable objectives, they failed to provide corresponding ways of translating these objectives into appropriate learning experiences. No theoretical distinctions regarding the types of learning experiences required by various types of objectives are made to differentiate the instructional techniques necessary to implement these objectives" (p.417).

Findings by Clark et. al. (1986) support those identified by Shavelson et.al.(1981) relating to the effect of teachers' individual teaching theories and beliefs on their planning and teaching practices. These established beliefs may be in conflict with certain

innovations being promoted (e.g., curricular changes, strategy recommendations) and result in teacher behaviors identified as inflexible or close minded. Although this study revealed much about the connections between planning and a teacher's actions in the interactive phase of teaching, no extension of the research was made to connect these phases to the assessment of the lesson.

Margaret Buchmann's (1983) study of teacher decision making found differences in the professional thinking of teachers. How teachers view themselves can influence their treatment of content and their choice of activities. The study categorized teachers as role-oriented or self-oriented based on their professional thinking revealed through interviews. Teachers who are identified as self-oriented demonstrated characteristics which were not reflective of the overriding goals of education. These teachers see events in the classroom and their own behaviors as inevitable or natural and thereby fail to consider change as an alternative to their behavior. They fail to accept responsibility if they see that the needs of the students are not being met by their method of teaching. Self-oriented teachers do not see curricular subjects as a justification for what they do (e.g., teaching the basics was not considered self justifying). Self oriented teachers are likely to dismiss the need for planning (as opposed to spontaneous instruction) if planning is inconsistent with their philosophy of life. What is best for their students may or may not coincide with their self interests.

Role-oriented teachers are more focused on helping students learn. They emphasize the curriculum and the importance of students' learning rather than their personal preferences. They are more likely to ask questions, see alternatives and deal effectively with the realities of the classroom with a view toward what may be possible in helping students (Buchmann, 1983).

The implications of these research findings on the practices of planning, selecting strategies / activities and assessing student achievement are evident. Change in behaviors and practices based on new and evolving information appear to be less evident with self-

oriented teachers. If their approach to events in the classroom is spontaneous rather than planned, the hierarchical stages of learning concepts and skills would be missing. Therefore, achievement of the goals of education would be more a 'chance happening' for some students rather than a goal achievable for most.

Another study dealing with the effect of teachers' beliefs and practices on instruction was conducted by Richardson, Anders, Tidwell, and Lloyd (1991). The findings of this research also suggest that teachers' beliefs do influence instructional practices and that unless teachers' beliefs are congruent with theoretical assumptions, change in practice will not occur. Much of what teachers do in linking planning, strategies/activities and evaluation depends on their understanding of the instructional process, teachers' beliefs, and the teachers exposure to theoretical assumptions relating to instructional practices.

Strategies/activities should be selected as a method of engaging students toward achieving desired instructional goals. Consideration for the level at which students will interact with curricular content is necessary. The type of activity or the method of engaging students in processing curricular content should be consistent with the level of information being processed. If significant curricular goals are to prepare students to engage in problem-solving, decision making and evaluation processes, then the activities and strategies should be those which engage students in a manner consistent with obtaining those intended goals. Furthermore, the activities should reflect progress toward achieving those goals. Introducing material may require activities and strategies enabling students to achieve basic understanding at a knowledge level. However, application of that knowledge in a new situation in order to solve problems may require a different level of interaction (Richardson et. al., 1991).

In his book, *A Place Called School,* John Goodlad (1984) summarizes his findings from a study of 1000 classrooms in 38 schools. His findings reveal certain characteristics of classroom life related to teaching. First, the dominant pattern of teaching

involves the group as a whole. Second, the students work and achieve alone within the whole group setting. Third, the teacher is central in determining the activities and in making classroom decisions. Fourth, the teacher most of the time the teacher is engaged in "frontal" teaching, monitoring seat work or conducting quizzes. The students rarely engage in learning from each other or in initiating interaction with the teacher. When they work in small groups, they are usually doing the same things and those things are determined by the teacher. Fifth, teachers tend not to respond positively or negatively to students. Students are engaged in a relatively narrow range of activities. Those activities are usually listening to teachers, writing seat work, or taking tests and quizzes. Seventh, the variety of activities is greatest in elementary schools and least in the secondary schools. Eighth, students were passively content with their classroom life. The activities they most liked were those involving physical movement which were those in which they were least engaged. Ninth, a significant number of students did not understand what the teacher wanted them to do and felt they did not receive sufficient help with mistakes and difficulties from the teacher.

Goodlad also refers to the gap between what teachers state as expectations for their students and their actual teaching practices. Teachers reported that behaviors which they intended for their students were those involved in critical thinking. At the high school level the behaviors which teachers saw as desirable were the involvement of students in scientific processes and ways of thinking. His observation of the classroom, however, showed inconsistences in teachers' practices and their stated expectations. He noted that teachers were not able to "square their performance with their theory" (Goodlad, 1984, p. 215). Furthermore, Thomas Koballa (1984) reports on a 1978 study by Stake and Easly which found that teachers rely on textbooks 90% of the time and that the most common method of instruction is assignment - recite - test - discuss.

Based on these studies one might conclude that inconsistencies between teachers' classroom practices and behaviors and important curricular goals suggest a lack of

connection between articulation of the intended goals as indicated in planning, and the selection of activities and strategies to successfully implement those goals. Hilda Taba refers to the importance of establishing learning sequences. She explains that, "Planning learning sequences such as these requires a way of organizing content as well as a sequence of reactions, behaviors, or learning experiences. Both the content and the learning experiences need to be broken into appropriate steps so that an active understanding becomes possible" (Taba, 1962, p.294).

A recent article by Jere Brophy and Janet Alleman (1991) confronts issues surrounding the selection of activities appropriate for instructional use. They suggest that within curricular units, activities serve different functions which are evolutionary. Thus, activities used when introducing new material differ from those used when developing content clusters or those used for concluding the unit. The success of the activities depends on using them with strategies which will motivate students to learn and which apply the curriculum in a context applicable to students lives outside the school environment. Brophy and Alleman view activities as opportunities to process, integrate and apply curriculum content in goals - driven ways. Although Brophy and Alleman are continuing their study of activities, they have prepared a set of formative criteria to be used in the design, selection and implementation of learning activities. Their criteria have been organized in a table, "Principles for the Design, Selection and Evaluation of Activities", which provides useful guidelines for analyzing individual learning activities.

The principles for analyzing activities have been organized into broad categories: A. Primary principles, B. Multiple goals, C. Principles that apply to sets of activities, Optional principles (alternate criteria), and E. Implementation principles. Within each of these categories multiple criteria are defined. Of significance for this study are criteria from each category relating specifically to the links between goals (as phrased in objectives), activities and assessment. Those categories follow:

A. Primary principles

A1. Goal relevance. Activities must be useful means of accomplishing worthwhile curricular goals. Each activity's primary goal must be an important one, worth stressing and spending time on,and there must be at least logical reasons for believing that the activity will be effective as a means of accomplishing that goal.

B. Secondary principles

B1. Multiple goals

B1a. An activity that simultaneously accomplishes many goals is preferable to one that accomplishes fewer goals (so long as it is effective in accomplishing the primary goals). This principle is probably the most useful one for distinguishing the best activities from other activities that also meet minimally necessary conditions. The best activities are effectively engaging, as well as cognitively instructive; provide students with opportunities to use critical and creative thinking, inquiry, problem-solving, values analysis, and decision-making skills in the process of applying knowledge; and call for natural and realistic applications rather than just for isolated practice or artificial forms of application that do not connect to students' lives outside of school.

C. Principles that apply to sets of activities.

C3. Progressive levels of difficulty or complexity. Activities should progressively increase in levels of challenge as student expertise develops.

D. Optional principles (alternate criteria).

D1. Inductive Inquiry. All activities should engage students in inquiry that will enable them to induce concepts, generalizations, or principles.

E. Implementation Principles.

E5. Debriefing/reflection/assessment. Activities should be brought to closure in ways that link them back to their intended goals and purposes. For students, this means opportunities to assess performance and to correct and learn from mistakes.Ordinarily, there also should be teacher-led post activity debriefing or reflection that reemphasizes the purposes and goals of the activity, reflects on how (and how well) these have been accomplished, and reminds the students of where the activity fits within the big picture undefined by the larger unit or curriculum strand. For teachers, post activity assessment and reflection includes evaluating effectiveness of the activity for enabling students to accomplish the goals (Brophy & Alleman, 1991).

Assessment

A teachers' planning (meaning the identification of objectives and the selection of activities and strategies) would clearly require assessment linked to those objectives as a method of determining whether students were moving steadily toward achievement of the curricular goals (Wolf, 1990). The variation of objectives in a goals directed curriculum should be matched by a corresponding variation of activities and strategies. Assessment

of the objectives would then reflect assessment questions or performance related criteria specific to the level of the curricular content, or related to the specific skill being developed. Including the objectives, teaching methods, and evaluation techniques in one general plan highlights the interrelatedness of these facets of classroom teaching and assures that planning for evaluation will be done at the beginning of the course (Gronlund, 1971).

Senta Raizen and Joyce Kaser (1989) have suggested that focusing on assessment of science outcomes can cause effective changes in the quality of science instruction in elementary science classrooms. If assessment focuses on the important learning outcomes of science (e.g., knowledge, process skills, relevancy to life, problem solving) then those outcomes become critical components of the curriculum. In their view, teaching and assessment go hand in hand.

Evaluation, as most frequently used in education, has served as a method of classifying students by determining who has succeeded and who has failed in a specific course or topic. Benjamin Bloom, Thomas Hastings, and George Madaus (1971) compiled the *Handbook on Formative and Summative Evaluation of Learning.* The purpose of the book was to present a broader view of evaluation as a method of improving the processes of teaching and learning. The authors contend that an essential step in instruction and evaluation is to consider, before instruction, what outcomes are possible and desirable. Thus teachers should be considering the desired outcome to be evidenced by changes in students' behaviors at the time the teachers are engaged in planning. Consideration for significant unexpected outcomes must also occur. The principal tasks of educators are to determine how they want students to change and to decide what they can do to assist the students in the process. Those tasks link instruction and evaluation in both an ongoing process as well as a summative process (Bloom et.al., 1971; Gronlund, 1971; Wolf, 1990).

Since the 1980's educational reform has been a topic of debate among educators and legislators. National educational assessment reports such as the 1983 National Commission on Excellence in Education report, *A Nation at Risk,* and the 1989 Educational Testing Services report on mathematics and science achievement, *A World of Differences, An International Assessment of Math and Science,* have been instrumental in calling attention to education on a national level. National reform projects such as Project 2061 (1989) are attempting to redefine the ideas and skills which have the greatest educational significance for all students.

Many educational reports redefine educational goals to more clearly address the core processes, skills and conceptual understandings which all students should have to function in life (AAAS, 1989; Koballa,1984). These core learnings reflect a global view that educational goals should engage students in applying curricular content to situations for the purposes of problem-solving, decision making, evaluation and other practices usually called thinking skills. These practices require careful spiraling of curricular content through introductory levels of student engagement with the content to transfer of the knowledge to new situations where it becomes a basis for problem-solving (Dewey, 1938; Tyler, 1949). In other words, there should be evidence of change in the level of learning. Objectives, therefore, should reflect this flow as students move from simple to complex behaviors (Taba, 1962). Requisite to this process is a linking or matching strategies and activities which will facilitate the development of appropriate behaviors at each level of complexity (Tyler, 1949; Taba, 1962). Concurrently, indicators of students' achievement must appropriately evaluate the mastery of the curricular goals. If students are to be encouraged to think and engage in problem solving related to real situations, methods of assessing those components of the curriculum in a different manner than the assessment of students' mastery of specific knowledge may be more appropriate. Performance assessment can be graded on multiple criteria, however, Resnick and Resnick (1989) report that developing criteria for fields such as scientific

thinking and reasoning in social sciences may be difficult due to the effects of many years of standardized testing. They contend that current testing practices were founded in routinized curriculum rather than curriculum designed to encourage thinking and suggest , " Two key assumptions of standardized testing technology, which we term the decomposability and the decontextualization assumptions, were compatible with the routinized skill goals of the mass educational system and with the psychological theories of the first part of this century. They are, however, incompatible with thinking goals for education and with what we know today about the nature of human cognition and learning" (Resnick and Resnick, 1989, p.4). Decomposibility refers to the theory that thought is described as a collection of separate pieces of knowledge. According to Resnick and Resnick, this theory has been discredited by recent cognitive research. Decontextualization refers to the idea that each component of a complex skill is fixed and will retain the same form regardless of where it is used. Resnick and Resnick refer to work in science by Laktos in 1978 and Toulmin in 1972 which suggests that knowledge and skills cannot be detached from their contexts of practice and use.

In addition, certain assessment practices are more appropriate for certain learning outcomes than others. Although written tests may be effective for determining what a student knows about a body of knowledge, such tests are usually ineffective in assessing process skills and problem solving. Written tests can be successful in some situations such as when students interpret data from a graph or chart. However, practical tests and observation in the context of hands -on / laboratory activities are the best assessments for process skills and problem solving (Meng & Doran, 1990). Taba (1962) points to the need for consistency between objectives and evaluation. She suggests that available devices for evaluating higher mental processes such as thinking are inadequate.

The need for varying methods of assessment to cover the range of important educational objectives has been noted by a number of authors. (Shepard, 1989; Stiggins, 1991; Raizen & Kaser,1989; Stiggins, 1988; Manatt, 1987; Wiggins 1989; Wolf, 1989;

Shavelson, Carey & Webb, 1990; Rief, 1990). Assessment must be redesigned to more closely resemble real learning tasks. (Shepard, 1989). White, et al. (1984) point to results of studies by Osborne in 1976; Broud, Dunn, Kennedy, and Thorley in 1980; and Ben - Zvi, Hofstein, Samuel, and Kempa which suggest that evaluation of laboratory experiences should include attitudinal, cognitive and motor outcomes.

A three year study of classroom achievement testing conducted by Bremme, Herman and Doherty (1983) at the Center for the Study of Evaluation, University of California between 1979 and 1982, focused on achievement testing practices in upper-elementary and high school levels. The survey addressed a nation wide sample of principals and teachers drawn through a random - selection procedure. The results show that in assessing students, secondary teachers do give highest importance to their own observations of students' work and their own clinical judgments. Furthermore, analysis of staff development practices related to assessment showed that only 21% - 25 % of the secondary teachers reported participation in staff development activities related to alternative ways (other than tests) to assess student achievement. And, between 25% - 37% of those teachers had participated in staff development to show them how to tie what is taught more closely to the skills and content covered on required tests. This study points to areas requiring serious consideration if teachers are to engage in assessment practices which validate their observations and judgments about student behaviors. Such observations and judgments are crucial when curricular priorities reflect performance related goals.

John Goodlad (1984) noted in his review of schools and classrooms that tests given by secondary science teachers emphasized factual recall rather than the exercise of higher intellectual functions which should be the major focus of a science curriculum. This finding is inconsistent with lists generated by those teachers in which they designated student behaviors consistent with critical thinking (scientific processes and ways of thinking) as being desirable. Richard Wolf (1990) states that the key to linking

objectives to evaluation procedures is appropriateness. He suggests that each evaluation procedure has strengths and weaknesses, however, the necessary variety of methods for appropriate assessment of objectives is available.

Based on these studies one might conclude that indicators of student achievement must assess the curricular goals which are identified as important. Students will learn what their teachers value and will respond accordingly. Resnick and Resnick (1989) suggest that "Whether we like it or not, what is taught and what is tested are intimately related" (p.17). If students are tested for factual recall, then they will focus on remembering discrete bits of information. If teachers emphasize processes used to arrive at a viable solution to a problem, then students will focus on processes to help them solve problems. The teaching/learning process often requires that students demonstrate specific performance skills or competencies, especially related to laboratory work. In these situations, student achievement may best be indicated through the use of performance indicators other than paper and pencil tests (Stiggins, 1987).

Links between objectives, activities/ strategies, and assessment should be traceable. Robert Stake (1967) suggests that evaluation (assessment) should measure the match between what an educator intends to do and what he does in practice. There is a need to look at antecedent conditions, classroom transactions, and various outcomes.

Summary

From this review of research, it is clear that connections between objectives, strategies and activities used for implementation, and the indicators of student achievement such as classroom tests and performance assessments should be evident in teachers' plans. One can conclude that the paths to learning are prepared by the teacher, therefore, the teacher should know what he/she is trying to teach in order to plan ways to achieve specified student outcomes. Furthermore, the curricular goals will be specified by objectives (e.g., concepts, process skills) that the student strives for through the application of certain strategies or by engaging in certain activities. It seems evident that

student outcomes will be influenced by the curriculum and that if different ways of thinking are important curricular goals, the elements of thinking such as problem solving and evaluation should be reflected in teachers' objectives. This would suggest assessment which reflects objectives at a level commensurate with the learning level identified by the objectives. Furthermore, the evidence suggests that in science, many desirable behaviors may require assessment of student performance in a manner other than with traditional paper and pencil tests.

CHAPTER III

METHODOLOGY

Problem

This study investigated teachers' instructional planning as revealed in an analysis of the objectives, strategy selection, and indicators of student achievement for a unit on cells in a level I Biology course. This chapter presents a discussion of the study methodology, to include research questions, population and sample, procedures, instrumentation, research design, analysis techniques, and summary of methodology.

Research Questions

The following research questions which were concerned with describing the results of teachers' decision making in the process of selecting content, strategies/activities, and modes of assessment to correlate with curriculum objectives, strategies/activities, and indicators of student achievement were investigated in this study:

1) Given a specified unit in biology, was there congruence in teachers' planning as reflected in the objectives and types of assessment within the same school system, and among systems using the same textbook?

2) To what degree were objectives reflective of low level and high level behaviors as determined by the use of a table of specifications?

3) What instructional strategies/activities were used to implement the levels of content and type of behavior identified in the objectives?

4) To what degree did the indicators of student achievement reflect the low level and high level behaviors described in the objectives as determined by the use of a table of specifications?

5) Were the indicators of student achievement valid for reflecting the levels of behavior noted in the objectives?

6) To what degree were indicators of student achievement other than classroom tests being used; additionally, what types of indicators were used for assessing student laboratory work?

Populations and Samples

The population for this study was level I biology teachers in Virginia public school systems. Level I biology, the first general biology course, is generally taught at the tenth grade level in high school.

Thirteen school systems were invited to participate. The geographic locations of the systems selected were: the eastern shore; the southeast and the southwestern parts of the state.

The target sample was 30 volunteers from these school systems. The volunteers were teachers who met certain requirements: certification by the Virginia State Department of Education, inclusion of a unit on cells in their instructional program, use of the same textbook within their own school system, and instruction of a general biology course (i.e., Level I Biology as classified by the Virginia State Department of Education code). The average number of years of teaching for the volunteers was 14.6 . The average number of years of teaching biology was 12.07 .

Nine of the thirteen superintendents contacted agreed to participate in the study, however, only five of the nine actually participated. The participation rate for volunteers from the five school systems was approximately 67%. Twenty volunteers responded from the target sample of thirty. All volunteers provided materials requested for the study.

Procedures

The data gathering methods for this study concerned collection of information for the purposes of describing teachers' instructional planning as revealed in an analysis of objectives , strategies/activities, and indicators of student achievement.

The first step was to determine if tables could be adapted to organize anticipated data prior to contacting prospective participants using works adapted from Bloom, Hastings and Madaus (1971), Brophy and Alleman (1991), Wolf (1991), and Gronlund (1971). These tables were adapted to accommodate objectives, strategies / activities, and indicators of student achievement similar to those anticipated from the teachers' materials which were to be requested. These tables presented an organized method for recording the extensive body of information from each teacher.

A practice exercise was completed in which similar materials obtained from a biology teacher were tracked through the tables. This exercise emphasized determining the utility and effectiveness of the methods to be used in recording information.

After establishing the effectiveness of the procedure to be used in recording data, an accessible population for the study was identified.

Each superintendent was asked to designate a contact person who could assist by disseminating information, identifying volunteers, coding information to insure confidentiality of the participants, and collecting the materials. The designated contact persons varied, however, they included science supervisors, science coordinators, department chairpersons, science specialists, and a research specialist. The contact persons were sent consent forms, a brief information sheet, participant instructions, and a checklist for each participant. These items were distributed to each volunteer. Consent forms were coded by the contact person to insure the confidentiality of each participant unless the volunteer opted to sign their form. The brief information sheet was provided to collect information from each participant on the date of availability of the materials, name of the textbook used, number of years of teaching experience, and number of years of experience teaching biology . These consent forms and information sheets were returned to the researcher except for participants within the researchers' local school system. Those forms were retained by a specialist in the Research and Planning Department of the local school

system who served as the contact. Copies of the consent form, information sheet, participant instructions, and checklist appear in the Appendix, pages 87-90.

A unit on cells in general biology was selected for this study since it is normally taught as part of a general biology course and as such would not require additional preparation by the participants. The time frame for implementing the study was in the the fall, since the cells unit is normally considered a foundation or introductory unit in biology, therefore, the topic normally has been completed during the first semester.

Teacher volunteers were asked provide the following materials for this study:

- Daily lesson plans to reflect the objectives for each day for the entire unit on cells.

- Strategies or activities used each day to implement the objectives to include such descriptions as laboratory activity, discussion, lecture, cooperative group activity, etc..

- Copies of indicators of student achievement used to assess the objectives such as teacher - made tests, commercially prepared tests, performance assessments, etc..

The teachers' names were removed from all materials before being returned to the researcher. This was done to insure the teachers' confidentiality. Each school system has been assigned a code for the purposes of this study.

Each contact person was provided paper for use in copying the materials from each volunteer as well as pre - paid mailers for returning all materials.

Research Design

This research utilized a descriptive research design similar to that described by Borg and Gall (1989) and certain qualitative measures as described by Brogan and Biklen (1982). These designs allowed for the systematic investigation of teachers plans in order to describe and explain certain practices. In this study it was helpful to use tables and charts adapted from Bloom, Hastings and Madaus (1971), Gronlund (1971), and Wolf (1991), and certain criteria adapted from Bloom (1956) and Brophy and Alleman (1991).

Analysis

Congruence

A content matrix was developed to determine congruence among content objectives for teachers within a given school system. This matrix was used for school systems having more than one teacher participant. The matrix allowed tracking of content for the entire unit with no regard to differences in order of the objectives. Thus, differences in sequencing had no effect on determining congruence of content within the unit. Congruence was then determined by comparing objectives in categories such as, Discovery / History of Cells, Cell Structure and Function, Cellular Transport, Photosynthesis, Cellular Respiration, and Cell Reproduction. Congruence of content objectives among school systems having multiple participants, and using the same textbook, was also tracked.

Objectives

A table of specifications adapted from the work of Bloom, Hastings and Madaus (1971) was used to relate objectives from the lesson plans to corresponding behavioral specifications of student performance. This table of specifications revealed the span of behaviors from low level to high level as developed through the unit. The criteria used in interpreting the behaviors was adapted from Bloom's *Taxonomy of Educational Objectives* to include descriptors for each behavioral level. Those criteria were:

> Knowledge - Remembering by recognition or recall of ideas, material or phenomena. Remembering is the major psychological process (Bloom, 1956, p.62).
>
> Comprehension - Know what is being communicated and be able to make use of the material or ideas contained in it. Those objectives, behaviors or responses which represent an understanding of the literal message.... In reaching such an understanding, the student may change

the communication in his mind or in his overt responses to some parallel form more meaningful to him (p.89).

Application - Given a problem new to the student, he will apply the appropriate abstraction without being prompted as to which abstraction is correct without having to be shown how to use it in that situation (p.120).

Analysis - Analysis emphasizes the breakdown of the material into its constituent parts and detection of the relationships of the parts and of the way they are organized (p.144).

Synthesis - A process of working with elements , parts, etc., and combining them in such a way as to constitute a pattern or structure not clear before. Generally this would involve a recombination of parts of previous experience with new material reconstructed into a new and more or less well-integrated whole (p. 162).

Evaluation - Evaluation is the making of judgments about the value, for some purpose, of ideas, works, solutions, methods, materials, etc.. It involves the use of criteria as well as standards for appraising the extent to which particulars are accurate, effective, economical or satisfying, The judgments may be either qualitative or quantitative, and the criteria may be either those determined by the student or those given to him (p.185).

The objectives for each teacher were listed on a table of specifications and classified using the criteria as defined by Bloom to determine the level of behavior specified by the objective. A copy of the table of specifications for analyzing objectives is provided in the Appendix, page 93 . The results were converted to show the percentages of objectives at each behavioral level for each teacher.

Strategies / Activities

The strategies / activities were analyzed by first placing them in a chart adapted from Gronlund (1971) whereby the activities and strategies were listed beside the objectives to which they pertain. The types of strategies and activities most frequently used by the teachers were noted. Then the frequency of use of each strategy or activity by each teacher was counted. The results of this analysis were presented in table form. Since all teachers used multiple strategies and activities to implement most of their objectives, the results were reported as percents. The percent indicates the total of each teacher's objectives which were implemented using a given strategy (e.g., the percent of all of a certain teacher's objectives which were implemented using lecture as a strategy).

For the purposes of this study, five criteria were adapted from principles developed by Jere Brophy and Janet Alleman (1991) for use in analyzing individual learning activities. Interpretation of the results must be considered in light of the fact that this was the first experience for this researcher in applying the criteria. In addition, there was no prior sample with which the results could be compared. Personal communication with Dr. Brophy, one of the criteria's developers, did not provide any leads to a source where the criteria had been practically applied in this way. The criteria selected for use in this study are:

A. Primary Principles

A1. Goal Relevance. Activities must be useful means of accomplishing worthwhile curricular goals. Each activity's primary goal must be an important one, worth stressing and spending time on, and there must be at least logical reasons for believing that the activity will be effective as a means of accomplishing that goal.

B. Secondary Principles

B1.Multiple Goals

B1a. An activity that simultaneously accomplishes fewer goals (so long as it is effective in accomplishing the primary goals). This principle is probably the most useful one for distinguishing the best activities from other activities that also meet minimally necessary conditions. The best activities are effectively engaging, as well as cognitively instructive; provide students with opportunities to use critical and creative thinking, inquiry, problem - solving, values analysis, and decision - making skills in the process of applying knowledge; and call for natural and realistic applications rather than just for isolated practice or artificial forms of application that do not connect to students' lives outside of school.

C. Principles That Apply to Sets of Activities.

C3. Progressive Levels of Difficulty or Complexity. Activities should progressively increase in levels of challenge as student expertise develops.

D. Optional Principles.

D1. Inductive Inquiry. All activities should engage students in inquiry that will enable them to induce concepts, generalizations, or principles.

E. Implementation Principles.

E5. Debriefing / Reflection / Assessment. Activities should be brought to closure in ways that link them back to their intended goals and purposes. For students, this means opportunities to assess performance and to correct and learn from mistakes. Ordinarily, there also should be teacher - led post activity debriefing or reflection that reemphasizes the purposes and goals of the activity, reflects on how (and how well) these have been accomplished, and reminds the students of where the activity fits within the big picture undefined by the larger unit or curriculum strand. For teachers, post activity

assessment and reflection includes evaluating effectiveness of the activity for enabling students to accomplish the goals (Brophy and Alleman, 1991).

A copy of the table used to analyze the strategies / activities is found in the Appendix, page 96.

Assessment

The types of assessment instruments were identified and their frequency of use throughout the unit were reported in a chart adapted from Wolf (1991). A table summarizing the results for each teacher was used.

The test items were analyzed to determine if they reflected the same levels of behavior as required by the objectives. Criteria used for analyzing the test items were adapted from Bloom (1956). However, interpretation of the data on test questions was considered in light of one limitation of the study: no observations of classroom interaction and actual learning situations were observed, therefore, a caution by Bloom was considered in the application of his criteria. Bloom suggests that, "The task of classifying test exercises is somewhat more complicated than that of classifying educational objectives. Before the reader can classify a particular test exercise he must know, or at least make some assumptions about, the learning situations which have preceded the test" (Bloom, 1956 p.51). The criteria applied to each item is described as follows:

> Knowledge - The major behavior tested in knowledge is whether or not a student can remember and either cite or recognize accurate statements in response to particular questions. The form of the question must not be too different from the way in which the knowledge was originally learned. The choices in the recognition form of the question must be at the level of discrimination originally intended by the learning rather than at an entirely different level (Bloom, p.78).

Comprehension - The answer to be selected (e.g., list of terms and definitions) differs in phraseology from the formal one learned. This included selecting the "best" definition where the student judges the adequacy of various definitions given. If evaluation of this behavior is to transcend knowledge, the context in which the terms appears must be new. Essay questions requiring the student to record steps in his thinking are useful for evaluating at this level (pps. 97,98).

Application - Problems should have some relation to the situations in which the student may ultimately be expected to apply the abstraction in a practical way. It is best to create a problem known to the student but with a new slant. Each distractor in a problem should be so phrased that it can be reached only by one set of problem - solving steps.

Analysis - Material for analysis may be a literary passage, description of scientific experiment, set of data, picture, etc., or an actual laboratory situation in which the student analyzes the reaction of materials. Responses may be free or guided responses or by selecting best answers to objective questions.

Synthesis - A single product may have to represent the students ability. There may be a lack of objective criteria for evaluating and external judges may be needed. Some tests attempt to test for this through multiple choice items (e.g., rearrange a group of sentences to form a coherent paragraph).

Evaluation - Most frequently used method is essay or recall which do not focus on the desired behavior. The focus is usually on internal standards such as consistency, logical accuracy, and absence of internal flaws (Bloom, 1956).

These criteria were applied to each item on the test to provide a global view of the link between levels of behavior noted in the objectives and the levels assessed

on the tests. Attempts to track individual assessment items directly to the objectives were subject to the limitation noted earlier. A copy of the table used to analyze the test items appears in the Appendix, page 93.

Summary of Methodology

This study has described the results of teachers' decisions in planning the selection of objectives, strategies/ activities for implementing those objectives and indicators of student achievement. The study examined the congruence among teachers' plans as revealed in the objectives, types of instructional strategies and types of indicators of student achievement used within each school system. It has analyzed each teacher's plans to relate objectives to corresponding levels of behavioral specifications of student performance. It has identified the strategies /activities used to implement the objectives and applied evaluative criteria to those activities. The study has also identified the indicators of student used and the frequency of their use. It has determined whether the indicators of student achievement reflected the low level and high level behaviors noted in the objectives.

CHAPTER IV

RESULTS

This chapter presents the results of this study of teacher planning as revealed through the analysis of objectives, strategies / activities and indicators of student achievement. The analysis encompassed two outcomes: evidence of individual teacher planning, and cumulative evidence of teachers' planning from data gathered at several sites. The cumulative evidence represents data collected from five school systems and 20 individuals from at least nine different high schools. The guarantee of confidentiality prevents disclosure of the school system, teachers' names, or identification of the schools. Figure 1 reflects the distribution of participants by school system.

FIGURE 1

DISTRIBUTION OF PARTICIPANTS

BY SCHOOL SYSTEM

School System	Number of Teachers
System A	1
System B	3
System C	7
System D	8
System E	1
N = 20	

The data analyzed (i.e., objectives, strategies and activities, and indicators of student achievement) were prepared and submitted by the teachers to represent the instructional practices which they planned and carried out in their classrooms. The strategies and activities are those described by teachers to reflect how they implemented their objectives. The indicators of student achievement are those selected or prepared by the teachers.

Research Questions

Research Question 1: Given a specified unit in biology, is there congruence in teachers' planning as revealed in the objectives and types of assessment within the same school system, and among school systems using the same textbook? This question was relevant to only three school systems in which there was more than one participant.

It was determined from information on the teacher information sheets that all of the participating school systems having multiple volunteers were using the same textbook. A copy of the information sheet is located in the Appendix, page 88.

The specific categories of content selected for this study were determined in several ways. Several high school biology textbooks were examined to determine the consistent content categories related to the study of cells. Reference was also made to the categories established by Leopold Klopfer in *The Handbook Of Formative and Summative Evaluation of Student Learning* (Bloom, Hastings, & Madaus, 1971). Using these sources as a frame of reference, six specific categories were established for use in this study: Discovery and History of Cells; Cell Structure and Function; Cellular Transport; Photosynthesis; Cellular Respiration; and Cell Reproduction.

After reviewing the objectives submitted from all participants it was noted that a category related to other topics in science but specifically related to the study of cells, was included by several teachers. Microscopes are requisite for the study of cells, and some teachers developed skills objectives related to microscopes for inclusion in the cells unit. Therefore, a skills category was added to the list for comparison. The objectives for individual teachers in each school system having more than one participant were compared

using the six content categories and the skills category. A content matrix allowed tracking of content for the entire unit with no regard for differences in the order of the objectives. Thus, differences in sequencing had no effect on determining the congruence of content and skills. The results of the review of objectives for congruence among teachers are presented in Table 1.

Congruence among the three teachers in System B was low. Only one teacher included objectives related to all of the cell categories. The other teachers were congruent in only two categories resulting in a total congruence in content among all teachers in only two of six content categories; Cell Structure and Function; and, Cellular Transport. Only one teacher included objectives in the category, Microscope Skills.

A high level of congruence was noted among teachers from System C. Every teacher included all of the content categories identified for this study in their objectives, however, only one teacher included objectives related to microscope skills.

Congruence among the eight teachers in System D was low. Only three of the six content categories were included in the teachers' objectives. Only one category, Cell Structure and Function, was covered by all teachers. The category, Discovery and History of Cells, was included by five teachers while Cellular Transport was included by three teachers. Four of the eight included the Microscope Skills category in their objectives.

A review of the indicators of student achievement used by the teachers revealed no methods of assessing students' achievement or students' performance other than paper and pencil tests and and use of a weighted checklist for a student project. Congruence for teachers within the same school system is shown in Table 2.

Although some teachers used experimental design as one of their instructional methods, they gave no indication of the procedure used to evaluate students' performance or the development of the experiment. In most cases there was no indication as to whether the students worked individually or in groups to design their experiments.

TABLE 1

CONGRUENCE OF CONTENT WITHIN SCHOOL SYSTEMS

Content	System B Teacher 1 2 3	System C Teacher 1 2 3 4 5 6 7	System D Teacher 1 2 3 4 5 6 7 8
Discovery/History	y n y	y y y y y y y	y n n y y y n n
Cell Structure and Function	y y y	y y y y y y y	y y y y y y y y
Cellular Transport	y y y	y y y y y y y	y n n y n y n n
Photosynthesis	y n n	y y y y y y y	n n n n n n n n
Cellular Respiration	y n n	y y y y y y y	n n n n n n n n
Cell Reproduction	y y n	y y y y y y y	n n n n n n n n
Other Microscope	n y n	y y y y y y y	n n y n n y y n

Key: y= topic covered
n= topic not covered

TABLE 2

CONGRUENCE OF THE TYPES OF INDICATORS OF STUDENT ACHIEVEMENT

Types of Indicators	System B Teacher 1 2 3	System C Teacher 1 2 3 4 5 6 7	System D Teacher 1 2 3 4 5 6 7 8
Paper and Pencil Test	y y y	y y y y y y y	y y y y y y y y
Experimental Design	n n n	n n n n n n n	n n n n n n n n
Checklist for Cell Model	n n n	n y n n n n n	n n n n n n n n

Key: y= topic covered

n= topic not covered

Several teachers required students to develop a model of the cell. Only one teacher included a method of evaluating the product by use of a modified checklist.

Research Question 2

Research question 2: To what degree were objectives reflective of low level and high level behaviors as determined by the use of a table of specifications? This analysis was conducted in two parts. Part 1 concerned the analysis of each teacher's objectives. Part 2 concerned a summary of the results for the entire sample.

In Part 1 the analysis was made by entering each objective into a table of specifications and applying criteria adapted from the *Taxonomy of Educational Objectives, The Classification of Educational Goals* edited by Benjamin Bloom (1956). The criteria are presented in the Appendix, page 91. In this taxonomy the lowest level of behavior is defined as Knowledge, and includes behaviors closely associated with earlier stages of the process. The ordering of educational outcomes then progresses through five additional levels with Evaluation at the highest level of behavior. A copy of the chart used for individual analysis is shown in the Appendix, page 93.

After the objectives were categorized on the table of specifications, the number of objectives in each category was converted to a percentage. These percentages were recorded for each teacher. A summary of the percentage distribution of objectives for each teacher at each behavioral level is shown in Table 3.

The table shows that most teachers submitted objectives which had been written at the lowest levels of behavior which are Knowledge and Comprehension. Only two teachers submitted objectives which were classified in the complete range of behaviors from Knowledge to Evaluation. Most of the teachers included objectives written at the Analysis level. The level of behavior least addressed by the teachers was Synthesis, followed by Evaluation and Application respectively.

The number of teachers who included objectives at each of the behavioral levels is revealed in Table 4.

Table 3

PERCENTAGE DISTRIBUTION OF OBJECTIVES AT EACH LEVEL OF PROCESSES/BEHAVIORS

Teacher	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
A_1	57%	38%		5%		
B_1	39%	30%	4%	25%	2%	
B_2	38%	23%	5%	29%		5%
B_3	31%	62%		6%		
C_1	23%	25%	8%	30%	12%	2%
C_2	18%	41%	6%	27%	6%	2%
C_3	13%	51%	3%	23%		10%
C_4	13%	51%	3%	23%		10%
C_5	13%	51%	3%	23%		10%
C_6	13%	51%	3%	23%		10%
C_7	13%	51%	3%	23%		10%
D_1	81%	6%		12%		
D_2	66%	33%				
D_3	32%	47%		21%		
D_4	17%	17%		66%		
D_5	50%	50%				
D_6	46%	34%	8%	8%		4%
D_7	37%	19%	4%	19%	21%	
D_8	50%	35%	5%	10%		
E_1	71%	14%		14%		

TABLE 4

NUMBER OF TEACHERS INCLUDING OBJECTIVES AT EACH BEHAVIORAL LEVEL

Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
20	20	12	18	4	9

N = 20

The table shows that all teachers submitted objectives which were written at the level of Knowledge and Comprehension. Objectives written at the Analysis level were included by 18 of 20 teachers. Therefore, this was the third most frequently noted level of behavior. Objectives related to laboratory activities were the most common among those written at the Analysis level.

The inclusion of objectives at each of the remaining levels is noted by decreasing frequency: Application, 12 of 20 teachers; Evaluation, 9 of 20 teachers; and, Synthesis, 4 of 20 teachers.

Research Question 3

Research Question 3: What instructional strategies and activities were used to implement the levels of content and type of behavior identified in the objectives? This analysis was conducted in two parts. Part one concerned the analysis of individual teacher's strategies. Part two concerned the application of criteria adapted from Brophy and Alleman (1991) for the evaluation of instructional activities.

The strategies identified for this study are those described by teachers as the methods they used for implementing their objectives. The teachers were asked to identify the strategies used to teach each objective and to include copies of any activities which were used. Strategies which were identified included lecture, discussion, use of audio visuals,

cooperative group work, and textbook work (e.g., questions, definitions). The types of activities included were worksheets, chapter outlines, crossword puzzles, study guides, and laboratory exercises. Many teachers also included copies of their notes and diagrams.

A matrix was developed to include the categories identified by the teachers. The strategies submitted for each of the objectives were tracked on a separate matrix for each teacher. A copy of the matrix used can be found in the Appendix, page 96. For the purpose of this discussion the term strategy will include the methods selected by teachers for presenting information and demonstrating procedures. Activities are the things students do, except for reading or listening, which assist them in learning the curricular content (Brophy & Alleman, 1991, p.9).

The most frequently used strategies and activities were: lecture, discussion, audio visuals (including use of transparencies), worksheets, textbook work, and student labs. The number of teachers who used each of these strategies and activities is summarized in Table 5.

TABLE 5

NUMBER OF TEACHERS USING THE MOST FREQUENTLY IDENTIFIED STRATEGIES/ACTIVITIES

Lecture	Discussion	Audio Visual	Worksheet	Textbook Work	Student Lab
17	17	18	19	18	20

N = 20

Other categories of strategies and activities which were identified include: use of cooperative groups; science, technology and society activities (STS); pre laboratory discussion; post laboratory discussion; teacher demonstrations; and, experimental design techniques. The numbers of teachers using these strategies is summarized in Table 6.

TABLE 6

NUMBER OF TEACHERS USING LESS

FREQUENTLY IDENTIFIED STRATEGIES/ACTIVITIES

Cooper groups	STS	Pre lab disc	Post lab disc	Teacher demo.	Exp. design
9	1	12	9	12	4

N = 20

Data from the individual matrices were converted to indicate the percent of objectives which were implemented using each strategy and activity. When interpreting the data, it must be noted that all teachers identified more than a single strategy or activity for implementation of many of their objectives. Therefore, the number of times a given strategy or activity was used to implement all of a certain teacher's objectives was counted. The results were reported in percentages to indicate the total number of each teacher's objectives which were implemented using a specific strategy or activity. A summary for all teachers is shown in Table 7.

Cooperative group activities were noticeably separate from the student lab groups. For some laboratory activities, the lab groups were specifically identified as "groups of four". However, this was mainly associated with some of the experimental design techniques. For example, a statement used was " Work in groups of four to design an experiment to .....". Only 9 of the teachers used cooperative groups with D7 indicating cooperative group work for implementation of 36% of the objectives.

The use of lecture as a technique was described by 18 of 20 teachers with one teacher indicating use of lectures for 43% of the objectives. Several teachers described lecture as a method used during the same lesson as discussion. A correlation was noted

Table 7

THE FREQUENCY OF USE OF STRATEGIES TO TEACH FOR OBJECTIVES*

Teacher	Cooperative Groups	Lecture	Discussion	Audio/Visual	Worksheet	Textbook Work	STS	Pre Lab Discussion	Student Lab	Post Lab Discussion	Teacher Demonstration	Experimental Design
A_1		13%	9%	63%	18%	4%			27%			
B_1		43%	34%	9%	9%	2%			18%	4%	18%	
B_2	16%	28%	32%	4%	20%	4%			36%		4%	
B_3	6%	31%	50%	25%	50%			16%	25%		25%	
C_1	6%	20%	12%	12%	16%	2%	6%	12%	37%	12%	2%	8%
C_2	5%	22%	5%	22%	30%	3%		3%	26%		3%	
C_3		19%	26%	53%	56%	2%		4%	7%	7%	2%	
C_4		19%	26%	53%	56%	2%		4%	7%	7%	2%	
C_5		19%	26%	53%	56%	2%		4%	7%	7%	2%	
C_6		19%	26%	53%	56%	2%		4%	7%	7%	2%	
C_7		19%	26%	53%	56%	2%		4%	7%	7%	2%	
D_1	5%	16%		5%	3%	27%			16%	11%		
D_2	14%			14%	28%	42%		28%	28%			
D_3	14%	23%		14%		4%		9%	42%			9%
D_4			20%	10%	60%	10%			50%		10%	
D_5		16%	16%		33%				33%			
D_6		25%	7%		39%	14%			17%		3%	3%
D_7	36%	3%	20%	10%	36%	6%		6%	23%			23%
D_8	17%	30%	4%	4%	8%	17%		4%	39%	4%		
E_1			5%	5%	38%	22%			11%			

*Rows may add up to more than 100%
For most objectives several strategies were used

for teachers B2, B3, C2 through C7, and D6 in which high use of lecture correlated with high use of worksheets. In addition, teachers C3 through C7 indicated use of transparencies to project chapter outlines which were copied and completed by students. This practice resulted in a very high percentage of objectives being implemented through the use of audio visuals and worksheets.

The analysis of strategies identified by teacher E1 showed high percentages associated with worksheets and textbook work. No use of lecture was noted and discussion and audio visuals were used infrequently.

Topics related to science, technology and society were noted by only one teacher. These topics were associated with activities such as; having students research and debate the smoking issue; reviewing newspapers and magazines to select a current issue in science for additional research; and, selecting an issue in science for the purpose of writing a letter. There was no clarification on the nature of the letter, however, it is assumed that the students were to make a personal statement related to the issue of their choice.

All teachers involved students in laboratory activities (20 of 20 teachers) and twelve teachers noted teacher demonstrations related to laboratory activities. However, reported use of pre lab discussion and post lab discussion varied. Seven teachers reported using pre lab and post lab discussions as strategies. Five teachers described only pre lab discussion, and 2 described only post lab discussion. Six of the teachers did not describe pre lab or post lab discussion.

Experimental design techniques were described by 4 of 20 teachers representing 2 of the 6 school systems.

Analysis by Criteria

A matrix was developed by which the strategies were checked against these criteria. The criteria were: Goal Relevance; Accomplishes Multiple Goals; Inductive Inquiry; Debriefing/Reflection/Assessment; and Progressive Levels of Complexity (i.e., sets of activities). A copy of the criteria is listed in the Appendix, page 94. These criteria

were applied to each activity to determine if the activity was effective as an opportunity to process, integrate and apply curriculum content in goals-driven ways. A summary of the analysis of strategies using the criteria is shown in Table 8.

Criterion 1: Goal Relevance

Results show that all teachers described strategies which were relevant to the most of the goals identified by the objectives, however, six teachers identified at least one strategy which was not relevant to the objective for which it was described. For example, the strategy described by a teacher to implement an objective which stated, "Conduct a lab to determine the rate of photosynthesis", was "lecture". A further check of all strategies did not reveal any strategy or activity which could reasonably relate to that objective. No lab was done on the topic. Another example of a strategy judged to be not relevant for the objective concerned the objective, "Exhibit his/her knowledge of traits of life". The strategy identified for implementation was "lecture".

Criterion 2: Accomplishes Multiple Goals

All teachers included some strategies which accomplished multiple goals, however, the percentage of activities meeting this criterion was not high in most cases. Strategies described by two teachers met this criterion 70% of the time, and strategies described by three teachers met the criterion at least 50% of the time. Others percentages ranged from a high of 47% to a low of 9%.

Criterion 3: Inductive Inquiry

Activities which engaged students in inductive inquiry were described by 7 teachers with the highest percentage of activities so described at 23%; the lowest percentage at 1%.

Criterion 4: Debriefing/ Reflection/ Assessment

The Debriefing / Reflection / Assessment criterion was applicable to activities described by 19 of the 20 teachers. Only one teacher did not describe activities in this category.

Table 8

ANALYSIS OF STRATEGIES BY CRITERIA

Teacher	Goal Relevance	Accomplishes Multiple Goals	Inductive Inquiry	Debriefing/Reflection/ Assessment (related back to goal)	Progressive Levels of Complexity (sets of activities)
A_1	100%	9%		9%	9%
B_1	100%	18%	6%	18%	25%
B_2	100%	32%	16%	24%	16%
B_3	100%	50%		25%	20%
C_1	100%	52%	16%	39%	27%
C_2	98%	52%	1%	26%	15%
C_3	90%	24%		46%	9%
C_4	90%	24%		46%	9%
C_5	90%	24%		46%	9%
C_6	90%	24%		46%	9%
C_7	90%	24%		46%	9%
D_1	95%	22%		11%	16%
D_2	100%	28%		14%	14%
D_3	95%	47%	9%	28%	19%
D_4	100%	70%		10%	10%
D_5	100%	33%			16%
D_6	100%	21%	3%	3%	17%
D_7	100%	70%	23%	33%	26%
D_8	100%	43%		17%	17%
E_1	*	11%		38%	

* unable to determine

Criterion 5: Progressive Levels of Complexity (sets of activities)

A sequence of activities which increased in complexity was identifiable for 19 of 20 teachers. The percentage of activities so identified ranged from a high of 27% to a low of 9%. One teacher did not describe activities to which this criterion could be reasonably applied.

Research Question 4

Research Question 4: To what degree did the indicators of student achievement reflect the low level and high level behaviors described by the use of a table of specifications?

The teachers were asked to submit copies of all indicators of student achievement used for assessing students on this unit. The first part of this analysis relates to the pencil and paper tests, including both commercially prepared and teacher made tests. A matrix containing the same categories used to analyze the objectives, was used to analyze the test items. Evaluation criteria adapted from the *Taxonomy of Educational Objectives: The Classification of Educational Goals* (Bloom, editor, 1956) were applied to each test item.. A copy of the criteria is located in the Appendix, page 97.

Each test item was classified by applying the criteria adapted from Bloom. The total number of test items classified at each of the levels was compiled for all tests submitted by each teacher. That data were converted to a percentage to indicate the total number of test items for all tests submitted by each teacher which fell within each category from Knowledge to Evaluation. The results of the analysis are noted in Table 9.

The analysis revealed that the majority of test items were written at the lowest levels known as Knowledge and Comprehension. Exceptions noted include one teacher who had no test items at the Knowledge level, and another who had 100% of the test items written at the Knowledge level. Twelve teachers had test items written at the Application level, and three teachers had items written at the Analysis level. No items were included at Synthesis or Evaluation levels.

Table 9
PERCENTAGE DISTRIBUTION OF TEST ITEMS IN EACH CATEGORY OF PROCESSES/BEHAVIORS

Teacher	Knowledge	Comprehension	Application	Analysis	Synthesis	Evaluation
A_1	22%	76%	2%			
B_1	13%	86%	0.9%			
B_2		73%	17%	10%		
B_3	32%	66%	2%			
C_1	47%	53%				
C_2	71%	16%	11%	2%		
C_3	46%	41%	13%			
C_4	46%	41%	13%			
C_5	46%	41%	13%			
C_6	46%	41%	13%			
C_7	46%	41%	13%			
D_1	63%	37%				
D_2	83%	17%				
D_3	63%	37%				
D_4	100%					
D_5	67%	30%	3%			
D_6	16%	84%				
D_7	9%	65%	17%	9%		
D_8	57%	43%				
E_1	85%	15%				

The second part of this analysis relates to the use of other types of indicators of student achievement to assess the levels of student behaviors.

One teacher submitted a weighted checklist as the assessment instrument for a student project requiring students to construct a model of a cell. Although other teachers referred to assigning a similar project in their description of the activities, none included a method of evaluation for the project.

The final item to be discussed was the use of experimental design techniques. None of the teachers referred to this as a method of assessing student achievement. Four teachers included experimental design techniques in their planning but they gave no indication of how the students were assessed. The process is, in itself, worthy of evaluation. Reference to the value as an indicator of student achievement was warranted at this time.

Research Question 5

Research Question 5: Were the indicators of student achievement valid for reflecting the levels of behavior noted in the objectives?

Analysis of this question was accomplished by comparing the results of the classification of objectives at the various behavioral levels (Table 3) with the results of the test item classification (Table 9). Since only one teacher included a method of evaluation a student project (i.e., to construct a model of a cell) comparison of other teachers' results for that indicator of student achievement was unnecessary. No other indicators of student achievement were included by any teacher.

Table 10 shows that 14 of 20 teachers selected (i.e., commercially prepared) or created (i.e., teacher made) test items at a level too low to appropriately assess students' learning at levels corresponding to the levels indicated by the objectives. One teacher used test items which tested behaviors at a level too high for the level at which the objectives were written.

TABLE 10

VALIDITY OF INDICATORS OF STUDENT ACHIEVEMENT

Teacher	Good Fit	Too High	Too Low
A1		x	
B1			x
B2	x		
B3	x		
C1			x
C2			x
C3			x
C4			x
C5			x
C6			x
C7			x
D1			x
D2	x		
D3			x
D4			x
D5	x		
D6			x
D7			x
D8			x
E1	x		
N=20	5	1	14

Five teachers had what is described as a "good fit" between the test items and the objectives. However, the fit between objectives and test items for teachers C1, D6 and E1 existed only because the objectives and test items were written at the lowest levels of the taxonomy: Knowledge and Comprehension. The remaining two teachers identified as a "good fit" would more accurately be described as a "close good fit" between objectives and test items. Teacher B2 had submitted objectives which were found to be within the first four levels of the taxonomy. Analysis of the test items showed items in 3 of the 4 levels. However, no test items were included at the Knowledge level. Objectives submitted by teacher B3 were classified at three levels: Knowledge (31%), Comprehension (62%) and Analysis (6%). The test items submitted by that same teacher were classified as follows: Knowledge (32%), Comprehension (66%), and Application (2%). Although there was a discrepancy between the two levels, Analysis and Application, the correlation between the remaining objectives and test items was very close.

Research Question 6

Research Question 6: To what degree were indicators of student achievement other than classroom tests being used; additionally, what types were used for assessing student laboratory work?

Only one other instrument for assessing students was submitted. This instrument was a weighted checklist used to evaluate a student project in which students constructed a model of a cell.

There were no indicators of student achievement or performance related to laboratory investigations submitted by any teacher. Although experimental design was a strategy used by 4 teachers, none of those teachers identified their methods of assessing students' performance, procedures or results.

Summary of Results

This chapter presented data that were used to analyze certain research questions. A summary of the results of that analysis is presented for each research question.

Research Question 1: Given a specified unit in biology, was there congruence in teachers' planning as revealed in the objectives and types of assessment within the same school system, and among school systems using the same textbook?

This question was relevant only to three school systems in which there was more than one participant. There was lack of congruence in the content included in the objectives for the unit on cells among teachers within the same school system. Congruence among teachers in System B and System D was low. There was a high level of congruence among teachers in System C. The same textbook was used in all three school systems compared for congruence.

There was a high level of congruence among teachers in the three school systems related to the types of assessment used. All teachers used used paper and pencil tests as the primary method of assessment. There was low congruence for the only other indicator of student achievement , a weighted checklist.

Research Question 2: To what degree were objectives reflective of high level and low level behaviors as determined by the use of a table of specifications?

The behaviors reflected most frequently in the objectives submitted by the teachers were classified at the lowest behavioral levels: Knowledge and Comprehension. Other behaviors identified in decreasing order of frequency were Application, Evaluation and Synthesis.

Research Question 3: What instructional strategies / activities were being used to implement the levels of content and type of behavior identified in the objectives?

The types of strategies and activities most frequently described by teachers for implementing their lessons were lecture, discussion, audio visuals (including use of transparencies) worksheets, textbook work, and student labs. The types of strategies and activities used less frequently included cooperative groups, STS activities, pre lab discussion, post lab discussion, teacher demonstration, and experimental design.

Analysis of the strategies and activities using criteria adapted from Brophy and Alleman (1991) showed that all teachers described strategies and activities which were reasonably related to their goals. However, some teachers described strategies or activities which were not relevant to their goals. All teachers included some strategies or activities which accomplished multiple goals. In the two categories, Debriefing/Reflection/ Assessment and Progressive Levels of Complexity, 19 of 20 teachers described some strategies or activities which met those criteria. Only 7 of 20 teachers described strategies or activities which met the criterion, Inductive Inquiry.

Research Question 4: To what degree did the indicators of student achievement reflect the low level and high level behaviors described in the objectives as determined by the use of a table of specifications?

The analysis of test items revealed that the majority of test items submitted by all teachers were written at the lowest levels: Knowledge and Comprehension. Twelve of 20 teachers submitted tests which included test items at the Application level; three of 20 included test items written at the Analysis level. No test items were written at the levels of Synthesis or Evaluation.

Research Question 5: Were the indicators of student achievement valid for reflecting the levels of behavior noted in the objectives?

The analysis of test items shows that teachers generally selected test items which were written at a level too low to appropriately assess students' learning at levels as indicated by the behavioral levels specified in the objectives.

Research Question 6: To what degree were the indicators of student achievement other than classroom tests being used; additionally, what types of indicators were used for assessing student laboratory work?

Only one teacher identified indicators of student achievement other than paper and pencil tests. That teacher included a weighted checklist which was used to assess the students' model of a cell. This checklist only evaluated the completeness of the model.

Although several teachers described the inclusion of experimental design techniques, none included any indicator for assessing the students' work.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

This study investigated the congruence in teachers' instructional planning as revealed through objectives and types of assessment; the levels of behavior indicated in the objectives; the types of strategies and activities used to implement the objectives; levels of behavior reflected in the indicators of student achievement; validity of the indicators of student achievement for reflecting the same levels of behavior; and, the types of indicators of student achievement used including the types of indicators for assessing student laboratory work. This chapter will interpret the findings in light of current research on effective teaching and make recommendations for future research.

The following limitations should be considered in the interpretation of the results of this study: The study reflects the teachers' own descriptions of their instructional planning and does not demonstrate what they actually taught; no classroom observations were made, therefore, the degree of student involvement is not known and the formality of instruction is unknown; the use of volunteers may complicate the interpretation of results; and, subjects were not identified through random selection. It should be noted, however,that the results were compiled from teachers representing five school systems representative of the Commonwealth of Virginia.

Problem

The purpose of this study was to describe teachers' instructional planning as revealed in an analysis of objectives, strategies and activities (including pre and post laboratory instruction), and indicators of student achievement to answer specific research questions. The research questions which were answered in this study follow:

1) Given a specified unit in biology, was there congruence in teachers" planning as revealed in the objectives and the types of assessment within the same school system, and among school systems using the same textbook?

2) To what degree were objectives reflective of low level and high level behaviors as determined by the use of a table of specifications?

3) What instructional strategies and activities were being used to implement the levels of content and type of behavior identified in the objectives?

4) To what degree did the indicators of student achievement reflect the low level and high level behaviors described in the objectives as indicated by the use of a table of specifications?

5) Were the indicators of student achievement valid for reflecting the levels of behavior noted in the objectives?

6) To what degree were indicators of student achievement other than classroom tests being used, and what types of indicators were used for assessing student laboratory work?

Review of Literature

The following brief review of the literature is intended to describe the body of knowledge that is supportive of "desirable" or generally accepted teacher behavior reflected in the research questions and is intended to help focus the discussion of the research questions. Teachers are the key to implementation of any instructional program. Furthermore, their influence on what their students learn is profound. Student outcomes are directly influenced by the decisions teachers' make when planning their instructional program. The importance of teachers' planning has long been recognized. Early educators such as John Dewey (1902) and Franklin Bobbitt (1924) recognized the importance of relating objectives to the method of implementing a lesson in order to insure that content knowledge and skills are appropriately developed.

Ralph Tyler (1949) specifically describes the importance of connections between objectives and the methods of implementation when he states that, " By defining these

desired educational results as clearly as possible, the curriculum- maker has the most useful set of criteria for selecting content, for suggesting learning activities, for deciding on the kind of teaching procedure to follow, in fact to carry on all the further steps of curriculum planning" (p.62).

Research by Shavelson and Stern (1981) suggests that planning provides a broad outline of what should happen during teaching and tends to guide transitions between activities, therefore increasing the chances that desired goal of instruction will be met in spite of interruptions. Findings by Haigh (1981) support those by Shavelson and Stern. In Haigh's study teachers revealed that through planning they were more likely to contemplate a lesson, identify possible problems associated with the lesson and identify possible solutions to those problems.

The current trend to redefine educational goals to address more clearly the processes, skills, and conceptual understandings which all students should have to function in life are evident in reports such as *Science for All Americans* (AAAS, 1989). These core learnings reflect a global view that educational goals should engage students in applying curricular content to situations for the purposes of problem solving, decision making, evaluation, and other practices usually called thinking skills. These practices require spiraling of curricular content through introductory levels of student engagement with the content, to the transfer of knowledge to new situations where it becomes the basis for problem solving (Dewey, 1938; Tyler, 1949). In other words, there should be changes in the levels of learning. Objectives, therefore, should reflect this flow as students move from simple to complex behaviors (Taba, 1962). Requisite to this process is a linking or matching of strategies and activities which will facilitate the development of learning at each level.

John Goodlad (1984) discovered discrepancies between what teachers state as their expectations for their students and actual teaching practices. Of particular significance to this study was Goodlad's finding at the high school level among science teachers. Those science teachers saw as desirable behaviors which involved students in scientific thinking.

His classroom observations showed inconsistencies in the teachers' practices and their stated expectations.

Science for All Americans (AAAS, 1989), a document on reform in science education, suggests that methods of instruction appropriate to science education should emphasize the exploration of questions, critical thought, understandings in context, debate of issues, and active involvement of students. Furthermore, the report suggests that students should work together, share ideas and information with each other, and use the tools of modern technology.

The need for varying methods of assessment to cover the range of important educational objectives has been noted by a number of authors (Shepard, 1989; Stiggins, 1991; Raizen & Kaser, 1989; Stiggins, 1988; Manatt, 1987; Wiggins, 1989; Wolf, 1989; Shavelson, Carey & Webb, 1990; Rief, 1990). Assessment must be redesigned to more closely resemble real learning tasks (Shepard,1989). Hilda Taba (1962) points to the need for consistency between objectives and evaluation techniques. She also suggests that available devices for evaluating higher mental processes such as thinking are inadequate.

Meng & Doran (1990) suggest that practical tests and observation in the context of hands - on / laboratory activities are the best assessments for process skills and problem solving. A study conducted by Bremme, Herman and Doherty (1983) showed that secondary teachers give highest importance to their own observations of students' work and their own clinical judgments. John Goodlad (1984) reported in *A Place Called School* that high school science teachers emphasized factual recall rather than the exercise of higher intellectual functions.

Discussion

Interpretation of the results for each of the research questions in light of the literature and the aims of science education are discussed as follows:

Research Question 1: Given a specified unit in biology, was there congruence in teachers' planning as revealed in the objectives and types of assessment within the same school system and among school systems using the same textbook?

Content Congruence

All teachers were asked to submit materials for the same unit in biology. The analysis of congruence was made among school systems having multiple participants. It is of importance to note that the school systems compared were using the same biology textbook. The content categories identified for comparison among the school systems were checked to insure that they were included in the textbook used by these teachers. If there was lack of congruence among teachers in the area of content, the possibility existed that teachers who relied heavily on the text for their decisions about the content may have been influenced by the text. The result of that check showed that the content categories analyzed in this study were in fact listed as the categories for the unit on cells in the textbook used by the three school systems. The possibility also exists that teachers who did not include certain content categories such as Cellular Respiration or Cell Reproduction may have taught these topics at another time in their curriculum. A review of the entire course sequence for those teachers is necessary to address that possibility. However, the topics found to be omitted by some teachers are normally included in a study of the cell.

The analysis of objectives showed that there was lack of congruence not only among the school systems, but among teachers within the same system. The trend in education has been to move away from the overwhelming body of facts and to identify essential concepts which all students should know. Concerns about the scientific literacy level of the population as reported by AAAS (1989) in *Science for All Americans*, and as shown in the latest study of National Assessment of Educational Progress add significance to the results noted by this analysis. The lack of congruence in the content categories appears to support the need for identifying essential content for all students to learn.

Assessment Congruence

Congruence existed for the assessment component of this question. All teachers used some form of commercially prepared or teacher - made tests. Lack of congruence existed in other categories such as use of experimental design and assessment of student projects. Assessment will be more closely examined in the discussion of Research Questions 5 and 6 which are directly related to indicators of student achievement.

Research Question 2: To what degree were the objectives reflective of low level and high level behaviors as determined by the use of a table of specifications?

The aims of education as revealed in the literature clearly indicate that objectives should prepare students to engage in problem solving, decision making, and evaluative processes (AAAS, 1989). Although these behaviors correspond to the higher levels as noted in the *Taxonomy of Educational Objectives* (Bloom, 1956), most learning situations would dictate that there must also evidence of student involvement at the introductory levels of behavior. The introductory levels of behavior are particularly apparent as new material is introduced. However, there should be evidence that as the curricular content spirals to various levels, there should be a concurrent spiraling of the levels of expected student behaviors.

The findings of this study indicate that most teachers are not creating guidelines in the form of objectives which correspond to the goals of education identified in the literature. Furthermore, the fact that teachers wrote objectives at the lowest behavioral levels, Knowledge and Comprehension, might be evidence of low teacher expectations.

Analysis of Objectives

Knowledge and Comprehension

The results of the analysis of teachers' objectives reveals that most objectives are written at introductory levels or low levels of expected student behaviors which are Knowledge and Comprehension. With the exception of one teacher, all teachers had the greatest percentage of their objectives written at the lowest levels. If the goals of science

education as described in *Science For All Americans*(AAAS, 1989) and *Research Within Reach: Science Education* (1984) (e.g., problem solving, decision making, evaluation) are to be realized, then one would expect that objectives written at the lower behavioral levels would not constitute the majority of a teachers' listing of objectives for an entire unit.

Application

Objectives written to involve students in the application of information to new situations was rare. Although 12 of 20 teachers included objectives at this level, the total percentage of objectives requiring students to apply previously learned information in a new situation was low. The highest percentage of objectives at the application level was 8%; the lowest 3%. Hilda Taba (1962) suggests that having students apply facts and principles to the solution of new problems and to explain new phenomena is an important aspect of thinking. Furthermore, she suggests, " The fact that the effectiveness of school learning depends on the extent to which students can apply to new situations what they have learned makes the transfer of learning an extremely important objective".

Analysis of the test items revealed that the same number of teachers who wrote objectives at the Application level included test items at the Application level (12 of 20). However, the teachers who tested at this level were not necessarily the same teachers who wrote objectives at this level: some teachers who included objectives at the Application level did not test at that level. Also, some teachers who did not include objectives at the Application level did test at that level. The percentage of test items at the Application level (for those teachers who had submitted objectives at the Application level) was greater than the percentage of objectives submitted at that level by the same teachers.

Ideally, situations in which students apply information should be new to the student or they should be situations containing new elements as compared to the context in which the original abstraction was learned. The situation should also require the student to apply the original abstraction in a practical way: there should be some relation to the way the student may ultimately use the abstraction (Bloom, 1956). Developing a new slant on

common situations may be difficult for teachers to devise. This finding may suggest the need for training teachers to develop appropriate situations and test items to engage students at this level of learning.

Analysis

Interpretation of the objectives at the Analysis level show that 18 of 20 teachers wrote objectives at this level. A review of these objectives and the strategies described for implementation showed that there was frequently a correlation between analysis objectives and student laboratory work. However, additional review of the laboratory activities which were submitted did not consistently support a level of involvement defined as analysis. With the exception of 4 teachers who used experimental design techniques for some of their laboratory exercises, and 3 teachers who had students write thorough conclusions to their labs, the remaining lab investigations were standard investigations. The purpose, procedures, and data charts were already prepared. The conclusion usually consisted of a series of questions for students to complete.

Bloom (1956) defines analysis as, "Analysis emphasizes the breakdown of the material into its constituent parts and detection of the parts and of the way they are organized" (p.144). In describing the nature and function of analysis, Bloom suggests that it may include: skill in distinguishing facts from hypotheses; ability to distinguish a conclusion from statements which support it; ability to check the consistency of hypotheses with given information and assumptions; ability to distinguish cause - and - effect relationships from other relationships (pp. 146-148). As a general rule, the labs reviewed do not allow students the opportunity to effectively engage in these functions.

Analysis of the objectives submitted by one teacher showed that 66% of that teachers' objectives were written at the Analysis level. It is interesting to note that the test items for that same teacher were all (100%) at the Knowledge level. Furthermore, the strategies for implementation described by that teacher reflected 50% student lab time and 10% teacher demonstration time. The high percentage of strategies identified as student

labs or teacher demonstrations may account for the high percentage of objectives written at the Analysis level. This finding is incongruent, however, with the structure of the laboratory activities used, and the results of the test item analysis.

Synthesis

The nature of science, as described in the literature review, supports a level of laboratory investigation at the Synthesis level. Bloom describes synthesis to be that the student pulls together elements from many resources and puts these together in a pattern not present before. Students engaged in experimental design practices should be involved at the Synthesis level. Four teachers submitted objectives related to experimental design, however, the analysis showed that only two of those teachers actually described experimental design in their strategies. The separate analysis of teachers' strategies revealed that two other teachers, who had not written objectives related to experimental design techniques, had described it as one of their implementation strategies. Clearly there are discrepancies between what these teachers described for this study and what is done in the implementation or interactive phase of instruction.

Evaluation

Objectives classified at the Evaluation level were submitted by 9 of 20 teachers. This analysis was very difficult for there was no evidence in the strategies to suggest that students had engaged in this activity. There were no test items written at the Evaluation level nor were any methods of assessing the experimental design process included by any teacher.

Other Findings

An interesting finding for this part of the study is that almost none of the behavioral objectives were written in a generally acceptable format for writing objectives. Several teachers prefaced their objectives with TSW (The Student Will) at the top of their listing. However, few objectives stated the degree to which the objective would be completed by the student. They were not specific. Examples of objectives follow:

- View cells and describe.
- Describe the behavior of cells in different types of solutions.
- List scientists who contributed to the study of cells.

Many objectives were poorly written in other ways. For example:

- Lab - organelles
- Students will continue and complete chart from the remainder of reports and drawing by other students.
- To do a worksheet exercise and to draw 2 pictures of a cell, plant and animal cell.
- To be evaluated on the knowledge ability of the cell and its functions.

These examples indicate a lack of technical skill in writing objectives.

Additional findings for this research question are:

1) Most objectives are written at the lowest levels of a taxonomy of educational objectives.

2) Teacher expectations of their students appear to be low.

Research Question 3: What instructional strategies were being used to implement the levels of content and type of behavior identified in the objectives?

The literature suggests that strategies and activities should be selected with consideration for the level at which the students are expected to interact with the content and with consideration for the types of skills which are desirable for students to master. This study found that there are inconsistences between the expectations as stated in the teachers' objectives, and the strategies and activities used for implementation. Some of those inconsistencies were pointed out in the discussion of objectives. Although 18 of 20 teachers submitted objectives at the Analysis level, with few exceptions the type of activities and strategies used do not correlate with the objectives.

Clifford Hofwolt (1984) refers to studies by the National Science Foundation (NSF) in the late 1970s describing teaching practices which had not changed since the 1950s. Some of those findings remain evident in teachers' practices as noted in this study. For

example, Hofwolt describes results from the NSF study showing that the predominant method of teaching was recitation (discussion), with the teacher in control, supplementing the lesson with new information (lecturing). The key to new information was the textbook (p.43). Findings in this study show that the predominant strategies used were lecture, discussion, use of audio visuals (including use of the overhead for note taking), use of worksheets, and textbook work. Student laboratory work was also a predominant method, however, the types of laboratory activities used were not consistent with inquiry methods of science education. The level of student interaction in discussions is not known since no classroom observations were made.

Hilda Taba (1962) points out the relationship between content and learning experiences. She suggests that in the actual learning act the two are in constant interaction. Furthermore, she points out that objectives related to thinking, skills, and attitudes must be attained through practice in the desired behavior. Findings of this study imply that the types of activities planned by most teachers would not place a student in a learning situation where practicing thinking would be a primary activity. The plan by one teacher to address thinking was apparent in an objective which stated, "To develop thinking skills by practice". The activity described by the teacher to implement that objective was to have students complete a worksheet on thinking.

Criteria for Evaluating Strategies and Activities

The criteria selected from principles outlined by Brophy and Alleman (1991) were very useful. These criteria provided guidelines for correlating objectives and the strategies and activities which were used. Application of the criterion, Goal Relevance, to objectives and the corresponding strategies and activities made it easier to track correlations between them by identifying specific points to be considered. The criterion, Levels of Increasing Complexity, was particularly useful in tracking the spiraling of content as described by Taba (1962). Application of the criterion, Inductive Inquiry, revealed that the

strategies described by 13 of 20 teachers did not encourage student involvement at the inquiry level which is usually identified as essential to effective science instruction.

The findings show that the planning objectives and the reported strategies described in this study were poorly correlated with one exception. Application of the criterion, Goal Relevance, to individual objectives appears to indicate that a strategy or activity might be a "reasonable" way to implement an objective. As the other criteria were applied, it became clear that many strategies were not closely related to the objective. Furthermore, the strategies and activities most frequently used were not those described in the literature as most effective for teaching science. As noted earlier in this study, some objectives were repeated. In these instances, an objective may be introduced with one type of strategy or activity and then repeated using a strategy involving students in laboratory investigations. In these cases, relevance of the strategy or activity to the goal (objective) was more meaningful.

Other Findings

There were similarities in some objectives submitted by most teachers. For example, the content concerned with "Structure and Function of Cell Organelles" was similar. However, the objectives were stated in slightly varying ways (e.g., "Name the major organelles found in the cell and describe their function"; "Investigate and describe the structure and function of cells"; "Describe the structure and function of cell organelles in plant and animal cells").

While there is no one best way, logic and experience indicate that certain strategies and activities are not appropriate. The strategies used to implement similar objectives varied greatly among teachers. The strategies and activities described to implement the objective, "Name the major organelles found in the cell and describe their function" were: "Lecture/discussion; students will diagram an animal cell and give a concise definition (one or two words) of the function of each organelle; and, show transparencies of electron micrographs of organelles". Strategies and activities described to implement the objective

" Investigate and describe the structure and function of cells" were: "Filmstrip on cell theory; and, Part two of chapter outline". The objective, "Describe the structure and function of cell organelles in plant and animal cells", was implemented through strategies described as follows: "Lecture and demonstration (I draw the cell on the board, describe the structure and function of each organelle. We have a short question and answer session as a conclusion)".

Another example of the variances in the strategies and activities selected by teachers to implement similar objectives is noted in objectives related to photosynthesis. One teacher's objective states, " Conduct a lab in which students determine the rate of photosynthesis in plants". The strategies for implementation were described as follows: "Show film on photosynthesis; discuss photosynthesis (light and dark reactions); view film and answer questions; go over review questions". The same content appeared in another teacher's objective as, " Design a lab (students) and carry out the experiment to test rate of photosynthesis". The strategy described was, " Students work in groups of four to set up and conduct the experiment they designed".

The strategies described by the first teacher are not relevant to the objective. No lab was conducted. In addition, the strategies were passive. Students were not involved in activities generally accepted as effective in developing problem solving skills. The use of experimental design techniques described by the second teacher had greater relevance to effective science instruction and the generally accepted goals of science.

Only one teacher described the use of computer activities by students. In light of the influence that this technology has on society, one could conclude that students should have experiences in the use of computers in the educational setting. A possible explanation of the lack of these student experiences may be related to availability of computers in the classroom as well as limitations in teachers' knowledge of this technology.

Research Questions 4, 5, and 6: To what degree did the indicators of student achievement reflect the low level and high level behaviors described in the objectives as

determined by the use of a table of specifications? Were the indicators of student achievement valid for reflecting the levels of behavior noted in the objectives? To what degree were indicators of student achievement other than classroom tests used; additionally, what types of indicators were used for assessing student laboratory work?

The questions on indicators of student achievement were clustered since there is a close correlation among them. The tests submitted by the teachers included both commercially prepared tests and teacher developed tests. There is much written in the literature concerning the need for methods of assessing students' behaviors at levels appropriate to curricular goals. Taba (1962) suggests that consistency between objectives and evaluation is important. Furthermore, studies of secondary teachers reveal that they place great importance on their assessment of students work and in their own clinical judgments (Bremme, Herman and Doherty, 1983).

Interpretation of the results of this analysis should be made in light of a caution noted by Benjamin Bloom. He states that, " The task of classifying test exercises is somewhat more complicated than that of classifying educational objectives. Before the reader can classify a particular test exercise he must know, or at least make some assumptions about, the learning situations which have preceded the test. He must also attempt to solve the test problem and note the mental processes he utilizes" (Bloom, 1956, p.51). In light of the fact that no classroom observations were made, assumptions made about the learning situations which have preceded the test are limited to those described by the teachers themselves. No assumption can be made about the level of student involvement other than that revealed through the analysis of strategies and activities used.

Based on the literature, one may conclude that the goals of education should encourage higher levels of thinking and action such as problem solving, decision making and evaluation. Therefore, the indicators of student achievement employed by teachers should include instruments or methods of assessing those types of behaviors. The findings of this study reveal that the indicators of student achievement employed by teachers in this

study were not adequate for assessing students at the higher levels of learning. No methods other than paper and pencil tests were identified by any teacher as a method of assessing student achievement, skills or performance. The exception noted was submitted by one teacher in the form of a weighted checklist used to assess a student project. Although constructing and interpreting models is an important skill in science, that skill was noticeably lacking in the objectives and assessments identified by most teachers. Several teachers referred to assigning a "cell model" in their strategies, however, there were no objectives related to the skill (construct and interpret a model), and only one teacher had included a method of assessing the product.

A finding by the National Science Foundation in the late 1970s relative to assessment which was reported by Hofwolt (1984) is supported by the findings of this study. NSF reported that teachers' evaluation of success in science emphasized definitions and knowledge dimensions (p.44). Findings in this study did include test items at other levels, however, the majority of test items were written at the Knowledge and Comprehension levels.

Science goals include the development of certain skills which are considered important to the processes of science and the utilization of the scientific method in investigations. As noted earlier in the review of literature, studies have shown that lab practicals and performance assessments are more effective in assessing students in certain aspects of science. These other methods of assessment were lacking in the review of all indicators of student achievement submitted for this study. Teachers place great importance on their assessment of students' work and in their own clinical judgments (Bremme, Herman, and Doherty, 1983). Therefore, indicators other than paper and pencil tests would seem more useful to teachers in making judgments about students' performance and skill development.

Summary of Conclusions

While this study uses subjects who are science teachers and data collected from science curriculum planning, the major focus is on the instructional planning process which should be used by all teachers. The intent is to focus on the planning process, not the content.

The findings of this study show inconsistencies and lack of congruence in teachers' planning as revealed in the analysis of objectives, strategies, and indicators of student achievement. One must recognize that the possibility exists that the teachers may have done more than they said versus what the evidence indicated in light if the limitations of the study.

It is appropriate to address possible factors which may have contributed to the results revealed in this study. Those factors are noted below:

1) The teachers lacked the technical skills for writing objectives.

2) There appeared to be a lack of knowledge of, or commitment to, the importance of connections between objectives, strategies and activities, and appropriate assessment.

3) There appeared to be a lack of agreement about which strategies and activities are best for effective science teaching.

4) Teachers seemed to lack skill, or did not practice skill, in developing tests.

5) The teachers appeared to lack the knowledge of how to test for the various levels of student behavior.

6) The teachers seemed to lack knowledge of instructional theory, or rejected it.

7) The teachers may have lacked certain resources to allow them to alter their expectations of student behaviors.

9) There appeared to be a lack of understanding of the nature and goals, as stated in the literature, of science education.

Implications for Preservice and Inservice Teacher Training

The following recommendations are made for preservice and inservice training of teachers based on the findings and conclusions of this study.

Teachers should have more experience in writing objectives in order to develop certain technical skills in that area.

Teachers should explore the body of literature which provides a rationale for making connections between objectives, the strategies used for implementation, and assessment.

Teachers should be more conversant with the current research on effective science teaching and the goals of science education as stated in the literature.

Teachers should have more experiences in writing appropriate test items.

Teachers should have experiences in developing and using alternative methods of assessing student achievement and performance.

Implications for Future Research

The following recommendations are made for future research which concern the limitations of this study and some of the questions raised by this study :

1) Repeat the study to analyze teachers objectives, strategies and indicators of achievement using classroom observations to record the formality of teaching and level of student involvement .

2) Study the extent of teachers' knowledge and understanding of the goals of science as noted in the literature on science education, and their knowledge of research on effective teaching.

3) Study and refine the use of the criteria established by Brophy and Alleman. The criteria were useful for judging the effectiveness of strategies described for this study.

4) Study the effects of different strategies on the achievement and performance among students for a given body of content.

Freema Elbaz (1983) describes a view of teachers' knowledge in her book, *Teacher Thinking: A Study of Practical Knowledge.* She uses the term practical knowledge because it "....focuses attention on the action and decision - oriented nature of a teacher's situation, and construes her knowledge as a function, in part, of her response to that situation" (p. 5). Furthermore, she suggests that teachers' wide ranging knowledge grows as experience increases. In light of her suggestion, one would expect to find that experienced teachers exhibit skill in applying what the body of research on effective teaching suggests. The participants in this study were experienced teachers: the average number of years of teaching was 14.6; the average number of years in teaching biology was 12.07. Experience did not seem to equate to greater knowledge in the areas analyzed in this study.

Findings by Haigh (1981) suggest that planning for instruction provides security for teachers in an environment which is frequently changed by circumstances within the classroom. Shavelson and Stern (1981) suggest that teachers' chief concerns lie with maintaining the flow of a lesson in a complex and changing environment. Furthermore, they suggest that much of a teacher's planning is focused on creating tasks and maintaining smooth implementation of those tasks. A study by Newman and Stallings (1982) reveals that teachers have only a moderate understanding of classroom testing principles. Furthermore, the literature review for this study reveals certain relationships which should exist among objectives, strategies and activities, and assessment.

The conclusions of this study and a review of the related literature indicate that teacher preservice and inservice training programs should emphasize the relationships which should exist among the objectives, strategies and activities selected for implementation, and the indicators of student achievement; and concurrently emphasize the diversity necessary to implement effective plans in the complex environment of a classroom.

APPENDICES

CONSENT FORM

Name of Researcher: Barbara S. Davis

Study Title: A Study of Teachers' Instructional Planning as Revealed by an Analysis of Objectives, Strategies and Indicators of Student Achievement

Study Participants' Role: You are asked to prepare the following items:

* Refine your lesson plans to reflect the daily objectives for the unit in general Biology on "Cells"
* Identify the strategy/activity used to implement each objective.
* Include copies of any indicator of student achievement (e.g., classroom tests, performance assessments) used to assess students' achievement during the instruction of the unit.

There are no risks involved in your participation. If you wish, you may use a code assigned to you by the contact person appointed by your superintendent to complete this form. Only the contact person will have your code identification. The purpose of this code is to insure your confidentiality. You may sign the form if you prefer. No disclosure of the participating teachers or the school systems will be made in the study. You may terminate participation at any time. Information concerning the study outcomes will be provided to the participating school system through official channels, if requested.

If you have any questions, please do not hesitate to call me directly or have the assigned liasion contact me at (804) 497-8358.

I voluntarily agree to participate in this study.

Name/ Code Date

Teacher Information Sheet

Please complete the following information and return it with your consent form. This information will let me know when to expect to receive your plans. Thank you for your assistance.

Approximate date I expect to complete the unit on cells:

_____ Late October ____ Early November ____ Late November

_____ December ____ Other (Please specify)

Title of the biology textbook you are using: _____

Number of years teaching: _____

Number of years teaching Biology: _____

INSTRUCTIONS FOR PARTICIPANTS

I want to thank you for participating in this study. With your help we hope to gain additional information about the complex processes by which teachers make decisions about their teaching.

The information needed for this study is focused on the objectives, strategies/activities and assessment instruments used for teaching the cells unit in general biology. This unit was selected because it is normally taught as part of a general level I biology course and as such should not require additional preparation by the participants. The information I am requesting from each participant is summarized below:

- Daily lesson plans for the cells unit reflecting the objectives for each day.
- Identify the strategy or activity used each day to implement the objectives. This can be written on the plan (e.g., laboratory activity, discussion, lecture, cooperative group activity).
- Copies of the indicators of student achievement used to assess the objectives (e.g., teacher-made tests, commercially prepared tests, performance assessments).

Since confidentiality of the participants and their school system is assured, your name should be removed from all papers. I will provide paper for copying all of the items requested and provide a self-addressed envelope for mailing them to me. I will pay all postage required. A copy of the findings of the study will be available to the school system upon the written request of the superintendent or his designee.

I have enclosed consent forms for each person to complete indicating willingness to assist me in this study. Please complete a form and return it directly to me in the pre-addressed envelope. You may sign the form or ask the contact person to provide a code for you.

On receipt of the consent form I will provide paper for copying and a pre-addressed, stamped envelope for you to return all materials. These materials will be sent to you via the contact person or directly to you if you so request.

If you have any additional questions, I can be reached at (804) 497-8358. I will be happy to meet with you if you prefer.

Barbara S. Davis
604 Sarah Court
Virginia Beach, Virginia 23464

Note: I would like to have the units before the Christmas holiday or as soon thereafter as possible.

Research Participants Checklist

Paper has been provided to you your contact person for copying all items requested. In addition, a mailer has been provided for use in returning the requested materials. Please try to return your information as soon as the cells unit is completed. I would like to have the units before the Christmas holiday or as soon thereafter as possible. The checklist below is to assist you in completing your materials.

I want to thank you again for your assistance. You are providing valuable information on the complex processes through which teachers make decisions about their teaching.

Checklist

_____Remove your name from all materials

Please include the following:

_____Daily lesson plans for the cells unit reflecting the objectives for each day.

_____Identify the strategy or activity used each day to implement the objectives. This can be written on the plan (e.g., laboratory activity, discussion, lecture, cooperative group activity).

_____Copies of the indicators of student achievement used to assess the objectives (e.g., teacher - made tests, commercially prepared tests, performance assessments).

_____Return all materials in the pre-addressed envelope using the postage included. Any additional postage needed will be reimbursed to you. (This step may be handled by the contact person if one has been designated in your school system.)

CRITERIA USED TO ANALYZE OBJECTIVES

The following criteria were adapted from the *Taxonomy of Educational Objectives: The Classification of Educational Goals,* Benjamin Bloom, editor.

Knowledge

Remembering by recognition or recall of ideas, material or phenomena.

Remembering is the major psychological process (p.62).

Comprehension

Know what is being communicated and be able to make use of the material or ideas contained in it. Those objectives, behaviors or responses which represent an understanding of the literal message. In reaching such understanding, the student may change the communication in his mind or in his overt responses to some parallel form more meaningful to him (p. 89).

Application

Given a problem new to the student, he will apply the appropriate abstraction without being prompted as to which abstraction is correct without having to be shown how to use it in that situation (p. 120).

Analysis

Analysis emphasizes the breakdown of the material into its constituient parts and detection of the relationships of the parts and of the way they are organized (p. 144).

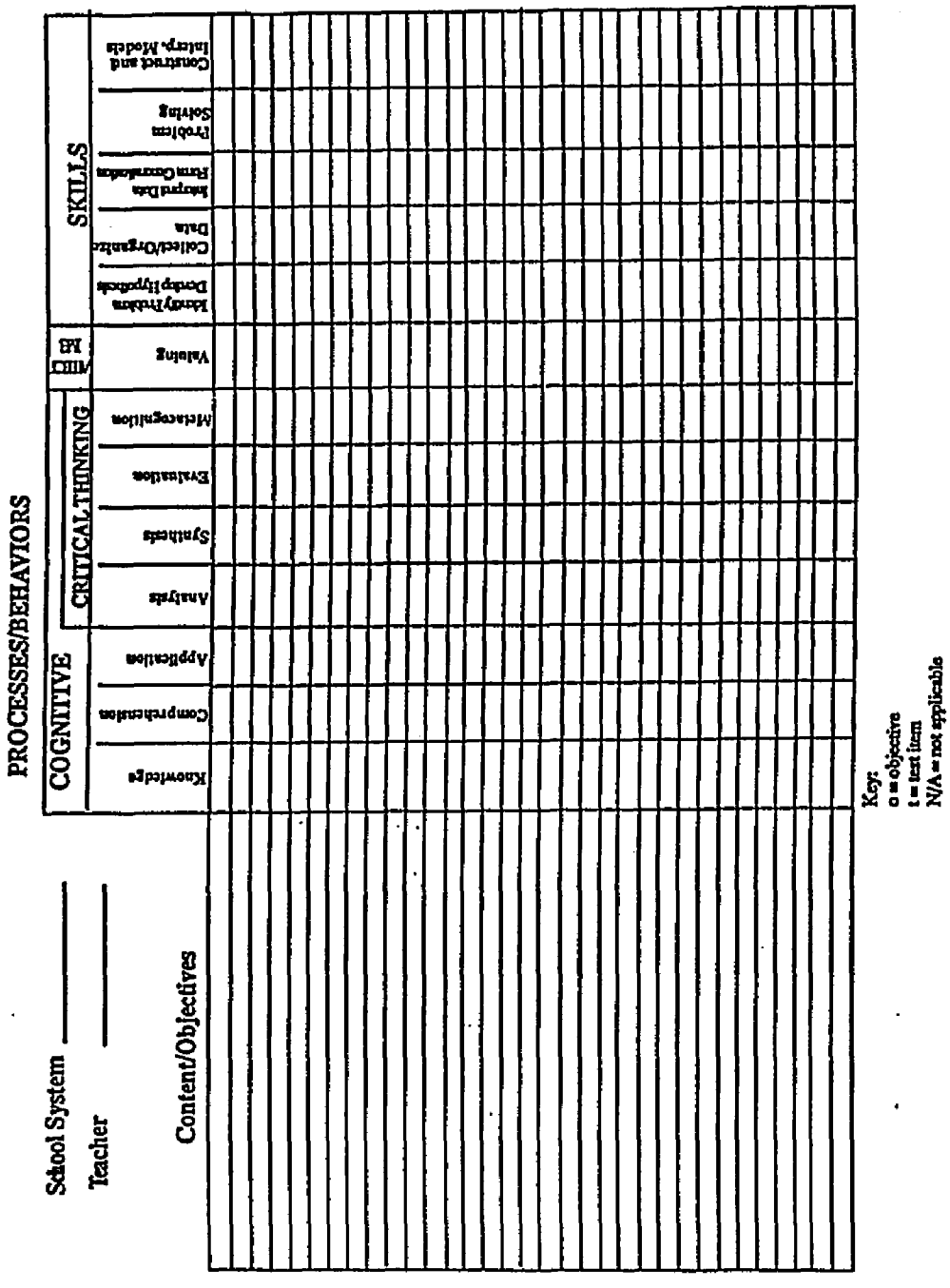
Synthesis

A process of working with elements, parts, etc., and combining them in such a way as to constitute a pattern or structure not clear before. Generally this would involve a recombination of parts of previous experience with new material, reconstructed into a new and more or less well-integrated whole (p. 162).

Evaluation

Evaluation is defined as the making of judgments about the value, for some purpose, of ideas, works, solutions, methods, material, etc. It involves the use of criteria as well as standards for appraising the extent to which particulars are accurate, effective, economical or satisfying. The judgments may be either quantative, or qualitative, and the criteria may be either those determined by the student or those given to him (p. 185).

TABLE OF SPECIFICATIONS USED TO ANALYZE
OBJECTIVES AND TEST ITEMS



CRITERIA USED TO ANALYZE STRATEGIES/ACTIVITIES

The following criteria were adapted from "Activities as Instructional Tools: A Framework for Analysis and Evaluation" by Jere Brophy and Janet Alleman.

A. Primary Principles

A1. Goal Relevance. Activities must be useful means of accomplishing worthwhile curricular goals. Each activity's primary goal must be an important one, worth stressing and spending time on and there must be at least logical reasons for believing that the activity will be effective as a means of accomplishing that goal.

B. Secondary Principles

B. Multiple Goals

B1a. An activity that simultaneously accomplishes many goals is preferable to one that accomplishes fewer goals (so long as it is effective in accomplishing the primary goals). This principle is probably the most useful one for distinguishing the best activities from other activities that also meet minimally necessary conditions. The best activities are effectively engaging, as well as cognitively instructive; provide students with opportunities to use critical and creative thinking, inquiry, problem-solving, values analysis, and decision-making skills in the process of applying knowledge; and call for natural and realistic applications rather than just for isolated practice or artificial forms of application that do not connect to students' lives outside of school.

C. Principles That Apply to Sets of Activities

C3. Progressive Levels of Difficulty or Complexity. Activities should progressively increase in levels of challenge as student expertise develops.

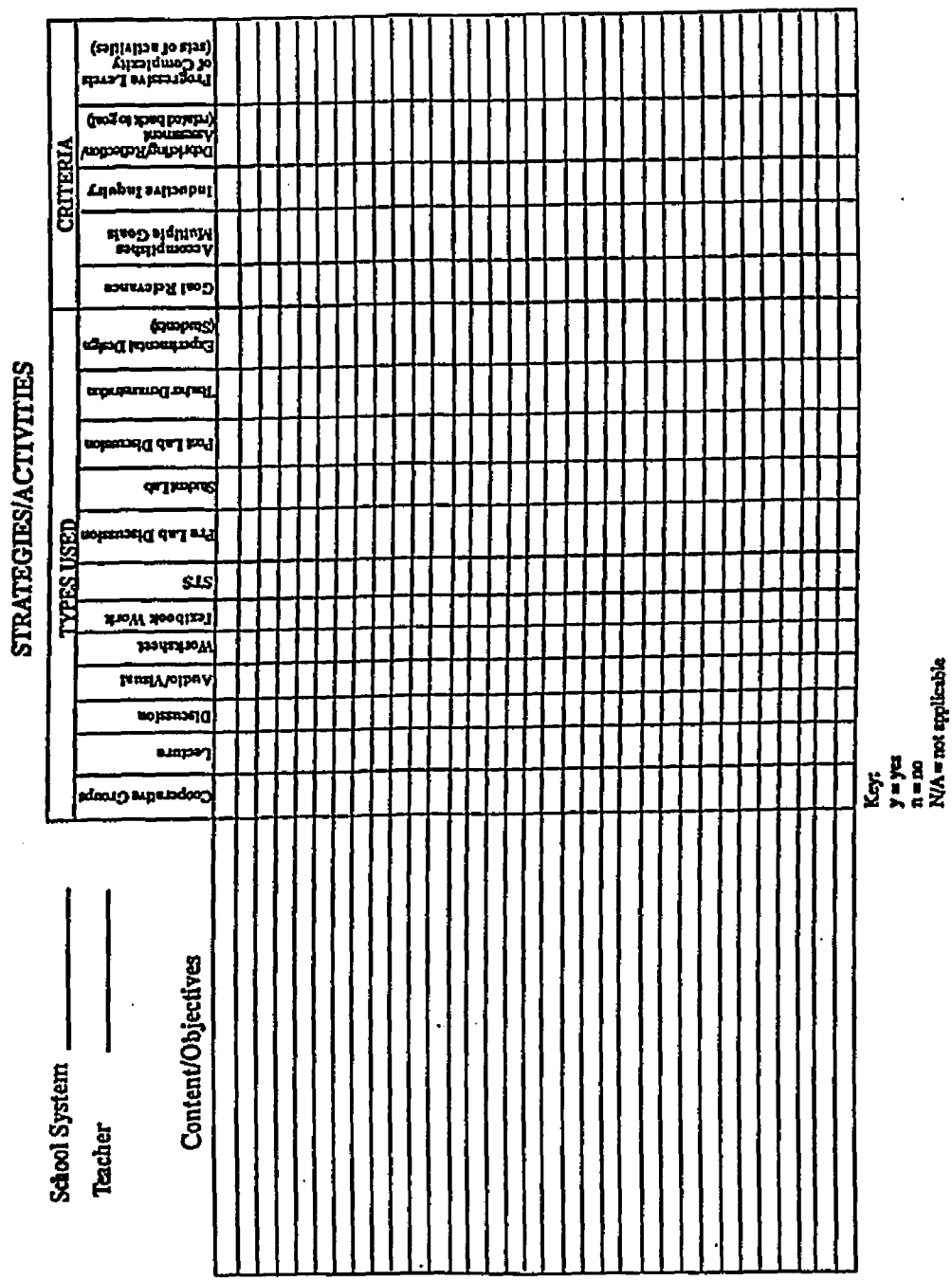
D. Optional Principles (alternate criteria).

D1. Inductive Inquiry. All activities should engage students in inquiry that will enable them to induce concepts, generalizations, or principles.

E. Implementation Principles

E5. Debriefing/Reflection/Assessment. Activities should be brought to closure in ways that link them back to their intended goals and purposes. For students, this means opportunities to assess performance and to correct and learn from mistakes. Ordinarily, there also should be teacher-led post activity debriefing or reflection that reemphasizes the purposes and goals of the activity, reflects on how (and how well) these have been accomplished, and reminds the students of where the activity fits within the big picture undefined by the larger unit or curriculum strand. For teachers, post activity assessment and reflection includes evaluation effectiveness of the activity for enabling students to accomplish the goals.

TABLE OF SPECIFICATIONS USED TO ANALYZE STRATEGIES/ACTIVITIES



CRITERIA USED TO EVALUATE TEST ITEMS

The following criteria were adapted from the *Taxonomy of Educational Objectives: The Classification of Educational Goals,* Benjamin Bloom, editor.

Knowledge

The major behavior tested in knowledge is whether or not student can remember and either cite or recognize accurate statements in response to particular questions. The form of the question and level of precision and exactness required should not be too different from the way in which the knowledge was originally learned. The choices in the recognition form of the question must be at the level of discrimination originally intended by the learning rather than at an entirely different level (p. 78).

Comprehension

The answer to be selected (i.e., list of terms and definitions) differs in phraseology from formal one he (student) learned.

Selection of "best" definition where the student must judge the adequacy of the various definitions given.

If evaluation is to be of a behavior transcending knowledge, the context in which the terms or symbols appear must be to some extend novel context. The nature of previous instruction is the deciding factor. (p. 97).

Additional complexity at the translation level occurs where more than one new term or symbol occurs and the student, while successfully translating the terms or symbols, will need to consider their interrelationships.

Problem: "Evaluation of objectives at higher levels of taxonomy may be impaired because of students inability to perform initial step in problem solution: translation of problem into known terms. if understanding of terms is not universal (e.g., Doppler

effect, Avogadro's principle) the concept represented must be given in simpler, less abstract phraseology" (p. 98).

These problems may be overcome through the use of appropriately worded essay exercises requiring student to record steps in his thinking.

Application

Problems should have some relation to the situations in which he (student) may ultimately be expected to apply the abstraction in a practical way. Best effort to create asituation is to create problem known to the student but with a new slant to avoid the possibility that some students may have had read ahead to material which others may not yet have read.

Actual recording of the student's problem-solving processes are preferable to inferences from the product as the best testing procedure.

To test, each situation in a problem should be so phrased that it can be reached only by one set of problem-solving steps.

Students ability is a function of particular situation so the sample should be over several problem situations.

Analysis

It is best to use new material since there will be no opportunity to use analytical comments recalled from previous discussion.

Material for analysis may be a literary passage, description of scientific experiment, set of data, picture, etc., or an actual laboratory situation in which he (student) analyzes the reaction of materials.

Responses may be free or guided responses or by selecting the best answers to objective questions. Objective questions can be structured to include common errors students may make.

Synthesis

Limitations: Providing situation favorable to creative work.

May take more than hour or two.

Sampling: Due to time needed a single product may have to represent the student's ability.

Evaluation: There is a lack of objective criteria for evaluating at this level.

In the absence of standards such as external framework, theory, etc., opinions of external judges may be needed.

Some published tests attempt to do this through multiple choice items (e.g., Rearrange a group of sentences to form a coherent paragraph or paragraphs to form an essay).

Evaluation

Problem: Since individuals in a democracy are urged to consider alternatives and make individual decisions, evaluation objectives in schools focus on internal standards such as consistency, logical accuracy and absence of internal flows rather than accuracy (p. 188).

The most frequently used methods of testing are essay or recall which do not focus on behaviors desired (p. 195).

TABLE USED TO LIST TYPES OF
ASSESSMENT USED

School System ____________

Teacher ____________

	Assessment Indicators of Student Achievement
Content/Objectives	Techniques Used

Source: Wolf (1991)

Michigan State University

Center for the Learning and Teaching of Elementary Subjects
College of Education, Erickson Hall
East Lansing, Michigan 48824-1034

Institute for Research on Teaching
(517) 353-6415

December 3, 1991

Barbara S. Davis
604 Sarah Court
Virginia Beach, VA 23464

Dear Ms. Davis:

I am writing to confirm our telephone conversation and formally express my permission for you to use criteria drawn from the article "Activities as instructional tools: A framework for analysis and evaluation" (co-authored by myself and Janet Alleman) in your dissertation research. Feel free to use the ideas and categories in that article, either as is or in ways that you might desire to adapt them for your own purposes. Having done a great deal of research myself, I am well aware that research instruments are tools, not ends in themselves. Therefore, if your research purposes will be better suited by using some adaptation of the material in the article, by all means go ahead and adapt it.

Professor Alleman and I have continued analyzing curriculum materials and writing about activities, so we would be interested in seeing your findings once your study is completed. Please send us a report at that time. Good luck with your dissertation.

Sincerely,

Jere Brophy
University Distinguished
Professor of Teacher Education
and Co-director, Institute for
Research on Teaching

JB:js

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ABSTRACT

A STUDY OF TEACHERS' INSTRUCTIONAL PLANNING AS REVEALED BY AN ANALYSIS OF OBJECTIVES, STRATEGIES AND INDICATORS OF STUDENT ACHIEVEMENT

Barbara Sewell Davis, Ed.D.

The College of William and Mary in Virginia, 1992

Chairman: Dr. Robert J. Hanny

The purpose of this study was to investigate teachers' planning through an analysis of objectives, strategies, and indicators of student achievement to answer six research questions. The questions were related to the following topics: congruence of content in objectives and congruence of the types of assessment among teachers in school systems using the same textbook; levels of student behavior indicated in the teachers' objectives; the types of strategies and activities used to implement the objectives; the types of indicators of student achievement selected by teachers; and, the levels at which test items were written as related to the levels of behavior noted in the objectives.

The study included volunteers from five school systems which were representative of the Commonwealth of Virginia. All volunteers were teachers of general biology who were using the same textbook within their school system.

Conclusions were: There was lack of content congruence among teachers using the same textbook; teachers objectives are written at the lowest levels as described by a taxonomy of behavioral objectives; the strategies most frequently used by teachers are not those which involve students in practices which encourage thinking; teachers lack skill in writing test items. Furthermore teachers may not use forms of assessment other than paper and pencil tests.

This study has implications for preservice and inservice training of teachers in areas related to writing objectives, selecting strategies, and assessing students .