THE DEVELOPMENT OF BEHAVIORAL OBJECTIVES FOR THE SECOND YEAR CHEMISTRY COURSE IN KUWAIT SECONDARY SCHOOLS

DISSERTATION

Presented to the Graduate Council of the
North Texas State University in Partial
Fulfillment of the Requirements

For the Degree of

DOCTOR OF PHILOSOPHY

By

Saleh A. Jasim, B. S., M. A.

Denton, Texas

May, 1979

Jasim, Saleh A., The Development of Behavioral Objectives for the Second Year Chemistry Course in Kuwait Secondary Schools. Doctor of Philosophy (Secondary Education), May 1979, 113 pages, two tables, one map, bibliography, eighty-five titles.

The purpose of this study is to develop a set of behavioral objectives for the Second Year Chemistry Course in Kuwait Secondary Schools. This set of behavioral objectives will help school teachers to choose their activities, teaching methods, questions, and evaluation procedures; it will be useful in the preparation and use of behavioral objectives in their other courses.

The Kuwaiti second year chemistry text was compared with the Chemical Education Material Study (CHEMS), a modern approach, and with an American traditional chemistry course in order to determine the similarities and differences between the Kuwaiti courses and the two American courses in the areas of content, laboratory work, and organization.

From the comparison, the Kuwaiti course appears closer to the Chemical Education Material Study by organization of subject matter in big units rather than by separate subjects as in the traditional course. The Kuwaiti course also appears more like the Chemical Education Material

Study in the manner of dealing with the subject matter. Both deal with atomic theory, for example, as something which may change or be modified in the future.

On the other hand, the Kuwaiti chemistry course appears closer to the traditional chemistry course in the area of questions that are listed at the end of each chapter; both list some easy and direct questions. Further, the Kuwaiti course appears more traditional in the area of laboratory work; both place little emphasis on discovery and observation.

In order to develop a set of behavioral objectives for the Kuwaiti second year chemistry course, a set of criteria for useful and valid behavioral objectives has been developed. Applying these criteria, a set of behavioral objectives is stated for each major division of the official text, Chemistry for the Second Year in Secondary School, which is used in Kuwaiti secondary schools. Each major division is provided with general objective(s), affective objectives, cognitive objectives, and a list of activities.

As a conclusion, the Chemical Education Material Study (CHEMS) appears more beneficial than the traditional chemistry course by its effect on student achievement and the stimulation of the cognitive abilities such as application and analysis processes. The present Kuwaiti chemistry course appears more organized than previous courses and the movement is toward the modern approach.

Use of behavioral objectives appears more effective than the use of general objectives (or no objectives) in the area of students' achievements and attitudes, in the area of course content, and organization of complex cognitive processes. Recommendations for improvement of the Kuwaiti chemistry course and for further studies on behavioral objectives are listed.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ILLUSTRATIONS

CHAPTER I

INTRODUCTION

Teaching in public schools in this complicated and changing world should be more than the giving of knowlege and facts to students. Teaching should be more than covering the subject matter without discovering if the students actually learn. One should care about what students learn, why they should learn, how they should learn, and if they will learn (3). Behavioral objectives may play a big role in achieving this kind of effectiveness.

Behavioral objectives are often viewed as an attempt to improve both the quality and effectiveness of teaching. It is argued that, by setting out what the student is expected to achieve, results can be brought more into line with expectations (8). Behavioral objectives may serve to make clear to teachers, students, and other interested persons what it is that is to be taught or what it is that has been taught (4). Behavioral objectives are useful in helping the students to know what they should achieve in their classes (17).

The teacher makes judgments about how to present subject materials to students. This requires that the teacher have some idea as to what are the specific educational goals. In making judgments, the teacher must not only decide what subject matter is to be taught but should define the desired outcome of the educational process (3). Measurable goals permit defensible quality judgments of achievement success; non-measurable goals do not (15). Behavioral objectives may also help the teacher to justify the course content and could allow him to cut out much irrelevance from a course (14, 17).

Behavioral objectives may help in motivation by stimulating students to do their best. Behavioral objectives help in instructional design; if one wants to know the best instructional strategy, one needs to know what the objectives are and when the desired behavior has been attained. They provide a systematic basis for devising ways of evaluating student performance and program (6, 10, 17). Hyman has said that "precise, specific behavioral objectives are the guides by which teachers select subject matter to teach, materials t use, method to employ, and test by which to measure achievement. In addition they serve as criteria for evaluating the accomplishments of teaching" (9). Taba gives specific objectives necessary in order for the objectives to serve as a platform for both curriculum development and evaluation (16). As a conclusion, Mager stated,

> Objectives are important for a number of reasons. Here are three of the main ones:

(1) When clearly defined objectives are lacking, there is no sound basis for the selection or designing of instructional materials, content, or methods. If you know where you're going, it is difficult to select a suitable means for getting there.

(2) To finding out whether the objectives have, in fact, been accomplished. Tests or examinations are the mileposts along the road of learning and are supposed to tell instructors and students, alike, whether they have been successful in achieving the course objectives. But, unless objectives are clearly and firmly fixed in the minds of both parties, tets are at best misleading; at worst, they are irrelevant, unfair, or uninformative.

(3) They provide students with the means to organize their own efforts toward accomplishment of those objectives. Experience has shown that, with clear objectives in view, students at all levels are better able to decide what activities on their part will help them get to where it is important for them to go. With clear objectives in view, it is no longer necessary to "psych out" the instructor (13).

Purpose of the Study

The purpose of this study is to develop a set of behavioral objectives in order to help the individual teacher of second-year chemistry in Kuwait Secondary Schools by

1. choosing teacher activities;
2. choosing teaching methods;
3. choosing questions;
4. choosing evaluation procedures;
5. understanding behavioral objectives, to the extent that objectives can be developed for other subjects.

Background and Significance of the Study

The State of Kuwait occupies the northwestern corner of the Arabian Gulf (Persian Gulf). It is bounded on the east by the Arabian Gulf, on the southwest by the Kingdom of Saudi Arabia, and on the north and the west by the Republic of Iraq (see map). The total area of Kuwait is approximately 17,000 square kilometers (7,000 square miles).

Since its inception, Kuwait has always been an autonomous state--always ruled by its people, not withstanding the protection treaty with Great Britain which was in effect from 1898 until its abrogation in June, 1961.

The population of Kuwait in 1975 was about 995,000. The Kuwaiti population was about 472,000 (47.5 per cent), and the non-Kuwaiti population was about 522,800 (52.5 per cent).

Kuwait has achieved remarkable progress in education. This progress is pointed up by the very rapid growth in the number of students, teachers, and schools in the last three decades. Kuwait's first regular school was opened in 1912. For over twenty-five years it remained the only educational facility. In 1936, Kuwait established the Board of Education and imposed educational taxes to provide needed funds to expand the existing meager facilities. Today the government's program provides free education from kindergarten through the university. In Kuwait, youngsters

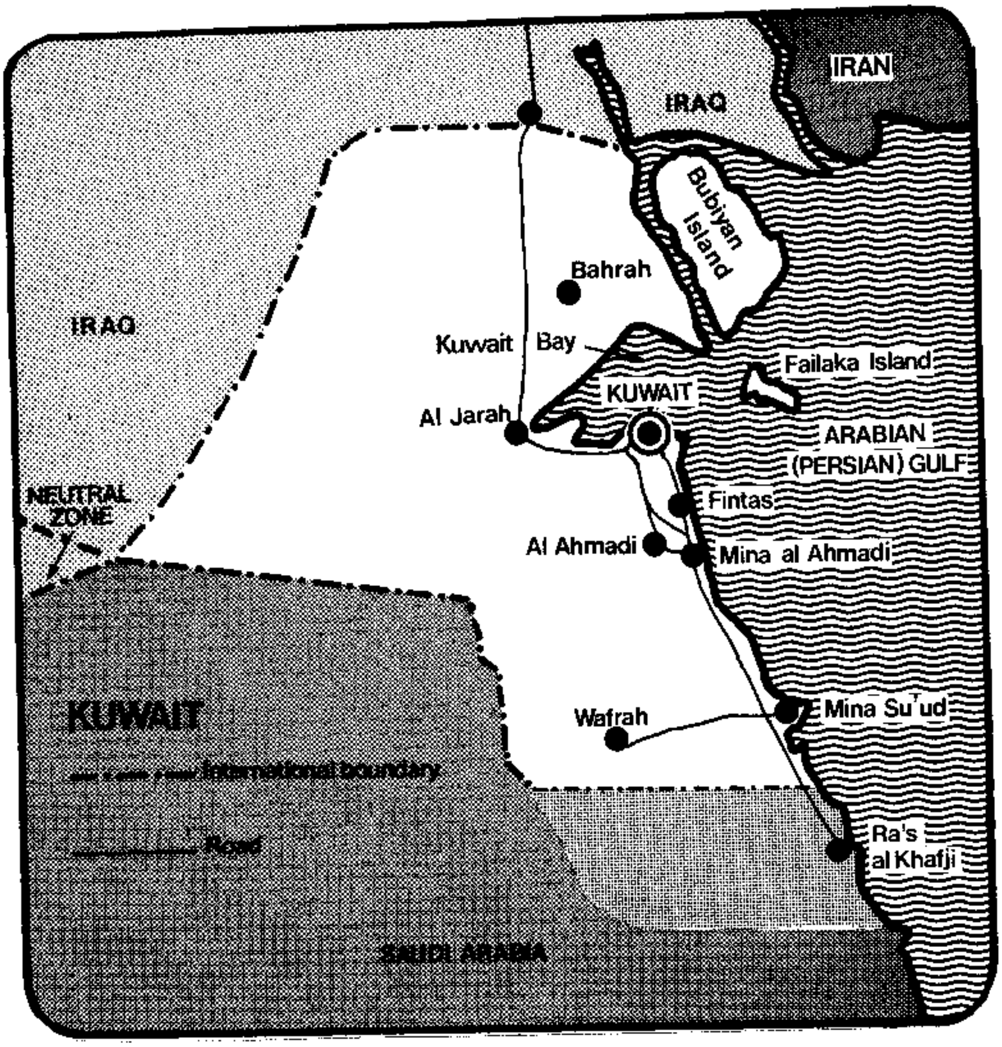

Fig. 1--Map of the State of Kuwait

are first given ten years of general education and, in the eleventh year, are allowed to specialize in science or the arts. In a final examination, those officially meeting Ministry of Education requirements are sponsored for university places. Students with high aptitudes are awarded scholarships to study abroad. Having top budget priority, education expenditures increased from ten million K.D. in 1963 to 106 million K.D. (about 380 million U.S. dollars) in 1976/77.

The number of students in public schools increased from 4,665 in 1948/49 to 229,127 in 1976/77. The number of teachers increased from 198 to 17,024 during the same period.

TABLE I

NUMBER OF GOVERNMENT SCHOOLS, STUDENTS, AND TEACHERS

School Level	1970/71	1975/76	1976/77
Kindergarten			
Schools	44	51	56
Students	12,830	14,457	14,860
Teachers	789	1,003	1,137
Primary			
Schools	83	116	137
Students	57,414	92,240	104,285
Teachers	2,813	5,444	6,369
Intermediate			
Schools	64	99	112
Students	47,065	59,767	74,356
Teachers	2,993	4,704	5,657
Secondary			
Schools	19	38	50
Students	15,997	29,962	35,626
Teachers	1,521	3,268	3,861

The number of students at Kuwait University reached 5,832 during the academic year 1975/76 compared to 418 in 1966. The Kuwaiti nationals counted 2,801 (48 per cent) of the total university studentship.

There are institutes for the education of adults, illiterates, the physically handicapped, the blind, and the mentally retarded. The goal is truly universal education in Kuwait (2, 5, 11, 12, 18).

Kuwait, as a developing country, is seeking to improve its economic situation and to find other resources besides oil production.

> One of the specific national guidelines influencing the state's economy planners when they determine various priorities and projects and shape Kuwait's economic thrust is to gain a greater degree of diversification in the sources of the national income of Kuwait, increasing the relative contribution of the non-oil sectors of the economy (18).

As Kuwait seeks to find other resources, it will require more and more specialists from its own people to work toward the national goal of industrialization. One of the goals that shapes Kuwait's economic thrust is that "Kuwaiti citizens must be educated in order to create specialized human skills in science and technology that will be able to round out the developmental boundaries of the Kuwaiti economy" (18). This is especially important since it cannot depend forever mostly on foreign people to supply labor in industrial and technical areas.

Kuwaiti people who work in the industrial and technical areas represent only 17 per cent of the total working in these areas (11). Only 37 per cent of the total Kuwaiti students are in the third and fourth year science curriculum of the secondary school. In addition, the number of Kuwaiti students in the College of Science and College of Petrol and Engineering represented only 21 per cent of the total Kuwaiti students in Kuwaiti University during 1975/76 (2).

From the above one can see that most of the Kuwaiti students usually choose the art curricula. This situation has created and will continue to create many problems because in time there will be a very big shortage of applicants for the occupations which require a science background. According to the 1975 population census, Kuwait needs about 26,830 technicians to work in the different technical jobs (1).

The educational literature in the United States shows that behavioral objectives, when used in teaching, helped to increase students' achievement and to improve attitudes not only in the science field but also in other fields of study. Many guides based on behavioral objectives have been developed to help teachers in their work.

Because of the significance of the role of behavioral objectives in teaching, because of the possiblity of improving science teaching in Kuwait public schools, and because this procedure is not used in Kuwaiti schools, this study has developed behavioral objectives for the second-year chemistry book at the secondary school level for the purpose of aiding teachers with the improvement of their students' achievements and attitudes toward the science program.

Definition of Terms

1. Behavioral objectives--a statement that would specify under what conditions and to what extent a certain kind of student performance can be anticipated. An objective is the intended result of instruction, rather than the process of instruction itself (4, 13).

2. Second year chemistry course--a course of study equivalent to the second year (advanced) chemistry course as taught in the United States secondary schools.

3. Chemistry book--the Ministry of Education text for all the students of the second year in Kuwait secondary school. Title: Second Year Chemistry in Secondary School. Authors: Dr. Ezzat Kayrey and others, published by Ministry of Education, Kuwait, second edition, 1977/78.

4. CHEM Study Chemistry--A Chemistry curriculum project prepared by the Chemical Education Materials Study under a grant from the National Science Foundation. The main emphasis is placed upon the student learning by

observation and experimentation thereby discovering principles and theories for himself (7).

5. Traditional chemistry--a secondary school chemistry course utilizing materials other than either the CHEM study materials or the Chemical Bond Approach (CBA) Materials. Typically, the traditional course is less laboratory centered; emphasis is placed upon historical and technological factors as opposed to observation and discovery (8).

Procedure for the Study

In this study the available literature on CHEM Study and traditional chemistry was surveyed. Using this as a basis, a comparison was made of the second-year chemistry course in Kuwait secondary schools with a traditional American chemistry course, and with the Chemical Education Materials Study (CHEM Study). This comparison was accomplished in order to determine how the Kuwaiti course compareds with the two American courses in the areas of content, laboratory work, and organization.

The available literature on behavioral objectives was surveyed, and a set of criteria for valid behavioral objectives was developed based on Mager's _Preparing Instructional Objectives_ (13) and Troyer's _Formulating Performance Objectives_ (17). Using these criteria, behavioral objectives were stated for each major division of the official text

Chemistry for the Second Year in Secondary School (that is used in Kuwaiti secondary schools) and samples of illustrative activities were provided.

In light of the comparison between the American and the Kuwaiti courses, and in light of the discusison on behavioral objectives, certain conclusions and recommendations are listed.

CHAPTER BIBLIOGRAPHY

1. Al Anba, Kuwait, May 14, 1978 (Arabic).

2. Annual Statistical Abstract, State of Kuwait, Ministry of Planning, Central Statistical Office, 1976.

3. Benis, Katherine A. and Glen B. Schroeder, "The Writing and the Use of Behavioral Objectives," Southwestern Cooperative Educational Lab, Albuquerque, New Mexico, ERIC ED 033 881, 1969.

4. Esbensen, Thorwald, "Writing Instructional Objectives," Phi Delta Kappan, XLVIII (January, 1967), 246-247.

5. "Focus on Kuwait," London, The London International Press Center, May, 1975.

6. Freeman, Donald F. and William A. Mehrens, "The Functional Limits of Behavioral Objectives," ERIC ED 103 345, 1973.

7. Hardy, Clifford A., "An Analysis of Achievement and Level of Critical Thinking in CHEM Study and Traditional Chemistry," unpublished doctoral dissertation, Texas Technological College, 1969.

8. Hartky, James and Ivor K. Davies, "Pre-Instructional Strategies: The Role of Pre-Test, Behavioral Objectives, Overviews, and Advance Organizers," Review of Educational Research, LXVI (Spring, 1976), 239-265.

9. Hyman, Ronald T., Ways of Teaching, New York, J. B. Lippincott Company, 1974.

10. Koran, John J. and others, "How to Use Behavioral Objectives in Science Instruction, National Science Teacher Association, Washington, D. C., ERIC ED 036 428, 1969.

11. "Kuwait Review," State of Kuwait, Ministry of Planning, Central Statistical Office, 1978.

12. "Kuwait Shares its Wealth," State of Kuwait, Ministry of Information.

13. Mager, Robert F., Preparing Instructional Objectives, Belmont, California, Fearon Publishers, 1975.

14. Popham, W. James, "Practical Ways of Improving Curriculum via Measurable Objectives," in Teaching Today, edited by J. Michael Patardy, New York, Macmillan Publishing Co., 1975, pp. 100-110.

15. ________________, "Must all Objectives Be Behavioral?" Educational Leadership, XXIX (April, 1972), 605-608.

16. Taba, Hilda, Curriculum Development: Theory and Practice, New York, Harcourt, Brace, and World, 1962.

17. Troyer, Donald Lee, "Formulating Performance Objectives," in Developing Teacher Competencies, edited by James E. Weigand, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1971, pp. 43-80.

18. "A View of Kuwait," The Embassy of the State of Kuwait, Washington, D. C., 1976.

CHAPTER II

REVIEW OF RELATED LITERATURE

In this chapter the available literature on behavioral objectives, CHEM Study, and a traditional American chemistry course are reviewed and comparisons made between the second-year Kuwaiti chemistry text, CHEM Study, and a traditional American text. Dissertation Abstracts International, the Education Index, and the Educational Resource Information (ERIC) were the main sources for the materials included in this chapter.

Studies on Behavioral Objectives

Behavioral objectives are applied in different courses of study and their use is supported by many research studies. In his study, Bryant (9) determined the effect of performance objectives on the achievement level of low-achieving science pupils in four predominantly black inner-city schools. Six teachers and 210 pupils were subjects for the study, and three of the teachers were trained to develop and use performance objectives as an instructional technique. Pedagogical techniques ordinarily used by the other teachers were not altered. A criterion test was developed both by trained and untrained teachers and administered to the pupils at the end of the study. The independent variables were treatment, sex of pupils, trained or untrained teachers, and individual teachers. Bryant found that the use of performance objectives appeared to facilitate the presentation of course content.

Martin (38) tried to relate attitude, critical operation, terminal achievement, and residual performance to the use of behavioral objectives in teaching a Basic Science I class. The vocational students who were the subjects of this study exhibited similar characteristics; all the students had IQ's ranging from below 70 to 105 and reading levels from the second to the ninth grades. Treatment for the experimental group differed only in that each student was given a copy of the behavioral objectives to be used during the lecture that initiated each daily module. A student was to consider was to consider his efforts successful in completing the module when he was capable of doing all the tasks specified by the objectives. Following the completion of eight modules, a two-day test was given that required manipulative demonstrations of the skills taught. Analysis of variance was used to search for significant differences between treatments and among ability groups. Prior knowledge of behavioral objectives produced significantly better performance by all in terminal achievement and attitude toward instruction. Significant F-ratios showed positive attitude gains for the experimental population.

In Anderson and other's (1) study, an investigation was made of the effect of systematically combined high- and low-level cognitive objectives upon the acquisition of science learning. An instructional unit based on a Biological Sciences Curriculum Study (BSCS) Inquiry Slide Set (structure and function, control of blood sugar, a homeostatic mechanism) was chosen because it stimulates learning on several levels. Forty students enrolled in an elementary science methods course were pretested by using the Process of Science Test (POST); based on their POST scores, the students were randomly assigned to two treatment groups in a 2 x 2 design. Prior to the experiment, subjects read a passage which contained either behavioral objectives or a placebo (a discussion on a recently developed science curriculum). Those students receiving the placebo had no special learning guidelines and relied entirely on the Inquiry Slide Set experience which was presented by an experienced biology teacher who also led the discussion following suggested guidelines provided by the BSCS Inquiry Slide Kit. The findings appear to support the assumption that behavioral objectives enable students to retain essential points and to organize complex cognitive processes needed for successful inquiry-oriented learning experiences.

In a basic speech communication course, Booth (7) investigated the effect that the communication of behavioral objectives has on student achievement and attitudes. The objectives provided for one group were written in behavioral terms; the objectives for the second group were written in non-behavioral terms. A research-design test was administered to both groups to assess student achievement of the objectives. The Purdue Rating Scale for instruction was used to measure student attitudes toward instruction. The results indicated that students provided with behavioral objectives scored higher than students provided with general objectives.

The purpose of Bassett and Kibler's (5) study was to develop a valid procedure for teaching students to use behavioral objectives and to determine minimal levels of competence in the use of objectives. The subjects were 159 undergraduate students enrolled in a survey course of human communication theory at Florida State University. It was hypothesized that, when objectives are provided for a unit of instruction, subjects trained to use objectives will score significantly higher on an examination consisting of items matched to the objectives than subjects not so trained. The hypothesis was supported by the data and implications for future research and classroom application are noted.

Booth (8) tried to determine if communication of behavioral objectives affected student achievement and attitude. His subjects were twenty instructors and 417 students, representing twenty class sections of the basic speech communication course at a midwestern university. Nine instructional objectives, based on three assigned chapters in the required textbooks, were investigated over a period of three weeks using two instruments to test the hypotheses of the study. A content test was devised by the researcher to measure overall student achievements, and subscales of this test were used to measure achievement at different levels of cognitive learning. The results of this study supported the contention that behavioral objectives have a positive, facilitative effect on student achievement.

Motillo (44) compared the achievement and attitudes of twelfth grade Physical Science Study Committee (PSSC) physics students who were given lists prior to instruction of behavioral objectives as compared to those who were not given these lists. Five classes of students were involved with one class remaining a control group throughout the twenty-week experiment. From the results obtained, the investigator concluded that physics students viewed instruction more favorably when they were given written objectives prior to instruction than when they were not.

Royer's (55) study investigated effects of specificity and position of written instructional objectives on learning from an audiotaped lecture. Subjects received either specific or general objectives before or after the four sections of the lecture. A control group received no objectives. Vocabulary items used throughout the experiment served as the covariate in the analysis. Results indicated that the "before" position increased intentional learning over the "after" position.

Hesson (27) tried to ascertain if there was a significant relationship between the use of performance objectives and improvement in reading comprehension. The study sought to identify the statistical relationship between the use of performance objectives and the three variables of reading comprehension, basic reading skills, and mastery of textbook material.

To identify these relationships, ninety-six students were administered (1) the Nelson Denny Reading Test to measure reading comprehension, (2) a criterion-referenced test to measure basic reading skills, (3) and a criterion-referenced test to measure mastery of textbook material. Posttests were administered for each of the three variables and in addition, a posttest was administered to ascertain the subject's knowledge of performance objectives. The study established that there was a significant correlation between the use of performance objectives and the variables of basic reading skills, mastery of textbook materials, and knowledge of objectives.

Payne (45) attempted to prove that the use of behaviorally-stated objectives in classes of chemistry would result in higher gains in achievement for students in these classes as compared to those in classes where non-behaviorally-stated objectives are used. The results do not provide adequate evidence that students achieve more when using behavioral objectives because the experimental group did not make significant gains over the control group. It can be hypothesized, however, from the strong implications of the increasing value of the F-ratios, the decreasing value of the probability, and the higher mean gains of the last chapter studied, that the experimental group, if given more time, would gain more than the control group. The results of the questionnnaires indicated that teacher and student attitudes vary somewhat, but that there was an overall favorable attitude toward the use of behavioral objectives.

Eberwin (22) made three studies to assess the effects of behavioral objectives on the performance of remedial readers. Subjects were three groups of sixteen pupils who were participating in a reading-center tutorial program. During the two-month instructional period, half of the students were given behavioral objectives and half were not.

For the post-instruction assessment, two tasks were developed for each pupil. On one task, the pupil was informed of the specific behavioral objectives; on the other similar task, no information about behavioral objectives was given. Results indicated that pupils who had been informed of behavioral objectives during the two-month period prior to assessment performed at a high level on both tasks, whereas those who had not been previously informed of behavioral objectives did less well. This was interpreted as supporting the assumption that information about behavioral objectives increases pupils' performance.

Mosley and Bell (43) examined the influence of the specificity of the objectives statement on student learning which resulted from an independent, laboratory-based physical science investigation program. Each teacher taught one section using specific behavioral objectives and one section using non-specific objectives. In both treatments, objective statements were presented prior to the instruction of the given unit. The effects of the different treatments were significant; higher means were obtained by the group provided with the specific behavioral objectives. A questionnaire indicated student perception of the use of behavioral objectives was helpful by providing guidance through the unit.

Rothkopf and Kaplan (54) explored (1) the use of instructional objectives as directions that describe the relevant instructional content in written discourse to subjects, and (2) the role of specificity of objectives in determining both intentional and incidental learning. Intentional and incidental learning was studied as a function of (a) the density in the text of sentences relevant to instructional objectives and (b) the specificity with which instructional objectives were described. The major findings were (a) more intentional learning resulted from specific rather than broad objectives, but incidental learning was not affected by this factor; (b) the increase in the density of instructional objectives resulted in a decrease in the likelihood that any intentional item was learned, but performance on incidental items was not affected. Intentional learning was generally greater than incidental and performance in both intentional and incidental items was considerably higher when instructional goals were explicitly described than when direction were used that were similar to those commonly employed in learning experiments.

Cook (18) investigated the differences in learning and retention between students informed and not informed of behavioral objectives and the learning hierarchy of a unit of instruciton. The subjects were eighty-eight elementary education majors at Towson State College, Baltimore, Maryland, randomly assigned to four treatements. Selfinstructional material for the unit was developed based upon the learning hierarchy. The treatment material, consisting of ten activity booklets, was administered by the experimenter for eight consecutive class days. After completion of the unit, posttests were administered to compare the degree of learning and the amount of retention. The results do not substantiate the thesis that informing students of behavioral objectives or of the learning hierarchy can enhance their performance on an immediate achievement test. However, giving students statements and examples of behavioral objectives is an instructional method that will result in resistance to forgetfulness. McNeil, Piatt, and Bryant found that training teachers in the use of behavioral objectives as guides to teaching enhances subsequent student achievement (9, 40, 47).

Cooper (19) investigated the interaction between tolerance of ambiguity and the use of behavioral objectives on students' achievement in English sentence skills. The study was conducted with fifteen senior English classes in an inner-city New York City high school. Four teachers participated in the study, and each teacher taught classes with and without the use of behavioral objectives. Eight classes were conducted with behavioral objectives while seven were conducted without behavioral objectives. The total sample consisted of 277 students. There were 136 females and 141 males. The analysis of data showed that the use of behavioral objectives had a significant effect on the learning of sentence concepts. There was, however, no significant interaciton between the use of behavioral objectives and tolerance of ambiguity. The group receiving behavioral objectives, irrespective of trait differences, significantly outperformed the group not receiving behavioral objectives. It was concluded that in certain instances students who are provided with behavioral objectives will perform better than students who are not provided with behavioral objectives.

Walbesserk and Eisenberg (63) reported that Smith tried to investigate the effects of instructions on learning by examining the effect of the learner being informed about the objectives of instruction. The behavioral objectives and instructional activity in his study dealt with mathematics. One hundred sixty-two eighth grade students, labelled as slow learners, were selected from ten classes; ten teachers were randomly assigned to one of two treatments. The classes of one group of teachers received the unit in its entirety while the classes of the other group received the unit lesson-by-lesson. Some students were randomly assigned to two groups and received different presentations of the instructional materials. One group of students received printed instructions concerning the expected outcome of each lesson while the other group did not. The performance of the two groups of classes and the performance of the two groups of students were examined. The null hypothesis was retained for both performance comparisons. Smith explained that the reason for the lack of significant differences was perhaps the manner in which the instructions were presented. Since the instructions were printed on the written materials, it was assumed that all students receiving the instructions would read them; the slow learning students might well have avoided these instructions and proceeded to the materials. There is no guarantee that the instructions had any impact at all on the experimental subjects.

Janeczko's (35) major purpose was to ascertain the relative effects of student exposure to behavioral instructional objectives upon student self-evaluation of psychomotor activities in a college-level power mechanics course. Half of the students were informed of the behavioral objectives describing the desired terminal behavior, and the other half were given a set of general objectives. It was concluded that while students who have prior knowledge of behavioral objectives can be expected to achieve at a higher level than students who have prior knowledge of general objectives, neither of the two approaches appears to be more effective than the other in terms of self-evaluation.

Merrill and Towel (41) studied the effects of presenting instructional objectives to students in a graduate computer-management course. It was expected that the availability of behaviorally stated objectives would reduce test item response latency, increase study time, and reduce stated anxiety. Since all subjects were required to reach criterion on each unit of the course, no differences were expected on post test performance. Results showed no significant difference found in study time or test item response latency. The availability of objectives did significantly reduce the level of anxiety. Apparently graduate students were able to figure out the course very rapidly so that the availability of objectives had little or no effect.

Baker (4) constructed and randomly assigned three lists of objectives to three groups of high school social science teachers. Two groups received behavioral objectives, but the third group was given non-behavioral objectives. All teachers were instructed to teach according to the objectives. The results indicated no significant difference between the students of the three groups, and that "teachers' faulty understanding of objectives, indicated by their inability to provide relevant classroom practice and to identify, when asked, test items measuring given objectives, may have accounted for the lack of differences" (4). It was suggested that the results might have been different if the teachers had been trained in the use of behavioral objectives.

Jenkins and Deno (36) provided specific or general objectives for students, teachers, or students and teachers. They found that neither knowledge of objectives nor type of objectives differentially influenced performance on a criterion test. To explain these data, the authors note that "when a unit is well structured, that is, designed to facilitate the attainment of particular objectives, explicitly stated objectives may be superfluous."

Courses Based on Behavioral Objectives

Preparing and developing behavioral objectives for different subject fields is widely practiced today with the intent of making the teacher's job easier and more successful. Popham states,

> To have teachers generate their own worthwhile, measurable objectives is simply asking too much, and it is for this reason that we have established as a non-profit agency in Los Angeles, the instructional objectives exchange. It is a beginning, an attempt to gather, in bank-like fashion, collections of objectives for particular subjects and grade levels. We want to give teachers a collection of objectives and say, "Here, select those which you think appropriate to your situtiion. If you want to add objectives, that's fine, but at least the collection relieves you of some of the burden of preparing all your own measurable objectives" (50).

Mesa Public Schools in Arizona published a booklet for science education in their schools which contains a compilation of program goals, behavioral objectives, and terminal goals for students. The program's goals and behavioral objectives span the science curriculum of students in grade one through senior high school. The four goals for students are (1) to know fundamental facts and principles of science, (2) to possess the abilities and skills needed to engage in the process of science, (3) to understand the investigative nature of science, and (4) to have an appreciation of scientists, science, and the consequences of science (56).

West traces the development of the seven-volume Florida catalog of performance objectives for reading and writing from kindergarten through grade twelve. The project was funded by the Florida Educational Department and the researcher built on earlier catalogs developed on reading and writing (65). The Utah State Board for Vocational Educational Guide for Cosmetology is part of a public school effort to articulate secondary and post-secondary vocational education programs. It is organized in a pattern of behavioral objectives so that students may enter and complete the program or may transfer and continue without loss of time (62). Hill and Simmons developed a catalog of behavioral objectives for occupational child care which is organized by units of instruction. As a bank for teachers use, each unit contains an outline of the content, general and specific objectives (32), and a catalog of behavioral objectives for selected units in consumer and homemaking education (31).

Delaware State Department of Public Instruction at Dover provides basic behavioral objectives designed for a middle school science curriculum (grades five through eight). For students in grade five, emphasis is placed on the study of theliving environment; objectives for grade six are based on an introduction to the physical sciences; earth and space science are studied in grade eight (10). As a bank for teacher use Hill and Williams (33) developed a catalog of behavioral objectives for selected units in a drafting course. The Agency-Bureau of Elementary and Secondary Education in Washington, D. C. publishes behavioral objectives for grades seven through nine for eighty-two topics in mathematics; a general objective is given for each followed by specific behavioral objectives (57, 58). Hill prepared a catalog of behavioral objectives for selected agricultural education units. Each unit contains an outline of the content and general and specific objectives (28).

The Rhode Island State Department of Education developed curriculum guides providing instructional objectives and activities for teaching science in grades seven through twelve. The guides are intended to serve as a resource to teachers, students, department chairmen, curriculum planners, or anyone involved in classroom planning (58). Hill and others developed a catalog of behavioral objectives for teachers of vocational automotive courses that is organized by units of instruction as listed in the Virginia State curriculum guides. Each unit contains a suggested outline of content, and general and specific objectives to provide a bank of objectives which could be related to task analysis and job description (29).

Rexroat developed a module which covers behavioral objectives and theuse of state mathematics curriculum guides. Objectives for the module are specified; prerequisites are listed and pre- and post-assessment and remediation activities are given (53). Hill and Schmidt prepared a catalog of behavioral objectives for selected units in business education to provide a bank of objectives (30). Hinerman presents a set of behavioral objectives which was developed and validated for a undergraduate science program for elementary teachrs. Some measure of validity was established by submitting the objectives to a group of scientists and educators who participated in writing the program (34). The Michigan Vocational Education Service, in September, 1972, implemented a Performance Objectives Development Project to generage objectives for all vocational/technical education programs in the State. In order to retain each school district's priority for program funding, it was necessary that each one adopt a set of minimum performance objectives for each program (46). Capper compiled behavioral objectives for courses in biology, chemistry, geology, physics, physiology, and zoology (11, 12, 13, 14, 15, 16).

Background and Related Studies on CHEM Study and Traditional Chemistry Courses

The CHEM Study course was developed initially in 1959; it is one of the curriculum projects sponsored by the National Science Foundation, and materials resulting from the project were available by 1963. During 1965-66, approximately 350,000 students in the United States were using the CHEM Study materials (25, 52).

It can be said that the development of the CHEM Study materials is a result of a growing dissatisfaction with the traditional approach to science teaching and the widespread demand for changes in high school science courses, particularly chemistry (6, 25). According to Pode (49), most of the ills of the traditional courses can be summarized under three headings:

1. Courses were too large, built up by a process of accretion, and impossible to finish without a terrible rush; no one seemed to take into consideration that it was no longer possible to know--and even less possible to teach--more than a fragment of any one field of knowledge.
2. Courses were too factual, and textbooks had become unreadable encyclopedias of "essential information."
3. Laboratory work was almost always a tepid demonstration of what the students knew already.

The traditional courses are usually based on historical structure, and this approach would appear to have certain limitations. One limitation is the economics of the approach, i.e., economical, if each important concept of chemistry were to be developed historically, the textbook would doubtless be several thousand pages in length (25).

The traditional textbook is usually supplemented by films and a set of laboratory experiments. Marshall (37) stated,

> The films, for the most part, describe the preparation of specific compounds, or they relate chemistry to our society, or they show laboratory techniques. The laboratory, which usually takes one period per week of the students' time centers around a laboratory manual which generally supplements the textbook. The students are probably given rather specific directions for carrying out exercises which verify certain things they have already learned from either the textbook or the teacher. For example, the student nearly always prepares oxygen gas by heaving potassium chlorate and manganese dioxide following the step-by-step directions given in the manual. After obtaining the gas they test it for its properties, again following specific instructions in the manual, to verifyy the properties already described in the text ("supports combusion, slightly soluble in water, odorless, colorless, etc.). The student "observations" are recorded in the laboratory manual, usually by filling in blanks in prefabricated sentences. They are then often asked to answer a few general questions based on the experience gained in the laboratory.

The objectives of the traditional course have been discussed by many writers. A curriculum bulletin published by the Fort Worth, Texas, Public Schools provides a clear definition of objectives (3).

1. To develop a knowledge of scientific facts, terms, and the principles which will be helpful in conversations, reading, and writing and in application of these principles in everyday living.
2. To develop an appreciation of the history of the science and scientists.

3. To know the scientific discoveries of the past in order to understand better discoveries that are inevitable in the future.
4. To create a desire for pursuing more science in the secondary school and after leaving the secondary school.
5. To cultivate an appreciation of beauty and to enjoy the wholesome use of leisure time.
6. To develop an appreciation of the ways in which the sciences have helped build the modern civilization in which we live.
7. To develop an understanding that science can be a friend or a foe; that it can be used for man's advancement or for his destruction.
8. To create a willingness to change opinions on the basis of evidence through a search for truth.
9. To develop accuracy in making observations, in measuring, and in keeping records and analyzing problems.
10. To recognize the relationship between cause and effect and to reject the influence of erroneous beliefs and superstititions.
11. To develop techniques in the effective and safe use of materials and the forces of nature.

According to Hardy, there are a number of ways in which CHEM Study deviates from the traditional approach. There is a shift of emphasis from descriptive chemistry toward the study of basic principles; obsolete materials and terminology are deleted; there is a systematic development of the relationship between experiment and theory (25).

The structure of the CHEM Study course is also different from that of the traditional course. In this regard Marshall (37) stated,

> They have ignored almost entirely the sequence of events in the history of chemistry. They have paid scant attention to the modern-day technological applications of chemistry to the scientific world in which the student lives; they have made no attempts whatever to give "complete" coverage to the field of chemistry; and

> they have left untouched a great many of the subjects which heretofore have been considered essential in any acceptable high school chemistry course.
>
> What they have done has been to develop courses which attempt to show the beauty and order in chemistry as chemists view it; they have seized the most fundamental ideas in the discipline and havebuilt around them conceptual schemes which honestly reflect the chemical behavior of matter. Above all, they have attempted to appeal to the students' intellect, to challenge him at the point where he is the most vulnerable--his innate curiosity about the natural world.

In CHEM Study students are expected to consider questions like "who do the facts come from?," and "what does it mean to 'explain' facts?" Answers to these questions constitute "the most abstract message of the course" (39).

The "charge to the students" made in the preface of the CHEM Study text (48) emphasizes understanding rather than memorization. Ramsey (52) summarized the preface in the following points:

1. An understanding of principles removes the need for endless memorization of innumerable chemical facts.
2. Principles grow out of observation.
3. Student becomes practiced in making unexpected observation, in weighing facts, and in framing valid conclusions.
4. Questioning and seeking understanding should become a habit.
5. Student will no longer be satisfied with dogmatic assertions.

From the above one can see that students have an important role in the instruction process. Emphasis is placed on the students' "finding out" rather than on the teacher's "telling" (52).

According to Ramsey (52) the kind of instruction that should be used with the CHEM Study course is stated in a CHEM Study newsletter which makes recommendations for facilities and class size.

> Class size and arrangement should be conditioned by the kind of teaching for which CHEM Study materials were designed. This involves a minimum of lecturing and a substantial amount of real discussion in which ideally all members of class should be actively involved.

The CHEM Study program incorporates a method that aids the student to learn chemistry by the discovery approach through guided laboratory experiences designed to lead to conclusions. Great emphasis is placed on the experimental nature of chemistry. Merrill (42), former executive director of the CHEM Study project defines the three major aims of the course as being

1. To stimulate and prepare those high school students whose purpose it is to continue the study of chemistry in college as a profession.
2. To encourage teachers to undertake further study of chemistry courses that are geared to keep pace with advancing scientific frontiers, and thereby improve their teaching methods.
3. To further in those students who will not continue the study of chemistry after high school an understanding of the importance of science in current and further human activities.

He also presents general criteria to be used in any selection and ordering of ideas in the textbook:

1. Is the idea so important that no first course is complete without it?

2. Can the idea be developed honestly in a way that is comprehensible to high school students?
3. Is the idea essential to the development of other major ideas in this course or useful in their applications?
4. Can the idea be developed from experimental evidence that high school students can gather or, at least, understand?

The authors of the CHEM Study project expressed some hopes about the achievements of the students by the end of the course. According to Pimentel (48),

> We hope that you will know enough chemistry and enough about science to feel that the part you don't know is understandable, not mysterious. Perhaps you will appreciate the great power of scientific methods and appreciate their limitations. We hope that you will have become practiced in making unexpected observations, in weighing facts, and in framing valid conclusions. We hope that you will have formed the habit of questioning and of seeking understanding rather than being satisfied with blind acceptance of dogmatic assertions. We expect that you will share in the excitement of science and that you will feel the rich pleasure that comes with discovery. If most of these hopes are fulfilled, then you have had an optimum introduction to science through chemistry.

Studies on CHEM Study and Traditional Courses

The available research studies on the CHEM Study and traditional chemistry courses were reviewed here.

The outcomes of 1,333 students enrolled in chemical bond approach (CBA), CHEM Study, and traditional chemistry courses were compared by Troxel (61) on the basis of grade and ability level. He used the Cooperative Chemistry Test (ACS-NSTA), the Test on Understanding Science (TOUS), the

Prouse Subject Preference Survey, and the Watson-Glaser Test of Critical Thinking. He also used many criteria to select his sample of teachers. They were required to have at least thirty-five semester hours of chemistry course work, to have taught the course before, and to agree with the stated philosophies and aims of the course they were teaching. From his study he found that students in the CHEM Study and CBA courses performed significantly better than traditional course students on the ACS-NSTA, TOUS, and WGTS.

Herron (26) in his study compared the CHEM Study with a traditional chemistry course in terms of the cognitive ability exhibited by the students. Cognitive ability refers to any of those abilities described by the Taxonomy of Educational Objectives as Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation as well as Critical Thinking as measured by the Watson-Glaser Critical Thinking Appraisal.

A chemistry test based on the six categories of the Taxonomy was constructed by the author. This test and the Watson-Glaser were administered to chemistry students in four Chicago suburban schools. The sample was stratified into three ability levels using the Iowa Tests of Educational Development.

Each subtest was tested for significance by analysis of variance using pre-test scores as a covariate and the differences were noted. CHEM Study students scored significantly higher on Application than did the traditional students. High ability students in the CHEM Study scored higher on Analysis than high ability students in traditional classes.

Cottingham (20) compared student achievement in CHEM Study and traditional courses. His participants included students from local high schools using both traditional and CHEM Study programs. A statistically significant difference existed between the CHEM Study and traditional groups on the achievement test, favoring the CHEM Study group; a significant difference existed between the grades of the two groups, favoring the CHEM Study group.

According to Cleare (17), a comparison was made of chemistry knowledge acquired between high school chemistry students whose cognitive patterns were similar to and different from those of their teachers. The CHEM Study midterm and final examinations were used to measure student achievement. It was found that there was a significant gain which favored those students whose cognitive patterns were similar to that of their teachers.

Atwood (2) studied achievement of the CHEM Study students who were classified on the basis of a specially developed cognitive performance test. Performances represented in the test were (1) memory of specific facts or terms, (2) practical applications, (3) critical questioning of information, and (4) fundamental principles. The study indicated that students with a strong preference to memorize specific data were at a disadvantage in the CHEM Study course. Students who questioned information initially, or preferred fundamental principles or a combination of principles and application, performed better than students with other cognitive preference patterns.

Torap (60) studied the effectiveness of four methods of laboratory reports used in teaching CHEM Study and their effect on CHEM Study outcomes. The four methods consisted of (1) essay laboratory reports, (2) mimeographed laboratory sheets prepared by Torap and completed by the students, (3) the laboratory manual, and (4) no report at all. Some seventy-five students were divided into the four groups for the study and the only instructional difference between the groups was the method of writing the laboratory report. The group that used the mimeographed laboratory sheet was superior on the CHEM Study semester final.

Swartney's (59) aim was to identify those science concepts and mathematical skills that may be sources of student difficulty in CHEM Study courses. The instruments utilized were four achievement tests prepared by CHEM Study. He found that the students earning low scores were (1) unable to define many technical terms, (2) could not verbalize key concepts, (3) did not possess the ability to solve simple algebraic equations, (4) could not solve problems of quantitative nature, and (5) lacked the skill necessary to interpret graphs and charts. Those same difficulties were present to a limited extent among students who performed at a satisfactory level.

Hardy (24) compared an experimental group of 104 students in CHEM Study chemistry with a control group of 104 students in traditional chemistry. Differences in the dependent variables of achievement in chemistry and critical thinking were analyzed by multiple classification analysis of variance. The American Chemical Society-National Science Teacher Association Cooperative Examination from 1967 was used. The Watson-Glaser Critical Thinking Appraisal test was also used.

These examinations indicated that CHEM Study students achieved at a significantly higher level than students in traditional courses. The CHEM Study approach, according to this study, appears to be valid for all levels of mental ability usually found in high school chemistry classes.

A Comparison of CHEM Study and Traditional Course with the Kuwaiti Text

I. Content and Organization

The contents of the three texts, Chemistry an Experimental Science (48), Modern Chemistry (21), and Second Year Chemistry in Secondary School (23), listed here, and a comparison based on contents and organization was made between the three texts as shown in Table II (pp. 42-43).

From comparisons of the contents of the three texts, the Kuwaiti text appears to have more similarities to the CHEM Study. It is organized by big units and each of these big units is divided by subheadings dealing with materials related directly to the unit. For example, in Unit V. Carbon Chemistry, there are subheadings such as Structure of Carbon Atom, Inorganic Compounds (carbon monoxide and dioxides), Organic Chemistry. There is no separate unit for Carbon and its Simple Compounds, and another separate unit for Common Organic Compounds as in the traditional text.

The Kuwaiti course is based on historical structure. According to the authors of the Kuwaiti text, "This course will complete the fundamental principles which have been studied in the first year, and it will be completed in the third and fourth courses" (23). This historical structure probably occurred because chemistry as a separate subject (not as part of general science which is usually an elementary school subject) is taught from the first year through the fourth year of secondary school. Therefore, the chemistry course of the second year is built on the chemistry course of the first year, the chemistry course of the third year is built on the chemistry of the second year, and so on.

TABLE II

CONTENT OF TRADITIONAL CHEMISTRY COURSE, KUWAITI CHEMISTRY COURSE, AND CHEM STUDY

Traditional Content (21)	Kuwaiti Content (23)	CHEMS Content (48)
Unit 1. Chemistry in a Modern World	I. Principles of the New Atomic Theory	Ch. 1. Chemistry an Experimental Science
2. The Organization of Chemistry	Electromagnetic Spectrum	Ch. 2. A Scientific Model: The Atomic Theory
3. Water and its Elements	Emission Spectrum	Ch. 3. Chemical Reaction
4. Chemical Calculation	Visible Spectrum	Ch. 4. The Gas Phase: Kinetic Theory
5. Carbon and its Simple Compounds	Absorption Spectrum	Ch. 5. Liquids and Solids
6. Ionization	The Quantum Number and Electron Energy	Ch. 6. Structure of the Atom
7. The Active Metals	Shortcoming of the Bohr Model	Ch. 7. Energy Effectsin Chemical Reaction
8. The Halogens and Sulfur	Extensions of the Bohr Model	Ch. 8. The Rate of Chemical Reaction
9. The Nitrogen Family	Hydrogen Atom	Ch. 9. Equilibrium in Chemical Reactions
10. The Colloidal State	II. The Long Form Periodic Table	Ch. 10. Solubility Equilibrium
11. The Light Metals	Elements According to Their Electron Configuration	Ch. 11. Aqueous Acids and Bases
12. The Heavy Metals	III. Structure and Bonds in Molecules and Bonds	Ch. 12. Oxidation Reduction Reactions
13. Nuclear Reactions	Chemical Affinity	Ch. 13. Chemical Calculations
14. Boron and Silicon	Ionization Potential	Ch. 14. Why We Believe in the Atom
15. Common Organic Compounds	Ionic Bonds	Ch. 15. Electons and the Periodic Table
	General Properties of Ionic Compounds	Ch. 16. Molecules in the Gas Phase
	IV. Hydrogen, Oxygen and Their Compounds	Ch. 17. The Bonding in Solids and Liquids
	Hydrogen	

Table II--Continued

Traditional Content (21)	Kuwaiti Content (23)	CHEMS Content (48)
	Oxygen Water Hydrogen Peroxide V. Carbon Chemistry Structure of Carbon Atom Inorganic Compounds Organic Chemistry	Ch. 18. The Chemistry of Carbon Compounds Ch. 19. The Halogens Ch. 20. The Third Row of the Periodic Table Ch. 21. The Second Column of the Periodic Table Ch. 22. The Fourth Row Transition Elements Ch. 23. Some Sixth-and-Seventh-Row Elements Ch. 24. Some Aspects of Biochemistry Ch. 25. The Chemistry of Earth, the Planets, and the Stars

The CHEM Study and traditional chemistry course use different approaches in handling materials and facts. Walter (54) stated,

> In CHEM STudy the student would have a pretty good understanding of chemistry if he were to read the book carefully. . . . CHEM STudy always winds-up with a single model or answer based on the available data and information. (It is not dogmatic, but rather makes it quite clear that there are other explanations and that the real answer is still not known.)
>
> Traditional chemistry, as expected,defines the parts of the atom, and informs the student on the correct number of electrons and their "exact" locations. The treatment is void of explanations as to why this is thought to be true.

In dealing with content material, the Kuwaiti text also appears to be closer to the CHEM Study. In dealing with atomic theory, for example, the Kuwaiti text states that "the scientists assumed that the atom consists of positive nucleus surrounded by electrons with negative charge. . . . The scientific assumption cannot be acceptable unless it explains all its related phenomena."

Examining the questions that are listed in the CHEM Study and traditional courses, the differences noted between the two texts are substantial. According to Walker, CHEM Study is a "thinking" course; the emphasis is placed upon ideas with facts serving as the vehicle. This appraoch is verified if one examines the questions at the end of a chapter in the text (64). According to Walker, Strong presented this question as an example for CHEM Study:

> An alkali element produces ions having the same electron population as atoms of the preceding inert gas. In what ways do these ions differ from the inert gas? In waht ways are they alike? "Explain why the energy necessary to dissociate the O-O bond in H_2O_2 is less than half the dissociation energy of the oxygen molecules (64).

The traditional chemistry course tends to deal with facts per se. According to Walker the following question is an example from the traditional course.

> In such compounds (peroxides) the two atoms of oxygen are linked together, . . . In dioxide, the oxygen atoms are bounded to other kinds of atoms, not to each other." Four pages later, at the end of the chapter, question, "Distinguish between peroxides and dioxides." How much reasoning or critical thinking is needed here? (64).

The questions in the Kuwaiti text do not require the stu dent to give much thought to the answers. There are some direct questions for which answers can be found easily in the text. In this sense the Kuwaiti text appears to be more like the traditional text.

Here are two examples of questions from the Kuwaiti text: Example I. On page eleven of the text, this statement appears: "The fourth principle quantum number is made up of four sub levels s, p, d, and f." In the end of the unit, page fifteen, question six, "What is the number of sub levels that may be found in the fourth principle quantum number?" Example II. On page ninety, this statement appears: "Carbon dioxide can be prepared from an inorganic acid and carbonate by using Ceb apparatus."

$2HCl + CaCO_3 \longrightarrow CaCl_2 + H_2O + CO_2$. On page ninety-one, under the chemical properties of carbon dioxide appears the following:

> If carbon dioxide is bubbled into limewater for a short period, a reaction takes place and a calcium carbonate ($CaCO_3$) is precipitated, it is insoluble and that is why it appears as a fine milky precipitate. If we continue to bubble carbon dioxide into the milky precipitate, a second reaction takes place and the bicarbonate $Ca(HCO_3)_2$ is formed, the precipitate will clear up because the insoluble carbonate changes to the bicarbonate which is insoluble.

Question two is at the end of the unit, page 115; "How can you prepare carbon dioxide? Draw the apparatus, and write the reaction equation. What is the effect of carbon dioxide when it is bubbled into limewater for a short period and for a long period?" Obviously, not much thought is required of the student to answer these questions.

This new Kuwaiti text is, however, a movement from the traditional content and methods of dealing with the materials toward the new approach as in the CHEM Study. It does resemble the traditional text in the questions listed at the end of each unit. There is a teacher's guide in addition to the text, but it lacks suggestions for further readings for both teachers and students and it also lacks behavioral objectives to help teachers in their teaching.

In general, this Kuwaiti text appears to be more effective than other texts which have been used in Kuwaiti schools during the last decades. Previously used texts were developed by individuals or imported from other Arab countries.

II. Laboratory Work

Laboratory work is given a different emphasis in the CHEM Study compared to the traditional course. In the CHEM Study the laboratory represents the nucleus of the teaching process. Emphasis is placed on laboratory work so that chemical principles can be student experiences, thus giving maximum opportunity for discovery--the most exciting part of scientific activity (6).

According to Rainey (51),

> In CHEM Study and CBA the attention is not on a cookbook approach and mechanical manipulations, but on the following questions: To what problems can an answer be sought experimentally? What data are relevant? How may observations be made quantitative? How can the data be ordered for the best interpretation? Thus one of the greatest differences in the new curricula and the traditional is that in the former the laboratory work does the teaching.

The results that the CHEM Study student obtains in the laboratory are a vital and integral part of the course. A great effort has been made to be certain these results are obtained (64).

> CHEM Study laboratory is built on science being an experimental endeavor, hence, the emphasis is on the experimental approach. CHEM Study uses a low level of math, needs little special equipment, and uses experiments of which the majority

> are of a quantitative nature. Even the simplest experiment such as the melting of solids, is so conducted that the student must collect data, categorize it, order it, and then generalize from it (64).

In the traditional course, the laboratory work is less effective than in the CHEM Study. Marshall (37) stated,

> The laboratory which usually takes one period per week of the students' time, centers around a laboratory manual which generally complements the textbook. The students are probably given rather specific directions for carrying out exercises which verify certain things they have already learned from either the textbook or the teacher.

According to Ramsey (52), Peterson notes that traditional teaching is strongly based on the formal presentation of materials followed by laboratory (verification) experiences. This practice provides very limited opportunity for the student to discover and verify the statements in the text.

In the case of the Kuwaiti course, the laboratory is conducted primarily by classroom teachers. Some teachers ask students to help them in their demonstrations; sometimes there is an opportunity for the students to conduct some experiments by dividing into groups. There is, however, small opportunity for discovery or problem solving in laboratory work because it often comes after a class discussion and the students usually have to work on an assignment of verification. Students follow step-by-step directions in their laboratory work. Although there are some who try to improve procedures, most teachers argue that since they have to teach such a large number of students, and they have such a lengthy curriculum to complete, they therefore have no time for more laboratory work.

Since the Kuwaiti text allows less time than the CHEM Study for laboratory work, it is less effective in this aspect of teaching. The Kuwaiti text is moving away from the traditional and toward the newer way of chemistry teaching in that it is providing more laboratory work (two periods per week) than previously plus more chances for student participation.

Summary

The literature on behavioral objectives indicates that the use of behavioral objectives is more effective than general objectives (or no objectives) in the areas of students' achievement and attitudes, of course content, and organization of the complex cognitive processes.

In some studies it is indicated that behavioral objectives have no effect upon student evaluation or study time. Other studies indicate that the behavioral objectives have no effect on student achievement (1) because the slow learning students might have avoided the instructions on behavioral objectives and proceeded to work on the material, or (2) because of the inability of the teachers to use behavioral objectives in their teaching. Some research results suggested that when a unit is well structured for the objectives then the behavioral objectives may be superfluous.

These and other studies which similarly find no difference between the effects of behaviorally-stated objectives and general objectives frequently cite problems in procedure or design defects of the studies as possible causes for the lack of statistically significant differencs. In view of this, along with the considerable amount of positive evidence available, it is concluded that the preponderance of the evidence favors the use of behaviorally stated objectives.

The literature on the CHEM Study approach and an American traditional course showed that the CHEM Study is more effective than the traditional course on student achievement and the cognitive abilities such as application and analysis processes. It was found that a specially prepared laboratory report (the mimeographed type) is a more affective procedure than the other three types considered.

In a comparison between the CHEM Study, an American traditional course, and the Kuwaiti course, the Kuwaiti chemistry course appeared closer to the CHEM Study in that the material is organized by units and in that way the subject matter is presented. On the other hand, the Kuwaiti course appeared closer to the traditional course in the areas of unit questions and the laboratory work.

CHAPTER BIBLIOGRAPHY

1. Anderson, Elaine J. and others, "Behavioral Objectives: Science Process and Learning from Inquiry-Oriented Instructional Materials," paper presented at the Annual Meeting of the National Association for Research in Science Teaching, ERIC ED 091 205, April, 1974.

2. Atwood, Ronald K., "A Comparative Study of Achievement in CHEM Study Chemistry Among Groups of Eleventh Grade Students Classified on the Basis of Frequency of Choices on a Cognitive Preference Examination," ERIC ED 030 571, 1966.

3. Bailey, J. M., Chemistry Handbook for Teachers, Fort Worth Public Schools Curriculum Bulletin Number A273, Fort Worth, Texas, 1964.

4. Baker, Eva L., "Effects on Student Achievement of Behavioral and Non-Behavioral Objectives," The Journal of Experimental Education, XXXVII, No. 4 (Summer, 1969), 5-8.

5. Bassett, Ronald E. and Robert J. Kibler, "Effect of Training in the Use of Behavioral Objectives on Speech Communication," paper presented at the Annual Meeting of the International Communication Association, New Orleans, Louisiana, ERIC ED 094 426, April 17-20, 1974.

6. Bennett, Lloyd M. and Barbra Kinnard Pyke, "A Discussion of the New Chemistry Programs (CHEMS and CBA) and the Traditional Programs in High School," School Science and Mathematics, LXVI (1966), 823-830.

7. Booth, James L., "An Investigation of the Effects of Two Types of Instructional Objectives on Student Achievement and Attitudes," unpublished doctoral dissertation, Purdue University, West Lafayette, Indiana, in Dissertation Abstracts International, XXXIV (1974), 4685.

8. _______________, "Behavioral Objectives: A Review of Theoretical Positions and Empirical Evidence and an Investigation of the Effects of Two Types of Instructional Objectives on Student Achievement and Attitudes in a Basic Speech Communication Course," paper presented at the Annual Meeting of the Speech Communication Association, Illinois, ERIC 101 412, December, 1974.

9. Bryant, Napoleon, Jr., "The Effect of Performance Objectives on the Achievement Level of Selected Eighth-Grade Science Pupils in Four Predominantly Black Inner City Schools," unpublished doctoral dissertation, Indiana University, in Dissertation Abstracts International, XXXI (1971), 5869.

10. "Capital Middle Schools Science Department Preliminary List of Behavioral Performance Objectives," Delaware State Department of Public Instruction, Del Mod System, Dover, Delaware, ERIC ED 096 112, 1973.

11. Capper, Michael R., "Instructional Objectives for a Junior College Course in Biology (First Semester)," California University, Los Angeles, ERIC ED 033 686, 1969.

12. ________________, "Instructional Objectives for a Junior College Course in Chemistry, California University, Los Angeles, ERIC ED 033 688, 1969.

13. ________________, "Instructional Objectives for a Junior College Course in Geology," California University, Los Angeles, ERIC ED 033 696, 1966.

14. ________________, "Instructional Objectives for a Junior College Course in Physics (First Semester)," California University, Los Angeles, ERIC ED 033 710, 1969.

15. ________________, "Instructional Objectives for a Junior College Course in Physiology (First Semester)," California University, Los Angeles, ERIC ED 033 711, 1969.

16. ________________, "Instructional Objectives for a Junior College Course in Zoology," California University, Los Angeles, ERIC ED 033 718, 1969.

17. Cleare, Bruce Emmanuel, "An Investigation of the Interaction Between Student-Teacher Cognitive Ability Patterns Using Achievement in the Chemical Education Material Study Chemistry Course as the Criterion Variable," unpublished doctoral dissertation, Florida State University, Tallahassee, ERIC ED 028 072, 1966.

18. Cook, J. M., "Learning and Retention by Informing Students of Behavioral Objectives and Their Place in the Hierarchical Learning Sequence," University of Maryland, College Park, Maryland, ERIC ED 036 869, 1969.

19. Cooper, Martin, "The Effect of Behavioral Objectives and Tolerance of Ambiguity on Achievement in English Skills," unpublished doctoral dissertation, Fordham University, in Dissertation Abstracts International, XXXVII (1976), 2734A.

20. Cottingham, Charles Louis, "A Comparative Study of CHEM Study and Traditional High School Chemistry in Relations to Students' Success in College Chemistry, unpublished doctoral dissertation, Texas A & M University, College Station, Texas, in Dissertation Abstracts International, XXXII (1971), 267A.

21. Dull, C. E., Clark Metcalf, and John E. Williams, Modern Chemistry, New York, Holt, Rinehart and Winston, Inc., 1962.

22. Eberwein, Lowell, "Effect of Behavioral Objectives Information upon Remedial Reader Performance," paper presented at the Annual Meeting of the Southeastern Regional International Reading Association, Louisville, Kentucky, ERIC ED 132 533, 1974.

23. Ezzat, Kayrey and others, Second Year Chemistry in Secondary School, 2nd edition, Ministry of Education, Kuwait, 1977/78 (Arabic).

24. Hardy, C. A., "Achievement and Level of Critical Thinking in CHEM Study and Traditional Chemistry," The Journal of Educational Research, LVV (December, 1971), 159-162.

25. ____________, "An Analysis of Achievement and Level of Critical Thinking in CHEM Study and Traditional Chemistry," unpublished doctoral dissertation, Texas Technological College, 1969.

26. Herron, J. D., "Evaluation and the New Curricula," Journal of Research in Science Teaching, IV (September, 1966), 159-170.

27. Hesson, Justus Clyde, "Effects of Performance Objectives on Reading Achievement in a Community College Reading Program," unpublished doctoral dissertation, University of New Mexico, in Dissertation Abstracts International, XXXV (1975), 5681A.

28. Hill, Richard K., "Behavioral Objectives for Selectee Agricultural Education Units, Vocational Education, Evaluation Project," State Department of Education, Richmond, Virginia, ERIC ED 094 199, 1973.

29. Hill, Richard K. and others, "Behavioral Objectives and Related Test Items for Selected Units in Automotive Machines," State Department of Education, Richmond, Virginia, ERIC ED 095 417.

30. ________________ and B. June Schmidt, "Behavioral Objectives for Selected Units in Business Education," Blacksburg, Virginia, ERIC ED 095 418.

31. ________________ and Helen A. Simmons, "Behavioral Objectives for Selected Units in Consumer and Homemaking Education," Vocational Education, Evaluation Project, ERIC ED 094 198, 1973.

32. ____________________________________, "Behavioral Objectives for Selected Units in Occupational Child Care Education," Vocational Education, Evaluation Project, ERIC ED 094 196, 1973.

33. ________________ and William R. Williams, "Behavioral Objectives for Selected Units in Drafting," Vocational Education, Evaluation Project, ERIC ED 094 197, 1973.

34. Hinerman, Charles O., "The Development of Behavioral Objectives for the Undergraduate Science Program for Elementary Teachers, Final Report," National Center for Educational Research and Development, Washington, D. C., ERIC ED 111 673, 1973.

35. Janeczko, Robert John., "The Effect of Instructional Objectives and General Objectives on Student Self-Evaluation of Psychomotor Performance in Power Mechanics," ERIC ED 057 188, 1971.

36. Jenkins, J. R. and S. L. Deno, "Influence of Knowledge and Type of Objectives on Subject Matter Learning," Journal of Educational Psychology, LXII, No. 1 (February, 1971), 67-70.

37. Marshall, J. S. and E. Burkman, Current Trends in Science Education, New York, The Center for Applied Research in Education, 1966.

38. Martin, William Joseph, "The Use of Behavioral Objectives by Basic Vocational Science Students," paper presented at the Annual Meeting of the National Association for Research in Science Teaching, Chicago, Illinois, ERIC ED 092 392, April, 1974.

39. Matthews, Charles C., "The Classroom Verbal Behavior of Selected Secondary School Science Student Teachers and Their Cooperating Classroom Teachers," ERIC ED 023 593, 1966.

40. McNeil, J. D., "Concomitants of Using Behavioral Objectives in the Assessment of Teacher Effectiveness," Journal of Experimental Education, XXXVI (1967), 69-74.

41. Merrill, Paul F. and Nelson J. Towle, "The Effect of the Availability of Objectives on Performance in a Computer-Managed Graduate Course," paper presented at the Annual Meetinf of the American Educational Research Association, Chicago, Illinois, April, 1972, ERIC ED 066 016.

42. Merrill, R. J. and David W. Ridgway, The CHEM Study Story, San Francisco, W. H. Freeman and Company, 1969.

43. Mosley, William E. and Paul E. Bell, "The Effect of Specific and Non-Specific Behavioral Objectives on Eighth Grade P.S. 1 Student Achievement," paper presented at the Annual Meeting of the National Association for Research in Science Teaching, San Francisco, California, ERIC ED 125 905, April 23-25, 1976.

44. Mottillo, Joseph Louis, "A Comparative Analysis of Achievement and Attitudes of the Twelfth Grade PSSC Physics Students When They Receive as Opposed to When They Do Not Receive Behavioral Objectives Prior to Instruction," unpublished doctoral dissertation, Wayne State University, in Dissertation Abstracts International, XXXIV (1973), 3034.

45. Payne, Charles Ray, "A Comparison of Achievement of High School Chemistry Classes Whose Students and Teachers Use Behaviorally Stated Objectives with Classes Whose Teachers and Students Use Non-Behaviorally Stated Objectives," unpublished doctoral dissertation, University of Virginia, in Dissertation Abstracts International, XXXIII (1973), 3428A.

46. "Performance Objectives Development Project," Michigan State Department of Education, Lansing, Vocational Education and Career Development Service, ERIC ED 105 246, 1974.

47. Piatt, R. G., "An Investigation of the Effect the Training of Teachers in Defining Writing and Implementing Educational Behavioral Objectives Has on Learner Outcomes for Students Enrolled in a Seventh Grade Mathematics Program in the Public Schools," Review of Educational Research, XLVI (1976), 239-265.

48. Pimental, George C., editor, Chemistry An Experimental Science, San Francisco, W. F. Freeman and Company, 1963.

49. Pode, J. S. F., "CBA and CHEM Study, An Appreciation," Journal of Chemical Education, XLIII (February, 1966), 98-103.

50. Popham, W. James, "The Instructional Objectives Exchange," in Teaching Today, edited by J. Michael Palardy, New York, Macmillan Publishing Co., 1975.

51. Rainey, R. G., "Comparison of the CHEM Study Curriculum and a Conventional Approach in Teaching H igh School Chemistry," School Science and Mathematics, LXIV (June, 1964).

52. Ransey, Gregor A., "A Review of the Research and Literature on the Chemical Education Materials Study Project," Research Review Series--Science Paper 4, Ohio State University, Columbus, ERIC ED 037 592, January, 1970.

53. Rexroat, Melvin E., "Math Objectives and Utilization of State Math Curriculum Guide, Module CMM:066:03," Idaho State University, Pocatello, Idaho, ERIC ED 130 827, 1972.

54. Rothkopf, E. Z. and R. Kaplan, "Explanation of the Effect of Density and Specificity of Instructional Objectives on Learning from Text," Journal of Educational Psychology, LXIII (1972), 291-302.

55. Royer, Paula Nassif, "The Effect of Specificity and Position of Written Instructional Objectives on Learning from Lecture," paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, California, ERIC ED 120 696, April, 1976.

56. "Science Education, Student Terminal Goals, Program Goals, and Behavioral Objectives," Mesa Public Schools, Arizona, ERIC ED 089 979, 1973.

57. "Secondary Schools Curriculum Guide, Mathematics, Grades 7-9," Agency-Bureau of Elementary and Secondary Education, Washington, D. C., ERIC ED 102 22, 1974.

58. "Secondary Schools Curriculum Guide, Science, Grades 7-9," Agency-Bureau of Elementary and Secondary Education, Washington, D. C., ERIC ED 100 709, 1974.

59. Swartney, Ilene Joyce, "Learning Difficulties Encountered by Students Studying the CHEM Study Program," Development Center for Cognitive Learning Sponsoring Agency--Office of Education, ERIC ED 036 445, 1969.

60. Torop, William, "An Experimental Study to Determine the Relative Effectiveness of Four Methods of Laboratory Reports in the Teaching of CHEM Study Chemistry," unpublished doctoral dissertation, Pennsylvania University, Philadelphia, in Dissertation Abstracts International, XXIX (1968), 1481A.

61. Troxel, Verne Aubry, "An Analysis of Instructional Outcome of Students Involvement with Three Courses in High School Chemistry," unpublished doctoral dissertation, University of Iowa, Iowa City, in Dissertation Abstracts International, XXIX (1968), 1832A.

62. "Vocational Cosmetology: An Integrated Secondary-Post Secondary Curriculum Guide," Utah State Board for Vocational Education, Salt Lake City, Utah, ERIC ED 089 914, 1971.

63. Walbesser, Henry H. and Theodore A. Esenberg, "A Review of Research on Behavioral Objectives and Learning Hierarchies," ERIC ED 059 900, 1972.

64. Walker, Noojin, "CHEM Study, CBA, and Modern Chemistry A Comparison," School Science and Mathematics, LXVII (1967), 603-609.

65. West, William W. and Elaine K. Tivnan, "What Seems to Be the Most Effective Way of Disseminating Reading Research in Meaningful and Useful Manner to Classroom Teachers?" paper presented at the Annual Meeting of the International Reading Association, New Orleans, Louisiana, ERIC ED 089 206, May 1-4, 1974.

CHAPTER III

DEVELOPMENT OF BEHAVIORAL OBJECTIVES

In this chapter a set of criteria for useful and valid behavioral objectives is developed. Using these criteria, behavioral objectives are stated for each major division of the official Kuwaiti secondary school text, Chemistry for the Second Year in Secondary School. A list of activities for each major division of the text is also provided.

Criteria for Useful and Valid Behavioral Objectives

In teaching, behavioral objectives are viewed as being more effective than are general objectives or no objectives and they are also widely supported by educators. According to Popham (6),

> Instructional specialists generally agree that the proper way to describe educational objectives is in terms of student behavior; for when instructional goals are stated in such a way that the instructional target is an observable pupil behavior, or an observable product of pupil behavior, the teacher has an explicit criterion for determining the quality of his instructional efforts. Such precise objectives are, unfortunately, far less common in our classrooms than they should be. While broad general objectives may be helpful to the teacher in initially deciding on what he wishes to teach, these vague objectives are of little assistance in guiding the teacher's selection of classroom learning activities, or in deciding how to evaluate the worth of the learning activities he

> has selected. Only behaviorally stated educational objectives allow the precise selection of learning activities and evaluation procedure.

Behavioral objectives can be useful in any place and in any instructional level. In this regard Troyer (7) stated,

> Instruction needs stated objectives. It does not matter whether the instruction takes place in a formal classroom setting or an informal one, nor does it matter if the instructional level is pre-school or post-graduate. What is important is that all concerned know where they are going.

Behavioral objectives can be helpful in planning a course of study, because they can be used to choose materials, teaching methods, and evaluation procedures. Nager (5) stated,

> Before you prepare instruction, before you select instructional procedures or subject matter or materials, it is important to be able to state clearly just what you intend the result of that instruction to be. A clear statement of objectives will provide a sound basis for choosing methods and materials and for selecting the means for assessing whether the instruction has been successful.
>
> Objectives are important in providing a sound basis 1. for the selection or designing of instructional content and procedures, 2. for evaluating or assessing the success of the instruction, and 3. for organizing the students' own efforts and activities for the accomplishment of the important instructional intents. In short, if you know where you are going, you have a better chance of getting there.

Characteristics of useful and valid behavioral objectives.--Educators have discussed behavioral objectives and the criteria to be used to make a behavioral objective more useful and valid. The educators agree that the valid behavioral objective should consist of three components or characteristics. According to Troyer (7),

> The performance objective differs from the "traditional" objective that is a statement clearly indicating how well a student must perform a given action (behavior) under particular conditions. It is a statement which (a) clearly gives the conditions under which the student will be evaluated (the situation), (b) designates the behavior the student must demonstrate (behavioral term), and (c) indicates the minimum level at which the student must perform in order to be rated acceptable (acceptable level statement).

Esbensen (2) in dealing with the valid behavioral objective components stated,

> A well-written instructional objective should say three things: 1. what it is that a student who has mastered the objective will be able to do, 2. under what conditions he will be able to do it, and 3. to what extent he will be able to do it. To put the matter in a single sentence, a well written instructional objective should specify under what conditions and to what extent a certain kind of student performance can be expected to take place.

Mager (5) has the same idea about the useful and valid behavioral objectives' components.

> A useful stated objective is one that succeeds in communicating an instructional intent to the reader. It is useful to the extent that it conveys to the others a picture of what a successful learner will be like that is identical to the picture the objective writer had in mind.

> And the most useful objective is the one that allows us to make the largest number of decisions relevant to its achievement and measurement. Three characteristics that help an objective communicate an intent. These characteristics answer theree questions: 1. what should the learner be able to do? 2. under what conditions do you want the learner to be able to do it? and 3. how well must it be done? The characteristics are these: 1. performance, 2. conditions, 3. criterion.

From the above, Troyer, Esbensen and Mager agree that the useful and valid behavioral objective should consist of three components of performance, conditions, and criterion. In some cases behavioral objectives can be useful with the first component (performance) and either one of the other two components (conditions, criterion), but the most useful behavioral objective should consist of the three components. According to Mager, "though it is not always necessary to include the conditions and not always practical to include the criterion, the more you say about them, the better your objective will communicate" (5).

Based on the foregoing, useful and valid behavioral objectives should consist of

1. Conditions (the situation): The condition that the student will be under during the time you ask him to perform the behavior being assessed is important. In short, the important condition under which the performance is expected to occur (5, 7). Such as:
   give a list of . . .
   given a standard set of tools . . .
   without any resources . . .

2. Performance (the behavioral level): It is what a student is expected to be able to do.

Is is taht word or phrase which expresses the type of task required of the student (5, 7). Such as:

the student will be able to write . . .
the student will be able to compare . . .
the student will be able to solve . . .

The words used in this component should be specific words that are open to few interpretations; general terms should be avoided in favor of the specific. In this regard, Troyer (7) stated,

> When developing behavioral objectives we will try to avoid words like know and understand. We want words of action for behavioral terms. Some behavioral terms are identify, select, list, name, construct, write, measure, distinguish, design, analyze, describe, contrast, transfer, match, classify, demonstrate, evaluate, order . . . Many more could be added. Just be sure your choices are action words; that is, that some act is performed and it can be measured.

3. Criterion (the acceptance-level statement): It is the minimum level of performance which is acceptable in such a way that both the teacher and his students will know when it is reached. In short is is the standard by which performance is evaluated (5, 7). Such as:

   with no more than two mistakes . . .
   correctly matching 5 of 7 words . . .

By applying these three components, a written example of a useful and valid behavioral objective would be

Given a list of ten United States presidents and a list of fifteen historical events in two different columns, the student should match the names of the presidents with events with which they are associated. Minimum acceptable performance is correctly matching eight of the ten presidents (7).

In examining the above behavioral objective, the three parts of the useful and valid behavioral objective are

1. Condition: Given a list of ten United States presidents and a list of fifteen historical events in two different columns.

2. Performance: The student should match the names of the presidents with events with which they are associated.

3. Criterion: Minimum acceptable performance is correctly matching eight of ten presidents.

Taxonomy of Educational Objectives

The taxonomy of educational objectives is a sophisticated and complex classification of objectives developed by Bloom (1), and by Krathwohl, Bloom, and Masia (4). This taxonomy is divided into three principal domains: cognitive, affective, and psychomotor (6, 8).

1. Cognitive domain: It covers those objectives which emphasize remembering or reproducing something which has presumably been learned, as well as objectives which involve the solving of some intellective task for which the individual has to determine the essential problem and then reorder given material or combine it with ideas, methods, or procedures previously learned. Cognitive objectives vary from simple recall of material learned to highly original and creative ways of combining and synthesizing new ideas and materials. In the literature the largest portion of educational objectives fell into this domain (4).

Example of cognitive domain:

Given a compound microscope and light source, the student should be able to adjust the microscope so that light passes through. Acceptable performance is achieved when totally white, fully round light can be viewed through tye eye piece under both low and high powers (7).

2. Affective domain: It refers to the objectives which emphasize a feeling tone, an emotion, or a degree of acceptance or rejection. Affective objectives vary from simple attention to selected phenomena to complex but internally consistent qualities of character and conscience. A large number of such objectives in the literature expressed as interests, attitudes, appreciations, values, and emotional sets or biases (4).

Example of affective domain:

Following a series of lessons on pollution, the student identifies a local industry contributing to pollution and formulates a suggested course of action to convince the industry to take precautions against pollution (3).

3. Psychomotor domain: It covers those objectives which emphasize some muscular or motor skills, some manipulation of material and objects, or some act which requires a neuromuscular co-ordination. Few such objectives in the literature and they were most frequently related to handwriting, and speech and to physical education, trade, and technical courses (4).

Example of psychomotor domain:

The student will be able to ski down the practice slope, falling no more than once, and breaking no more than one bone (5).

Behavioral Objectives for the Second Year Chemistry Course in Kuwaiti Secondary Schools

Using the criteria of useful and valid behavioral objectives, a set of behavioral objectives have been stated for each major division of the official Kuwaiti secondary school text, _Chemistry for the Second Year in Secondary Schools_. Each major division contains general objective(s), affective objectives, essential cognitive objectives, additional cognitive objectives, and a list of activities. Psychomotor objectives were not developed here because of the nature of the subject matter. Some measure of validity for the whole set of behavioral objectives has been established by submitting them to some educators in the Department of Education at North Texas State University.

UNIT I

PRINCIPLES OF THE NEW ATOMIC THEORY

GENERAL OBJECTIVES:

To inform the students that the most recent model of the atom is a model developed to explain experimental evidence and imagination and that it will probably be changed or modified in the future.

AFFECTIVE OBJECTIVES:

1. At the end of this unit the student will reflect his interest in the topic by selecting books to read during his free time which are related to the unit.
2. The student will reflect his interest in the unit topic by collecting pertinent articles, charts. slides for his own private file.

COGNITIVE OBJECTIVES:

1. Without any resources the student will be able to recite in forty words or less what is meant by spectral series and give at least two examples of products of the hydrogen atom. The student will be able to state why this experimental information is important in the development of an appropriate theory of atomic structure. He will do this in class,

within twenty minutes, with no more than two mistakes.

2. Without any resources the student will be able to draw and make a comparison of the Emission Spectrum and Absorption Spectrum and explain how each of these spectra produce according to the Bohr model of hydrogen atom. He will do this in class within twenty-five minutes, with no more than two mistakes.
3. Without any resources the student will be able to write in class in sixty words or less the extensions advanced by the quantum theory to help explain spectra of multi electronic atoms, and state why this recent theory is more appropriate than the Bohr model. He will do this within twenty minutes with no more than three mistakes.
4. Given a two day period the student will be able to illustrate the atom structure changes. He will do this at home in 150 words or less without any mistakes.
5. Given a list of electron levels and sublevels the student will be able to place them without any mistakes in ascending order in term of energy. He will do this in class within fifteen minutes.

6. Given the following letters, N, L, M, and Ms, the student will be able to define and compare correctly these four letters. He will do this in class, within twenty minutes.
7. Without any resources the student will be able to list correctly the bases used in the electronic configuration of the multi electronic atom. He will do this in class, within fifteen minutes.

Additional Cognitive Objectives:

1. Given the following terms, Emission Spectrum, Visible Spectru, and Absorption Spectru, the student will be able to match the given terms correctly with their proper definitions. He will do this in class, within fifteen minutes.
2. In class, without any resources the student will be able to compare the Rutherfurd Model with the Bohr Model and list the shortcomings of the extensions on the Bohr model within a twenty-five minute time limit, with no more than two mistakes.
3. In class, given the following terms, electron, proton, charge, neutron, atomic number, electromagnetic spectrum, the student will be able to match the given terms with their proper definitions within twenty minutes, with no more than two mistakes.

ACTIVITIES:

1. Have the students construct an atomic model to show the arrangement of electrons.
2. Provide more time for the students to draw the structure of a number of simple atoms.
3. Provide more time for the students to draw the atomic orbitals in specific sub-levels.
4. Use the available films and charts to help teach this unit.
5. Assign questions three and ten from the student text.
6. Define and discuss the different kinds of spectrum series.
7. Discuss the new model of the atom and how it differs from the previous models and theories.
8. Define and discuss the main parts of the atom. Use different atoms in your discussion.
9. Discuss the different bases that were used in the electronic configuration of the multi electronic atoms.

UNIT II

THE LONG FORM PERIODIC TABLE

GENERAL OBJECTIVE:

To understand the idea behind the organization of the different elements in the periodic table; to understand that the properties of any element can be known and predicted from its location in the periodic table.

AFFECTIVE OBJECTIVES:

1. At the end of this unit the student will reflect his interest in the topic by collecting and classifying samples of some common elements.
2. During class discussions about the periodic table, the student will ask for more explanation and for the titles of books that are related to the topic so that he can read in his free time.

COGNITIVE OBJECTIVES:

1. Outside class and within a two-day period, the student will be able to write with no more than three mistakes the law that was used in the organization of the elements in the periodic table.
2. Given ten elements the student will be able to write correctly the number of protons, neutrons, and

electrons for each element and to name the period and group for at least five elements. He will do this in class within a twenty-minute time limit.

3. In class and without any resources, the student will be able to solve the following problems with no more than two mistakes:

    1. State the elements of a specified atomic number,
    2. State the group number of the specified elements,
    3. State the elements of the given electronic configurations,
    4. State the oxides formulas of the given elements,
    5. State the elements of the given periodic numbers.

4. Given these terms of transitional elements, inner-transitional elements, and typical elements, the student will be able to define and differentiate correctly between the three terms on the basis of their general electronic configurations and give at least two examples for each of the three terms. He will do this in class within twenty minutes.

5. Given six elements and the periodic table only, and using his knowledge of the atomic number, the

student will be able to predict and write correctly the chemical and physical properties for at least four of the six elements. He will do this in class within a twenty-minute time limit.

6. Outside class and within a two-day period and using the periodic table only, the student will be able to list and write correctly the electronic configurations for at least four elements that in nature play especially important roles in living systems, and at least four elements that are found in minute amounts in animals and plants.

Additional Cognitive Objectives:

1. Given fifteen elements the student will be able to draw a periodic chart and place correctly at least thirteen of the fifteen elements. He will do this in class within twenty minutes.
2. In class without any resources, the student will be able to list within twenty minutes and with no more than two mistakes the chemical symbols for the elements in the first three periods of the periodic table and to draw the electronic configurations for at least one element from each of the three periods.
3. Outside class using the periodic table only, the student will be able to compare correctly between at least five periodic properties of Group I and Group

VII. He will do this within a two-day period.

ACTIVITIES:

1. Select five common elements from the periodic table and ask the students to draw the atomic structure of each along with its electronic configuration.
2. Provide a periodic chart for each student, select twenty-five elements from the periodic table, and ask the students to place the elements in their proper positions on the periodic chart.
3. Discuss the role of some elements on animal and plant life.
4. Discuss how atomic size varies for the elements of the periodic table.
5. Ask the students to participate voluntarily in designing a periodic table for their class using possible samples of real elements instead of just chemical symbols, and to give a short description of each element.
6. Assign questions three, four, and five from the student text.
7. Discuss the law that was used in the organization of the elements in the periodic table.
8. With examples, discuss how any element in the periodic table can be placed by knowing the main parts of the atom.

9. With examples define and discuss the transitional, inner-transitional and typical elements.
10. Discuss the preparation, chemical, and physical properties of certain group elements in the periodic table.

UNIT III

STRUCTURE AND BONDS IN MOLECULES AND COMPOUNDS

GENERAL OBJECTIVE:

To understand how atoms are held together by chemical bonds to form molecules and ions, and the role of the electronegativities of the atoms in the type of bond that will occur between two atoms.

AFFECTIVE OBJECTIVES:

1. By the end of this unit the student will show his interest by collecting some real samples of common compounds and classify them according to their properties and their chemical bonds.
2. By the end of this unit the student will reflect his interest by using simple materials to design and construct models for some common molecules and compounds.

COGNITIVE OBJECTIVES:

1. Given ten elements the student will be able to list them in the ascending order of their electron affinity. He will do this in class, with no more than two mistakes, within a fifteen-minute time limit.

2. Given these terms, chemical affinity, ionization potential, cation, anion, electronegativity, the student will be able to match these terms correctly with their definitions. He will do this in class without any mistakes within twenty minutes.
3. Given ten incomplete and ten unbalanced chemical equations, the student will be able to complete at least six of the incomplete equations and balance correctly at least six of the unbalanced equations. He will do this in class without any mistakes within a twenty-five minute time limit.
4. Given ten pairs of elements the student will be able to list correctly the elements that produce cation and the elements that produce anion in each pair when they are combined together. He will do this in class, without any mistakes, within a twenty-minute time limit.
5. Given these terms, ionic bond, covalent bond, and coordinate bond, the student will be able to differentiate between these terms, using at least two examples for each of these terms. He will do this in class, without any mistakes, within a twenty-minute time limit.
6. Given five elements the student will be able to construct and balance at least six chemical equations

from these elements. He will do this in class within a twenty-minute time limit and without any mistakes.

7. Given that "although the ion of an alkali element and the preceding inert gas have the same electron population, they are different in some ways and alike in the other ways," the student will be able to explain the above statement using at least one example. He will do this in writing at home within a two-day period with no more than two mistakes.
8. Given that "energy necessary to dissociate the O-O bound in H_2O_2 is less than the dissociation energy of the O_2 molecule," the student will be able to explain in writing the above statement at home within a two-day period with no more than two mistakes.
9. Given a list of ten chemical formulas, the student will be able to distinguish correctly between these formulas according to their chemical bonds in class within a fifteen-minute time limit.
10. Given a mixture of three ionic-bond compounds and three covalent compounds, the student will be able to draw the bonding electron configurations for at least two of each group in class within a twenty-minute time limit.
11. At home and without any resources, the student will be able to explain the role that polarity plays in covalent bonding and to relate polarity of molecule

to electronegativity of its atom. He will do this in writing and within a two-day period with no more than two mistakes.

12. Given a list of five different ions only, the student will be able to identify correctly the inert gases that have the same electron populations as the given ions. He will do this in class, with no mistakes within a twenty-minute time limit.

Additional Cognitive Objectives:

1. Given a list of chemical formulas for fifteen compounds, the student will be able to name and write correctly the balanced chemical equations for at least five of the listed. He will do this in class within a fifteen-minute time limit.
2. Given the terms sigma bond, hybridization, polarity, and hydration, the student will be able to distinguish correctly between the given terms and give at least one example for each of the given terms. He will do this in class within a twenty-minute time limit.
3. Without any resources the student will be able to write the correct formulas for at least twenty of the thirty compounds whose names are given by the instructor. He will do this in class within a twenty-minute time limit.

4. In class without any resources the student will be able to define correctly the Octet Rule and its role in forming the covalent bonds and give at least two different examples for the Octate Rule. He will do this in writing within a twenty-minute time limit.

ACTIVITIES:

1. Provide time for students to construct or draw certain models of molecules and compouns, possibly using simple materials.
2. Have students collect a certain number of samples of some common compounds and write an evaluation of their properties and chemical bonds for class use.
3. Use the available films, charts, and forms.
4. Assign questions eight, ten, fourteen, sixteen, and seventeen from the student text.
5. Define and discuss ionization potential, cation, anion, electron affinity, and electronegativity.
6. Discuss the way that the items listed in the preceding question are used in the balance of chemical equations.
7. Using examples, discuss how to write the correct products or the initial components in incomplete chemical equations.
8. Using examples, discuss ionic bond, covalent bond, and coordinate bond.

9. Using examples, discuss the differences between the bond of similar atoms and the bond of different atoms.
10. Using examples, discuss the bonding electron configuration of the different kinds of bonds.
11. Discuss the role of polarity and its relation to the electronegativity of the atom.
12. Using examples, define and discuss sigma bond, hybridization, polarity, and hydration.
13. Using examples, discuss how to write the correct formula for a specified number of chemical compounds.
14. Using examples, discuss the role of the Octate Rule in covalent bonds.

UNIT IV

HYDROGEN, OXYGEN, AND THEIR COMPOUNDS

GENERAL OBJECTIVES:

1. To learn and understand the laboratory methods of preparing hydrogen and oxygen; learn some of the physical and chemical properties of these elements.
2. To become familiar with the different sources of water, the structure of water molecules, and some of its physical and chemical properties; understand why water is an unusual liquid.
3. To become familiar with the structure, properties and uses of hydrogen peroxides; understand a laboratory method for its preparation.

AFFECTIVE OBJECTIVES:

1. At the end of this unit the student will reflect his interest by explaining to his family and neighbors the dangers of dirty water; he will explain how people can purify their water by using simple methods. He will do this voluntarily and in his extra time.
2. When provided with a choice of outside class activities, the student will join and participate in the school science club.

3. During this unit the student will reflect his interest by visiting the water distillation plants and several locations of natural water in Kuwait.

COGNITIVE OBJECTIVES:

1. In class, without any resources and within a twenty-minute time limit, the student will be able to identify correctly the location of hydrogen in the periodic table, the chemical bond in the hydrogen molecules, and write the structural formula of the hydrogen isotopes.
2. In the laboratory, with available materials and within a tenty-minute time limit, the student will be able to perform an experiment for preparing oxygen. He will then wirte the correct balanced chemical equation for his experiment and for two other ways of hydrogen preparation.
3. In the laboratory, with the available materials and within a twenty-minute time limit, the student will be able to perform an experiment to show that hydrogen is a reducing agent and to explain oxidation-reduction by equations according to the electronic configurations of the elements used in the experiment. He will do this with no more than two mistakes.
4. In the laboratory, with available materials and within a twenty-minute time limit, the student will be

able to construct an experiment to prepare oxygen, write the balanced chemical equations of his experiment, and list at least two physical and two chemical properties for oxygen.

5. Given three different oxidation-reduction equations, the student will be able to identify correctly the substance oxidized, the substance reduced, the oxidizing agent, and the reducing agent. He will do this in class within a fifteen-minute time limit.
6. Given a list of fifteen different oxides, the student will be able to sort those oxides correctly into acidic oxides, basic alkali oxides, basic non-alkali oxides, amphoteric oxides, and peroxides. He will do this in class within a twenty-minute time limit.
7. Outside class, with available resources and within a two-day period, the student will be able to write an essay in 250 words or less on the role of oxygen in animal and human life.
8. Given a list of chemical and physical properties of oxygen and hydrogen, the student will be able to distinguish between the chemical and physical properties of oxygen and those of hydrogen. He will do this in class, within a twenty-minute time limit, and with no more than two mistakes.

9. Using an appropriate religious text as a resource, the student will be able to write a minimum of three statements about the importance and the necessity of water for life. He will do this at home within a two-day period.

10. In class, without any resources and within a twenty-minute time limit, the student will be able to list a minimum of three kinds of water impurities and explain a minimum of four methods used in water purification.

11. In class,w ithout any resources and within a fifteen-minute time limit, the student will be able to write a comparison of a minimum of five different properties of regular water (H_2O) and heavy water (D_2O). He will do this with no more than two mistakes.

12. In class,without any resources and within twenty minutes, the student will be able to draw the structure of water molecules and use examples to explain two of the unusual properties of water. He will do this with no more than two mistakes.

13. In the laboratory, with available materials and within a twenty-minute time limit, the student will be able to distinguish between the cause of temporarily hard water and the cause of permanent hardness; by experiment he will be able to explain one method each that can be used to control the temporary

hardness and the permanent hardness of water. He will do this with no more than two mistakes.

14. In the laboratory, with available materials, within a thirty-minute period and with no more than two mistakes, the student will be able to construct an experiment to prepare the hydrogen peroxides and give a minimum of three physical and three chemical properties for hydrogen peroxides.
15. In the laboratory, with available materials, within a thirty-minute time limit and with no more than two mistakes, the student will use balanced chemical equations to prove that hydrogen peroxide is an oxidizing and reducing agent.

Additional Cognitive Objectives:

1. Given a list of ten elements, the student will be able to write (1) the chemical equations for those elements which can be substituted for the hydrogen cations in the acid and (2) those elements which can be substituted for the hydrogen atoms in water. He will do this in class, within a twenty-minute time limit and with no more than two mistakes.
2. In class, without any resources, within a twenty-minute time limit and with no more than two mistakes, the student will be able to write the structural formulas for a minimum of three of the hydrogen

compounds and name the chemical bonds in the three compounds.

3. Given a list of eight elements, the student will be able to list and write the balanced chemical equations for those elements which can be substituted for oxygen in its compounds. He will do this in class, within a fifteen-minute time limit and with no more than two mistakes.

4. Given these formulas, H_2O, H_2S, H_2Te, and H_2Se, the student will be able to identify and explain the formula with the stronger hydrogen bond. He will do this in class within a fifteen-minute time limit.

5. Outside class, within a two-day period and in 100 words or less, the student will be able to write an essay covering three areas in which hydrogen peroxides are used.

ACTIVITIES:

1. Visit the manufacturers which are related to the topics of this unit.

2. Visit the sea water distillation plants and several locations of natural water in Kuwait.

3. Have the students draw the Kuwait map indicating the location of portable and brackish water in Kuwait.

4. Use available films.

5. Assign questions twelve, thirty-one, and thirty-four from the text.
6. Discuss the location of hydrogen in the periodic table, the bond in hydrogen molecule, and the structural formulas of the hydrogen isotopes.
7. Using examples, discuss the chemical bonds in some hydrogen compounds.
8. Provide laboratory time for the students during which they can prepare and test the chemical and physical properties of hydrogen, oxygen, and hydrogen peroxides.
9. Using chemical equations and laboratory experiments, define and discuss the oxidation-reduction in hydrogen, oxygen, and hydrogen peroxides. Explain how oxidation always is accompanied by reduction--one cánnot occur without the other.
10. Using examples, discuss the oxidizing and reducing agents.
11. Provide more time for the students to write and balance oxidation-reduction equations.
12. Using examples, discuss the acidic oxides, alkali oxides, basic unalkali oxides, amphoteric oxides, and peroxides.
13. Discuss the role of oxygen in human and animal life.
14. Discuss water impurities and the different ways to purify water in the laboratory. Ask the students

to suggest some other ways that water can be purified.

15. Discuss the differences between regular water and heavy water, the structural formula of water molecules, and the unusual properties of water.

16. Define and discuss temporarily-hard and permanently-hard water. Using experiments, explain the usual ways of controlling these two kinds of water.

UNIT V

CARBON CHEMISTRY

GENERAL OBJECTIVES:

1. To become familiar with the structure of the carbon atom along with the structure, prepration, and properties of carbon monoxide and carbon dioxide.
2. To know and understand the principles of organic chemistry, its classifications, and its role in our daily lives.

AFFECTIVE OBJECTIVES:

1. During the study of this unit the student will show his interest by discussing with his family and neighbors the dangers of living in a closed room with incompletely burned coal and the effect of CO and CO_2 on their daily lives.
2. By the end of this unit the student will reflect his interest by discussing and explaining to friends, family, and neighbors the role of oil energy in our daily lives and how to avoid the waste of energy in and outside of the home.
3. When given a choice of the science or art curriculums, the student chooses the science curriculum for his future study.

COGNITIVE OBJECTIVES:

1. In class, without any resources, within a fifteen-minute time limit and with no more than two mistakes, the student will be able to write the electronic configuration of the carbon atom and explain why carbon atoms are rarely from anions and cations.
2. In class, without any resources, within a twenty-five minute time limit and with no more than two mistakes, the student will be able to list the names and the chemical formulas for at least five organic and five inorganic compounds of which carbon is a part. Identify the chemical bond in each of the ten compounds.
3. In the laboratory, with the available materials, within a one-hour time limit and with no more than two mistakes, the student will be able to prepare carbon dioxide and carbon monoxide. He will be able to compare the experiments, showing a minimum of two physical properties and three chemical properties, and write the balanced chemical equations including the one for oxidation-reduction.
4. Given sodium carbonate [Na_2CO_3], potassium carbonate [K_2CO_3], and ammonium carbonate [$(NH_4)_2 CO_3$], as unknowns, the student will be able to distinguish between these compounds in the laboratory within a

thirty-minute time limit and with no more than two mistakes.

5. Given the organic compounds methane, ethance, butane, propane, acetylene, and cylothexene, the student will correctly write the structural formulas, identify the group of each, and identify which ones are saturated or unsaturated compounds. He will do this in class, without any resources and within a twenty-five minute time limit.
6. Given the terms alkanes, alkyl radical, and homologous series, the student will be able to match each term with its correct definition and give at least two correct structural formulas for each. He will do this in class, without any resources and within a thirty-minute time limit.
7. Given the terms polymerization, substitution reactions, and addition reactions, the student will correctly define each term and give at least one example of each. He will do this in class, without any resources within a twenty-five minute time limit.
8. In the laboratory, with available materials, within a one-hour time limit and with no more than three mistakes, the student will be able to prepare one compound for each of these groups, alkanes, alkenes, and alkynes. He will write the structural formula and the chemical

equation for one chemical property from each group.

9. In class, without any resources and within a twenty-minute time limit, the student will select a correct use for each of the petroleum products and biproducts on a list that is provided by the instructor.

10. Given that "our world is facing a big industrial problem because of its dependence on oil and natural gas which will be depleated at some time in the future," the student will be able to write an essay of no more than 250 words discussing the statement and suggesting at least two ways to avoid a critical energy shortage in the future. He will do this outside of class and within a two-week period.

Additional Cognitive Objectives:

1. In class, without any information or resources and within a twenty-minute time limit, the student will be able to write the correct electronic configuration of carbon monoxide and carbon dioxide and explain the resonance phenomena.

2. In the laboratory, with available materials, and within a thirty-minute time limit, the student will be able to distinguish experimentally between a solution of potassium carbonate [K_2CO_3] and a solution of sodium bicarbonate [$NaHCO_3$] which have been given as un-

knowns by the instructor. He will do this with no more than two mistakes.

ACTIVITIES:

1. Have students research and discuss the history of oil in Kuwait.
2. Have students draw a map of Kuwait indicating the location of oil fields.
3. Take a trip to the oil exhibition in Ahmedi City, Kuwait.
4. Have the class collect samples of oil derivitives and draw a cross-section of an oil well.
5. Have students discuss the role of oil and its products in our daily lives suggest ways to conserve petroleum energy.
6. Show students films on oil and its uses.
7. Discuss the different uses of petroleum products and biproducts.
8. Provide more time for laboratory preparation and testing of CO and CO_2.
9. Have the students discuss the effects of CO and CO_2 on life.
10. Discuss the electronic configuration of the carbon atom and the carbons' cations and anions.
11. Provide more laboratory time so that students will have the opportunity to distinguish between selected

carbon compounds.

12. Provide more time for the students to draw the structural formulas of the common organic compounds, name their bonds, classify according to groups, and distinguish between saturated and unsaturated compounds.
13. Using examples, discuss the differences between the addition and substitution reactions.
14. Provide laboratory time so that students may prepare and test the chemical and physical properties of methane, ethene, acetylene. The students should list the chemical equations of the reactions and the structural formulas of these compounds.
15. Name and write the structural formulas of the first five compounds of alkanes, alkenes, and alkynes series.
16. Assign questions seventeen, eighteen, nineteen, and twenty-one from the text.

Summary

In this chapter a set of criteria for useful and valid behavioral objectives was developed. Using these criteria a set of behavioral objectives for each major division of the Kuwaiti chemistry course was outlined. Each major division was provided with general objective(s), affective objectives, cognitive objectives, and a list of activities.

CHAPTER BIBLIOGRAPHY

1. Bloom, Benjamin S., ed., Taxonomy of Educational Objectives, Handbook I: Cognitive Domain, New York, David McKay Company, Inc., 1956.

2. Esbensen, Thorwald, "Writing Instructional Objectives," Phi Delta Kappan, XLVIII (January, 1967), 246-247.

3. Koran, Jr., JOhn J., and others, "How to Use Behavioral Objectives in Science Instruction," ERIC ED 036 428, 1969.

4. Krathwohl, David R., Benjamin S. Bloom, and Bertram B. Masia, Taxonomy of Educational Objectives, Handbook II: Affective Domain, New York, David McKay Company, Inc., 1964.

5. Mager, Robert F., Preparing Instructional Objectives, Belmont, California, Fearon Publishers, 1975.

6. Popham, W. James and Eva L. Baker, Establishing Instructional Goals, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1970.

7. Troyer, Donald Lee, "Formulating Performance Objectives," in Developing Teacher Competencies, edited by James E. Weigand, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1971, pp. 43-80.

8. Zaid, Robert S., Curriculum Principles and Foundations, New York, Thomas Y. Crowell Company, Inc., 1976.

CHAPTER IV

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

In this chapter a summary of the study is provided and certain conclusions are drawn. Recommendations for the Kuwaiti chemistry course, the use of behavioral objectives, and for further studies on behavioral objectives are listed.

Summary of the Study

The purpose of the study is to develop a set of behavioral objectives for the Second Year Chemistry course in Kuwaiti secondary schools. The set of behavioral objectives has been developed to help the teachers to choose their activities, teaching methods, questions, evaluation procedures, and to use as a guide in the preparation and use of behavioral objectives for other courses.

The available literature on the CHEM Study and an American traditional course was reviewed which indicated that the CHEM Study approach is more effective than the traditional course in the areas of student achievement and cognitive abilities (such as application and analysis processes). Research also indicates that the mimeographed laboratory sheet is the most effective type of laboratory report.

Based on this review of the literature, a comparison of the CHEM Study, an American traditiona course, and the Kuwaiti course was made in order to determine how the Kuwaiti course compares with the two American courses. This comparison concentrated on the areas of content, laboratory work, and organization. By comparison, the Kuwaiti course appeared to be closer to the CHEM Study in that the subject matter is organized in big units rather than separate subjects as in the traditional course. The Kuwaiti course appears to be similar to the CHEM Study since the subject matter is approached in the same manner. For instance, on the subject of atomic theory, both the CHEM Study and the Kuwaiti course deal with this topic as one that is subject to change or modification in the future with the advent of more advanced instruments and research.

On the other hand, the Kuwaiti course has more similarity to the traditional course in the area of the type of questions that are listed at the end of each chapter. Both the Kuwaiti course and the traditional course list some easy questions that students can answer without much thought or research because the answers are clearly stated in the text. The Kuwaiti course is also closer to the traditional approach in the area of laboratory work. Both require few activities that could lead to discovery and useful observations becaue laboratory work and procedures are so simple.

The available literature on behavioral objectives has been surveyed and the results of the reviewed studies indicates that the use of behavioral objectives is more effective than the general objectives (or no objectives) on students' achievement and attitudes, course content, and the organization of complex cognitive processes.

A set of criteria for useful and valid behavioral objectives has been developed based on Mager's _Preparing Instructional Objectives_ (1) and Troyer's _Formulating Performance Objectives_ (2). Using these criteria, a set of behavioral objectives has been stated for each major division of the Kuwaiti secondary schools' official text, _Chemistry for the Second Year in Secondary School_. Each major division contains general objective(s), affective objectives, essential cognitive objectives, additional cognitive objectives, and a list of activities. Psychomotor objectives were not developed in this study because of the nature of the subject matter of the course under study.

Conclusions

From the related literature on the CHEM Study and the American traditional course, from the comparison between the CHEM Study, American traditional course, and the Kuwaiti course, and from the related literature on the behavioral objectives, the following conclusions are drawn.

1. The CHEM Study as a modern approach appears more effective than the traditional course in the teaching of chemistry especially in the areas ofstudents' achievement and the stimulation of high cognitive abilities such as application and analysis processes.

2. The present Kuwaiti text appears more organized than the texts which were used previously; it is a movement toward the modern approach in chemistry teaching. This is most apparent in the use of unit organization and the manner in which the subject matter is handled.

3. Use of behavioral objectives appears more effective than the use of general objectives (or no objectives) in teaching learning processes, especially in the areas of students' achievement and attitudes, the course content, and the organization of complex cognitive processes.

Recommendations of the Study

Based on a survey of the related literature and the discussion presented in this study, the following recommendations are made.

1. The teacher guide of the Kuwaiti course should be provided with

a. more learning activities,

b. suggestions of further reading for both teachers and students,

c. behavioral objectives.

2. Revise the text to include more examples and problems that lead the students into more discussion and research.

3. Revise the text to include more effective end-of-unit questions that are stated in a thought-provoking, indirect, and challenging way.

4. Make the laboratory work more effective by allowing more time and opportunity for students to experiment and participate, i.e., construct the apparatus, observe, explain, analyze, draw conclusions.

5. Provide more time for students to experience the potential applications of their knowledge of chemistry through field trips and in the classroom.

6. Develop behavioral objectives for the different courses in the Kuwaiti Public Schools.

7. Provide more time for teachers to develop behavioral objectives for their own courses by allowing students to participate in the development of these objectives.

8. Initiate a research program in which behavioral objectives are used with one group and non-behavioral objectives are used with a second group in order to determine the relative effectiveness of the behavioral objectives on student achievement.

9. Design a research study in which the behavioral objectives are given to the first experimental group prior to instruction, are given to the second experimental group after instruction, and non-behavioral objectives are given to a third (control) group in order to see which procedure is most effective on student achievement.

10. Design a research study for a science course in which behavioral objectives are used with the experimental group and non-behavioral objectives are used with the control group in order to see which procedure is more effective on student attitudes toward the science curricula.

11. Design a research project using chemistry laboratory students wherein one group uses behavioral objectives and the second group uses non-behavioral objectives to find which of these procedures is more effective on student achievement.

12. Design a research study to evaluate how teachers feel about behavioral objectives and the effect of behavioral objectives on the teaching process.

CHAPTER BIBLIOGRAPHY

1. Mager, Robert F., Preparing Instructional Objectives, Belmont, California, Fearon Publishers, 1975.

2. Troyer, Donald Lee, "Formulating Performance Objectives," in Developing Teacher Competencies, edited by James E. Weigand, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1971, pp. 43-80.

BIBLIOGRAPHY

Books

Bailey, J. M., Chemistry Handbook for Teachers, Fort Worth Public Schools Curriculum Bulletin Number A273, Fort Worth, Texas, 1964.

Bloom, Benjamin S., ed., Taxonomy of Educational Objectives, Handbook I: Cognitive Domain, New York, David McKay Company, Inc., 1956.

Dull, C. E., Clark Metcalf, and John E. Williams, Modern Chemistry, New York, Holt, Rinehart and Winston, Inc., 1962.

Ezzat, Kayrey and others, Second Year Chemistry in Secondary School, 2nd edition, Ministry of Education, Kuwait, 1977/78.

Hyman, Ronald T., Ways of Teaching, New York, J. B. Lippincott Company, 1974.

Krathwohl, David R., Benjamin S. Bloom, and Bertram B. Masia, Taxonomy of Educational Objectives, Handbook II: Affective Domain, New York, David McKay Company, Inc., 1964.

Mager, Robert F., Preparing Instructional Objectives, Belmont, California, Fearon Publishers, 1975.

Marshall, J. S. and E. Burkman, Current Trends in Science Education, New York, The Center for Applied Research in Education, 1966.

Merril, R. J. and David W. Ridgway, The CHEM Study Story, San Francisco, W. H. Freeman and Company, 1969.

Pimental, George C., editor, Chemistry An Experimental Science, San Francisco, W. F. Freeman and Company, 1963.

Popham, W. James and Eva L. Baker, Establishing Instructional Goals, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1970.

Taba, Hilda, Curriculum Development: Theory and Practice, New York, Harcourt, Brace, and World, 1962.

Zaid, Robert S., Curriculum Principles and Foundations, New York, Thomas Y. Crowell Company, Inc., 1976.

Articles

Backer, Eva L., "Effects on Student Achievement of Behavioral and Non-Behavioral Objectives," Journal of Experimental Education, XXXVII, No. 4 (Summer, 1969), 5-8.

Bennett, Lloyd M. and Barbra Kinnard Pyke, "A Discussion of the New Chemistry Programs (CHEMS and CBA) and the Traditional Programs in High School," School Science and Mathematics, LXVI (December, 1966), 823-830.

Esbensen, Thorwald, "Writing Instructional Objectives," Phi Delta Kappan, XLVIII (January, 1967), 246-247.

Hardy, C. A., "Achievement and Level of Critical Thinking in CHEM Study and Traditional Chemistry," The Journal of Educational Research, LXV (December, 1970), 159-162.

Hartky, James and Ivor K. Davies, "Pre-Instructional Strategies: The Role of Pre-Test, Behavioral Objectives, Overviews, and Advance Organizers," Review of Educational Research, LXVI (Spring, 1976), 239-265.

Herron, J. D., "Evaluation and the New Curricula," Journal of Research in Science Teaching, IV (September, 1966), 159-170.

Jenkins, J. R. and S. L. Deno, "Influence of Knowledge and Type of Objectives on Subject Matter Learning," Journal of Educational Psychology, LXII (February, 1971), 67-70.

McNeil, J. D., "Concomitants of Using Behavioral Objectives in The Assessment of Teacher Effectiveness," Journal of Experimental Education, XXXVI (1967), 69-74.

Piatt, R. G., "An Investigation of the Effect the Training of Teachers in Defining Writing and Implementing Educational Objectives Has on Learner Outcomes for Students Enrolled in a Seventh Grade Mathematics Program in the Public Schools," Review of Educational Research, XLVI (1976), 239-265.

Pode, J. S. F., "CBA and CHEM Study, An Appreciation," Journal of Chemical Education, XLIII (February, 1966), 98-103.

Popham, W. James, "Must All Objectives Be Behavioral?" Educational Leadership, XXIX (April, 1972), 605-608.

Popham, W. James, "Practical Ways of Improving Curriculum Via Measurable Objectives," in Teaching Today, edited by J. Michael Palardy, New York, Macmillan Publishing Co., 1975, pp. 100-110.

Rainey, R. G., "Comparison of the CHEM Study Curriculum and a Conventional Approach in Teaching High School Chemistry," School Science and Mathematics, LXIV (June, 1964), 539-544.

Rothkopf, E. Z. and R. Kaplan, "Explanation of the Effect of Density and Specificity of Instructional Objectives on Learning from Text," Journal of Educational Psychology, LXIII (1972), 291-302.

Troyer, Donald Lee, "Formulating Performance Objectives," in Developing Teacher Competencies, edited by James E. Weigand, Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 1971.

Walker, Noojin, "CHEM Study, CBA, and Modern Chemistry A Comparison," School Science and Mathematics, LXVII (October, 1967), 603-609.

Public Documents

Annual Statistical Abstract, State of Kuwait, Ministry of Planning, Central Statistical Office, 1976.

"Focus on Kuwait," London, The London International Press Center, May, 1975.

"Kuwait Review," State of Kuwait, Ministry of Planning, Central Statistical Office, 1978.

"Kuwait Shares its Wealth," State of Kuwait, Ministry of Information.

"A View of Kuwait," The Embassy of the State of Kuwait, Washington, D. C., 1976.

ERIC Documents

Anderson, Elaine J. and others, "Behavioral Objectives: Science Process and Learning from Inquiry-Oriented Instructional Materials," paper presented at the Annual Meeting of the National Association for Research in Science Teaching, ERIC ED 091 205, April, 1974.

Atwood, Ronald K., "A Comparative Study of Achievement in CHEM Study Chemistry Among Groups of Eleventh Grade Students Classified on the Basis of Frequency of Choices on a Cognitive Preference Examination," ERIC ED 030 571, 1966.

Bassett, Ronald E. and Robert J. Kibler, "Effect of Training in the Use of Behavioral Objectives on Speech Communication," paper presented at the Annual Meeting of the International Communication Association, New Orleans, Louisiana, ERIC ED 094 426, April 17-20, 1974.

Benis, Katherine A. and Glen B. Schroeder, "The Writing and the Use of Behavioral Objectives," Southwestern Cooperative Educational Lab, Albuquerque, New Mexico, ERIC ED 033 881, 1969.

Booth, James L., "Behavioral Objectives: A Review of Theoretical Positions and Empirical Evidence and an Investigation of the Effects of Two Types of Instructional Objectives on Student Achievement and Attitudes in a Basic Speech Communication Course," paper presented at the Annual Meeting of the Speech Communication Association, Illinois, ERIC ED 101 412, December, 1974.

"Capital Middle Schools Science Department Preliminary List of Behavioral Performance Objectives," Delaware State Department of Public Instruction, Del Mod System, Dover, Delaware, ERIC ED 096 112, 1973.

Capper, Michael R., "Instructional Objectives for a Junior College Course in Biology (First Semester)," California University, Los Angeles, ERIC ED 033 686, 1969.

________________, "Instructional Objectives for a Junior College Course in Chemistry, California University, Los Angeles, ERIC ED 033 688, 1969.

________________, "Instructional Objectives for a Junior College Course in Geology," California University, Los Angeles, ERIC ED 033 696, 1966.

________________, "Instructional Objectives for a Junior College Course in Physics (First Semester)," California University, Los Angeles, ERIC ED 033 710, 1969.

Capper, Michael R., "Instructional Objectives for a Junior College Course in Physiology (First Semester)," California University, Los Angeles, ERIC ED 033 711, 1969.

_______________, "Instructional Objectives for a Junior College Course in Zoology," California University, Los Angeles, ERIC ED 033 718, 1969.

Cook, J. M., "Learning and Retention by Informing Students of Behavioral Objectives and Their Place in the Hierarchical Learning Sequence," University of Maryland, College Park, Maryland, ERIC ED 036 869, 1969.

Eberwein, Lowell, "Effect of Behavioral Objectives Information upon Remedial Reader Performance," paper presented at the Annual Meeting of the Southeastern Regional International Reading Association, Louisville, Kentucky, ERIC ED 132 533, 1974.

Freeman, Donald F. and William A. Mehrens, "The Functional Limits of Behavioral Objectives," ERIC ED 103 345, 1973.

Hill, Richard K., "Behavioral Objectives for Selected Agricultural Education Units, Vocational Education, Evaluation Project," State Department of Education, Richmond, Virginia, ERIC ED 094 199, 1973.

Hill, Richard K. and others, "Behavioral Objectives and Related Test Items for Selected Units in Automotive Machines," State Department of Education, Richmond, Virginia, ERIC ED 095 417.

_______________ and B. June Schmidt, "Behavioral Objectives for Selected Units in Business Education," Blacksburg, Virginia, ERIC ED 095 418.

_______________ and Helen A. Simmons, "Behavioral Objectives for Selected Units in Consumer and Homemaking Education," Vocational Education, Evaluation Project, ERIC ED 094 198, 1973.

_______________________________, "Behavioral Objectives for Selected Units in Occupational Child Care Education," Vocational Education, Evaluation Project, ERIC ED 094 196, 1973.

_______________ and William R. Williams, "Behavioral Objectives for Selected Unites in Drafting," Vocational Education, Evaluation Project, ERIC ED 094 197, 1973.

Hinerman, Charles O., "The Development of Behavioral Objectives for the Undergraduate Science Program for Elementary Teachers, Final Report," National Center for Educational Research and Development, Washington, D. C., ERIC ED 111 673, 1973.

Janeczko, Robert John, "The Effect of Instructional Objectives and General Objectives on Student Self-Evaluation of Psychomotor Performance in Power Mechanics, ERIC ED 057 188, 1971.

Koran, John J. and others, "How to Use Behavioral Objectives in Science Instruction," National Science Teacher Association, Washington, D. C., ERIC ED 036 428, 1969.

Martin, William Joseph, "The Use of Behavioral Objectives by Basic Vocational Science Students," paper presented at the Annual Meeting of the National Association for Research in Science Teaching, Chicago, Illinois, ERIC ED 092 392, April, 1974.

Matthews, Charles C., "The Classroom Verbal Behavior of Selected Secondary School Science Student Teachers and Their Cooperating Classroom Teachers," ERIC ED 023 593, 1966.

Merrill, Paul F. and Nelson J. Towle, "The Effect of the Availability of Objectives on Performance in a Computer-Managed Graduate Course," paper presented at the Annual Meeting of the American Educational Research Association, Chicago, April, 1972, ERIC ED 0-6 016.

Mosley, William E. and Paul E. Bell, "The Effect of Specific and Non-Specific Behavioral Objectives on Eighth Grade P.S.1 Student Achievement," paper presented at the Annual Meeting of the National Association for Research in Science Teaching, San Francisco, California, ERIC ED 125 905, April 23-25, 1976.

"Performance Objectives Development Project," Michigan State Department of Education, Lansing, Vocational Education and Career Development Service, ERIC ED 105 246, 1974.

Ramsey, Gregor A., "A Review of the Research and Literature on the Chemical Education Materials Study Project," Research Review Series--Science Paper 4, Ohio State University, Columbus, ERIC ED 037 592, January, 1970.

Rexroat, Melvin E., "Math Objectives and Utilization of State Math Curriculum Guide, Module CMM,066:03," Idaho State University, Pocatello, Idaho, ERIC ED 130 827, 1972.

Royer, Paula Nassif, "The Effect of Specificity and Position of Written Instructional Objectives on Learning from Lecture," paper presented at the Annual Meeting of the American Educational Research Association, San Francisco, California, ERIC ED 120 696, April, 1976.

"Science Education, Student Terminal Goals, Program Goals, and Behavioral Objectives," Mesa Public Schools, Arizona, ERIC ED 089 979, 1973.

"Secondary Schools Curriculum Guide, Mathematics, Grades 7-9," Agency-Bureau of Elementary and Secondary Education, Washington, D. C., ERIC ED 102 22, 1974.

Swartney, Ilene Joyce, "Learning Difficulties Encountered by Students Studying the CHEM Study Program," Development Center for Cognitive Learning Sponsoring Agency--Office of Education, ERIC ED 036, 445, 1969.

"Vocational Cosmetology: An Integrated Secondary-Post Secondary Curriculum Guide," Utah State Board for Vocational Education, Salt Lake City, Utah, ERIC ED 089 014, 1971.

Walbesser, Henry H. and Theodore A. Esenberg, "A R view of Research on Behavioral Objectives and Learning Hierarchies," ERIC 059 900, 1972.

West, William W. and Elaine K. Tivnan, "What Seems to Be the Most Effective Way of Disseminating Reading Research in Meaningful and Useful Manner to Classroom Teachers?" paper presented at the Annual Meeting of the International Reading Association, New Orleans, Louisiana, ERIC ED 089 206, May 1-4, 1974.

Unpublished Materials

Booth, James L., "An Investigation of the Effects of Two Types of Instructional Objectives on Student Achievement and Attitudes," unpublished doctoral dissertation, Purdue University, West Lafayette, Indiana, in Dissertation Abstracts International, XXXIV (1974), 4685.

Bryant, Napoleon, Jr., "The Effect of Performance Objectives on the Achievement Level of Selected Eighth-Grade Science Pupils in Four Predominantly Black Inner City Schools," unpublished doctoral dissertation, Indiana University, in Dissertation Abstracts International, XXXI (1971), 5869.

Cleare, Bruce Emmanuel, "An Investigation of the Interaction Between Student-Teacher Cognitive Ability Patterns Using Achievement in the Chemical Education Material Study

Chemistry Course as the Criterion Variable," unpublished doctoral dissertation, Florida State University, Tallahassee, ERIC ED 028 072, 1966.

Cooper, Martin, "The Effect of Behavioral Objectives and Tolerance of Ambiguity on Achievement in English Skills," unpublished doctoral dissertation, Forham University, in Dissertation Abstracts International, XXXVII (1976), 2734A.

Cottingham, Charles Louis, "A Comparative Study of CHEM Study and Traditional High School Chemistry in Relation to Students' Success in CollegeChemistry, unpublished doctoral dissertation, Texas A & M University, College Station, Texas, in Dissertation Abstracts International, XXXII (1971), 267A.

Hardy, C. A., "An Analysis of Achievement and Level of Critical Thinking in CHEM Study and Traditional Chemistry," unpublished doctoral dissertation, Texas Technological College, 1969.

Hesson, Justus Clyde, "Effects of Performance Objectives on Reading Achievement in a Community College Reading Program," unpublished doctoral dissertation, University of New Mexico, in Dissertation Abstracts International, XXXV (1975), 5681A.

Mottillo, Joseph Louis, " Comparative Analysis of Achievement and Attitudes of the Twelfth Grade PSSC Physics Students When They Receive as Opposed to When They Do Not Receive Behavioral Objectives Prior to Instruction," unpublished doctoral dissertation, Wayne State University, in Dissertation Abstracts International, XXXIV (1973), 3034.

Payne, Charles Ray, "A Comparison of Achievement of High School Chemistry Classes Whose Students and Teachers Use Behaviorally Stated Objectives with Classes Whose Teachers and Students Use Non-Behaviorally Stated Objectives," unpublished doctoral dissertation, University of Virginia, in Dissertation Abstracts International, XXXIII (1973), 3428A.

Torop, William, "An Experimental Study to Determine the Relative Effectiveness of Four Methods of Laboratory Reports in the Teaching of CHEM Study Chemistry," unpublished doctoral dissertation, Pennyslvania University, Philadelphia, in Dissertation Abstracts International, XXIX (1968), 1481A.

Troxel, Verne Aubry, "An Analysis of Instructional Outcome of Students Involvement with Three Courses in High School Chemistry," unpublished doctoral dissertation, University of Iowa, Iowa City, in *Dissertation Abstracts International*, XXIX (1968), 1832A.

Newspaper

Al Anba, Kuwait, May 14, 1978.