AN EVALUATION OF THE OKLAHOMA STATE UNIVERSITY ENERGY AWARENESS PROGRAM FOR ELEMENTARY AND SECONDARY TEACHERS

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CHAPTER I

INTRODUCTION

The United States is faced with some energy problems. The world's oil supply is dwindling and there seems to be no end in sight. For every decade that passes, the world's consumption rate is more than all consumption in history (Ehrlich, 1979). Even though the consumption rate has increased, some wells are capped and left alone because they are deemed too expensive to pump.

Solar energy has not been broadly used. Scientists have made progress in researching the use of solar energy, but it is still not a viable, cost efficient source of energy. Solar energy has its problems. Diurnal, seasonal and climatic variations in available sunlight require the use of sizeable energy storage systems or hybrid applications with other energy sources in order to provide reliable around-the-clock energy supplies (Hart, 1978). Also, solar energy is a diffuse source and varies in intensity from place to place over the earth (Hart, 1978). Using it on a large scale therefore requires elaborate collection and concentration systems (Hart, 1978).

While nuclear power seems to supply a limitless amount of energy, and to some is the energy of the future, its popularity has had some setbacks. Three-mile Island, along with the Chernobyl accident that occurred in the Soviet Union, remain in the minds of many. The mining of uranium, a fuel source of nuclear power plants, has been costly. Along with workers being exposed to the high risks of radon gasses, deposited reserves are harder to find. Also, disposal practices have not been adequate in recent years. Leaking storage canisters and a lack of states that want to bury the waste have been two of the major concerns of the nuclear industry.

Because of all the above stated problems, students in this nation should be taught the hazards of the energy problem. Along with the hazards, students must learn about conservation as well. Geil and Sheldon (1983) state,

Schools can and should play a major role in educating today's youth to the facts of our energy situation and the interrelationships between lifestyles and energy use. In addition, formal instruction must promote the development of an energy conservation ethic. In order to meet this challenge, teachers at all levels need to be knowledgeable of basic energy concepts and technologies, and of methods and materials for incorporating energy topics into their classrooms. To make this information available and to keep teachers abreast of new developments, workshops with appropriate content and pedagogy need to be provided (p. 91).

Statement of the Problem

The ever-increasing reliance upon fossil fuels as a primary source of energy accompanied by a subsequent decrease in their availability makes it imperative to the well-being and security of all Americans that the production, the use, and the conservation of energy be well understood by each individual (Ehrlich, 1979). In order for the present dilemma in energy to be understood, everyone must be educated as to the current problem that has faced our nation for many years: the depletion of non- renewable energy sources.

Society must be made aware of the facts in order to wisely consume the remaining non-renewable energy sources. Ernest Boyer (1977), United States

Commissioner of Education, called for schools and colleges of this nation "to begin to bring about curricular changes that focus on the development of perspectives and attitudes that will ensure our global survival in an energy-short world" (p 55-58). Energy Education materials have been developed for people of all ages, from preschool to adulthood and have included all aspects of the prevailing problem, from energy conservation to energy use.

In the summer of 1976, Oklahoma State University presented the first Energy Awareness Program, which focused on the development of course materials for elementary and secondary education teachers. The program was summarized as follows: The program is a cooperative venture between the college of education and the energy producing industries of Oklahoma. The purpose of the work conference is to explore the energy problem in an informal setting as it relates to private industry, government and the consumer. The forms of energy that will be covered are solar, wind, oil, natural gas, and coal. Time will be devoted to implementation of energy education materials into the classroom. Field trips to energy production sites will also be a major portion of the program (1988, n.p.)

The general problem lies in the fact that there has not been an evaluation of the energy awareness program during the last 17 years that considers behavioral changes in the participants' life; as well as a change in the participants' instructional time in the classroom concerning energy education. Since the teachers have attended the Energy Awareness Program, what changes have been made in their present behaviors in their personal life and in the classroom? Did the participants have any attitude changes? Did the teachers make any curricular changes after the energy program concerning instructional time and techniques in the classroom? This study was undertaken to see what changes the Energy Awareness Program had on its participants, if any.

Statement of the Purpose

The purpose of this study is to evaluate the Energy Awareness Program at Oklahoma State University by assessing the participants' personal attitudes and ways in which their attitudes and behaviors changed as a result of the program.

Research Questions

1. What influence has the conference had on the participants' present energy consumption behavior, if any?
2. What areas have changed in the participants' personal life because of something presented in the energy program?
3. Is there any difference in the participants' energy units after attending the energy program compared to before the energy program?
4. Did the participants perceive the energy awareness program to direct awareness to all grade levels of the curriculum?

Significance of the Study

It is hoped that the information gained from this study will benefit future Energy Awareness programs. Harris (1963) stated that in-service education is a "major function of supervision which consists of activities which promote the growth of instructional staff members to make them more effective and more efficient" (p. 75). Hopefully, this study will enable the instructors at the Awareness Program to become more aware of the professional needs of the participants and thus more effective teachers may be produced in the realm of Energy Education.

Assumptions of the Study

For the purpose of this study, the following assumptions were accepted by the researcher: (1) that the former participants who were interviewed in this study did so voluntarily, (2) that the teachers provided honest and complete answers to the questions, and (3) participants provided accurate evaluations regarding their experiences during the Energy Awareness Programs.

Limitations of the Study

The limitations of this study were limited to the following: (1) only former Energy Awareness Program teachers were interviewed, (2) only available former participants surrounding the Stillwater, Oklahoma area were interviewed, and (3) the direction of each interview. The researcher used interviewing techniques based upon available methodologies and current research

CHAPTER II

REVIEW OF THE LITERATURE

Introduction

A brief history of the development of energy and resources will provide a better understanding of the energy dilemma today. This section will be found in Appendix A. Since this study centers around the evaluation of the Oklahoma State University Energy Awareness Work Conference, a history of the conference and experiences of the participants is also presented. This section will be found in Appendix B.

The third section of this chapter contains a review of the literature relative to the evaluation and interviews. The Review of Literature section titles will be as follow:

1. Aspects of Education,
2. Types of Designs,
3. Aspects of Interviewing in Evaluation, and
4. The Audience of Evaluation.

Aspects of Evaluation

This section of the review of literature will concern itself with areas of evaluation. The first section will be on evaluation itself; the second section will discuss formative and summative evaluations; section three is on interviews.

Evaluation is defined in many ways by different researchers. Cooley and Lohens (1976) define evaluation as the following:

> An evaluation is a process by which relevant data are collected and transformed into information for decision making. Evaluation is defined as a process rather than a product. Educational procedures are never completely, finally evaluated. Evaluation transcends research and extends into decision making. Evaluation is successful insofar as the information it generates becomes part of the decision-making processes in education (p. 3).

Still another definition by Rossi, Freeman, & Wright (1979) states that "any information obtained by any means on either the conduct or outcome of interventions, treatments, or social change programs is considered to be evaluation" (p. 30).

Evaluations may take place for many reasons. Some Evaluations may be undertaken for management purposes, to test professional principles, and to identify ways to improve programs to meet requirements of funding organizations who have fiscal responsibility for allocation of program monies (Rossi, Freeman, & Wright, 1979).

The structure of evaluation designs is central to most types of evaluations, regardless of the purpose. Stufflebeam (1985) proposes the following structure for designs of evaluations.

1. <u>Focusing the Evaluation</u> – who the evaluation is targeted at (teacher, students) and at what level (local, state).
2. <u>Collection of Information</u> – specify the methods for obtaining data.
3. <u>Organization of Information</u> – classifying information for coding, organization and storing.

4. Analysis of Information – provide a description of data to be reported to the decision makers.
5. Reporting of Information – the audience for the evaluation must be made.
6. Administration of the Evaluation – define the overall program evaluation and specify a schedule for updating the evaluation design.

Evaluation research has been dominated in the past by what is known as the natural science paradigm of hypothetico-deductive methodology (Patton, 1978). This paradigm is known as quantitative, scientific, methodical, statistically oriented, and it is the basis for a large majority of research done today. This paradigm tries to quantify or describe every detail in a numerical fashion.

The alternative paradigm comes mainly from anthropology. This alternate view is holistic, qualitative, value laden, and centers more around understanding the phenomena than "knowing by numbers".

Many differences hold apart the two methods of quantitative and qualitative methodology. McCracken (1988) lists several differences between the two methods.

Quantitative methods isolate and define categories as specifically and numerically as possible before the study is begun. Qualitative, on the other hand, defines categories during the research process. These categories can be refined and changed as the process continues.

The qualitative researchers have a wide field of perception that lets them see patterns and themes between many categories. The quantitative researchers, on the other hand, have a narrow field of vision that lets them see a sharp contrast between a limited number of categories. Qualitative research is a much more intensive and thought-provoking process.

Qualitative research tends to be used more heavily in the disciplines with emphasis on description and explanation. Fields like psychology, sociology, and anthropology use the qualitative methods quite frequently (Hakim, 1987).

Bryman (1988) gives five intellectual underpinnings of the Qualitative Research movement. These foundations are based on the study of social reality. The foundations are phenomenology, the philosophical study of phenomena; social interactionism, the study of social life; verstehen, which means "to understand" in German; naturalism, which is to treat the phenomena under study as naturally as possible; and ethogenics, which is defined as understanding social episodes in life.

Qualitative and quantitative research methodologies differ in several other main areas as well. Stainback & Stainback (1988) mention ten main areas of differentiation:

1. Purpose – quantitative purpose is geared to prediction and control whereas qualitative purpose rests upon an understanding of actions.
2. Reality – quantitative research has a single reality where qualitative research has realities based upon collective definitions of a particular social situation.
3. Viewpoint – the viewpoint from the quantitative research method is from the outside. Qualitative viewpoints are from firsthand experience with an insider's point of reference.
4. Values – quantitative researchers believe that research should be value-free and objective. Qualitative researchers believe, on the other hand, that qualitative research should be value laden and subjective.

5. Focus – quantitative research is intended to isolate specific variables for study. Qualitative research concentrates on the whole or complete view of what is being studied.
6. Orientation – quantitative studies are to verify facts and figures where qualitative studies are exploratory and discovery directed.
7. Data – quantitative researchers focus on objective data, data that exists apart from people. Qualitative data is subjective and seeks meaning.
8. Instrumentation – quantitative research relies on tests, preconstructed records, rating scales, numerical values and the like. Qualitative researchers rely on the human subjects and the meanings and feelings that those people place on situations within their environment.
9. Conditions – quantitative studies are carried out under a strict sterile controlled system. Qualitative research is carried out in a natural manner.
10. Results – quantitative data are reported as "hard core facts" that rely heavily upon reliability and validity. Qualitative data provide a deep understanding about the topic under study.

Formative Evaluation

Formative evaluation refers to the curriculum and to the improvement of that curriculum. Improvement that is a continuous process and not just product oriented. Lunney (1987) refers to the principle purpose of formative evaluation: to ensure that the planning process and the implementation of that process is the best possible given the time and experience which the institution has put into that process. He also states that planning is an ongoing process which is never finished.

Four main reasons for data collection in the formative evaluation processes as suggested by Herman, Morris, & Fitz-Gibbon (1987) are:

1. Pinpoint areas of program strengths and weaknesses,
2. Refine and review program plans and, if necessary, your evaluation plan,
3. Hypothesize and cause-effect relationships between program features and outcomes,
4. Draw conclusions about the relative effectiveness of program components or of alternative approaches (p. 36).

Along with the four main reasons for formative data collection, Herman, Morris, & Fitz-Gibbon (1987) give four steps for conducting formative evaluations.

Phase A – set boundaries for the evaluation - the aspects of the program on which the researcher will concentrate.

Phase B – select appropriate evaluation methods - plans for monitoring and analyzing the program.

Phase C – collect and analyze information - included in this phase are periodic observations and assessments.

Phase D – report findings - changes to be made in the program and additional formative activities.

Summative Evaluation

This study lends itself to formative evaluation and summative evaluation as well.

Summative evaluation refers to evaluation that has taken place at the conclusion of a program, school term, or presentation. Summative evaluations are conducted to see if a program, etc. is effective and should be continued (Patton, 1987; Mason & Bramble, 1989).

Scriven (Worthen & Sanders, 1973) states that evaluation has only one functional goal: determining the worth or merit of something. Scriven also points out that a study made of any program may not be considered evaluation until some type of judgment is made. Values are an important part of evaluations. Therefore, the values held by the evaluator are very important.

Interviewing

Interviewing is a survey technique that many researchers rely on for data to support other methods of data collection. There are two basic types of interviews (Orlich, 1978).

The first type of interview is known as an unstructured interview or a nondirected interview. Within this type of interview, the researcher chooses a topic and then probes in the areas of interest. No pre-determined questions are asked and at times the interview may take the form of rambling. When this interview process is used, the researcher is usually conducting a study of a previously unexplored topic (Ferman & Levin, 1975).

A second type of interview is the structured or directed interview. This interviewing process requires some thought and preparation on the part of the interviewer before the interview takes place. An interview guide or interview schedule is made in order to guide the interview through a meaningful direction (Singleton, Straits, Straits, & McAllister, 1988). One reason for structure is to improve the quality of the data. Another reason is that time may be limited. An hour to an hour and a half is usually about all the time allotted for interviews. Structure prevents unnecessary rambling by both the researcher and the interviewee.

Orlich (1978) lists several advantages of the interview process.

In interviews, the feelings of the respondents are revealed through spoken words and body language. True meanings can be gathered by the researcher.

Discussions are allowed concerning the causes, problems, suggestions, and solutions to questions about the topic under scrutiny.

The respondent is allowed maximum opportunity for free expression of ideas, concepts, and thoughts. Both the respondent and the researcher (interviewer) have the same chance to express concerns openly and freely.

As alluded to earlier, the interviewer can observe and record nonverbal behaviors of the individual being interviewed.

Respondents may provide personal information, attitudes, beliefs, and perceptions that might not be gained with a written instrument.

Conducting interviews yields a high rate of response for the interviewer.

Unlike other data gathering techniques, the researcher has the opportunity to follow up on remarks made by the respondent in order to probe more deeply and get new leads.

Individuals who cannot read or write (as in very old or very young respondents) can participate in the interviewing process.

For data analysis, fewer individuals may be needed for the collection of data in interviews. One interview can usually provide much more information than questionnaires and other techniques.

Comparisons can be made between responses on mailed questionnaires and responses in interviews to validate the information received.

Myriad of Evaluation

Evaluation can be defined in many ways. Gay (1980) defines it as the systematic process of collecting and analyzing data in order to make decisions. Similarly, Flagg (1990) contends that evaluation means the systematic collection of information for the purpose of informing decisions to design and improve the product. Green and Stone (1977) postulate, "Evaluation (appraisal) is the systematic documentation of the consequences (results or effects) of programs (curriculums) and the determination of their worth (merit) in order to make decisions about them" (p. 4).

Herbert (1986) defines evaluation as a naturalistic concern and states that evaluation is a process by which evaluators seek to know and understand an evaluand. Afterward, they present their knowledge and understanding to others. This type of evaluation involves describing and judging, as does any other form of evaluation, but the difference is in how the description and judgment are achieved and presented. Naturalistic evaluation aims at understanding, extending the experience, and at increasing the conviction of what is known (Stake, 1978).

There are as many definitions of evaluation as there are books on the subject of evaluation. Gephart (1976) comments,

> We have reached a point of absurdity! In a recent conversation 27 "different" models of the evaluation process were delineated. . . . This sorry state of affairs is made even worse by our tendency to refer to the Stake, or Stufflebeam, or Scriven, or Alkin, or Scriven #2, or Provus models . . . . (p. 2)

Gay (1980) agrees:

> A false dichotomy has been fostered in the minds of many to the effect that classroom, or pupil, evaluation and other types of evaluation, such as project evaluation, involve entirely different processes. Further, it is incorrectly believed by a number of people that each type of evaluation requires a different process or model. The current proliferation of "different" evaluation models only serves to reinforce this erroneous belief (p. 14).

Regardless of what is being evaluated, the evaluation process is the same. The difference lies in what is being evaluated, how the evaluation process is applied, and the types of decisions made from that evaluation (Gay, 1980). Depending upon what is being evaluated, different kinds of data will be collected, different criteria will be applied to the data, and different kinds of decisions will be made (Pereles, 1987).

Purposes of Evaluation

The purpose of the evaluation should be made at the planning stage of curriculum development. The purpose should be to provide some form of assurance that the activities of the students will lead to the agreed upon educational goals. Stufflebeam et al. (1971) maintain that the purpose of evaluation is to delineate, obtain, and provide information to serve as the basis for making educational decisions.

Of course, evaluation serves some more practical purposes as well. Some program administrators see evaluation as a source of funding as well as a potential guide to improve and strengthen the course, or as a way to justify the program and therefore pave the way for additional monies (Caro, 1977).

Green and Stone (1977) maintain that usually evaluation efforts only have meaning for the investigators, provided arrangements have been made to utilize the findings for future curriculum making. Some critical issues on purposes of evaluations will include:

> Is the value of the evaluation intrinsic? Where does the value exist? Is it evaluation for evaluation's sake?
>
> Is the value measured only to the extent that the findings were used?
>
> Is the value lost if the decisions are made before the findings of the project have been made public?
>
> Is it enough simply to realize that just going through the process of evaluation may serve a purpose, if nothing else so that the faculty members become aware of their teachings? (Green & Stone, 1977, p. 120)

Along the same lines Cronbach (1977) suggests the following purposes:

> Course improvement: deciding what is sufficient and what would need to be changed.
>
> Decisions about individuals: identifying needs of the pupil, judging the pupil for purposes of selection and grouping, acquainting the pupil with his/her own progress and deficiencies.
>
> Administrative regulations: judging how good the school is, how well the student met objectives, and how effective the teachers were in presenting the material (p. 320).

McNeil (1981) states that teachers may have additional purposes for evaluation in the classroom:

Placement. At what level must the learner be placed in order to be challenged, but not frustrated?

Mastery. Has the learner made enough progress in order to succeed in the next planned phase of work?

Diagnosis. Is the learner experiencing any difficulties?

The purpose of this dissertation was to evaluate the Energy Awareness Program at Oklahoma State University for elementary and secondary teachers as perceived by the participants' personal attitudes and changes.

Scientists' Ideals of Dominant Evaluation

Science is also defined in various ways, depending on the writer's purpose. Titus (1964) states that science comes from the Latin word "scire" which means "to know", but that definition that is used today is narrower in scope – meaning a quantitative and objective knowledge of nature. He also gives three other possible meanings of the word "science." Titus notes that science may imply an area of study along the lines of chemistry, geology, and biology, etc.; a systematic knowledge base including theories and laws that have been built up over time by various scientists, and a method of obtaining knowledge that is objective and verifiable.

Along those same lines, Bigge and Hunt (1980) define science as "a body of knowledge whose truth is confirmed by the best methods available." Examples include physics, chemistry, geology, mathematics and logic. Bigge and Hunt also state that science means a body of supposedly true statements that fit together in some sort of logical fashion and that serve as a tool for analyzing new problems in a given field. Science can also be defined as a method. "In this sense, science and epistomology are approximately the same" (p. 2). The purpose of the scientific method is to provide us with dependable knowledge rather than ignorance, confusion, misunderstanding and doubtful facts. "Scientific generalizations represent carefully organized, accurate summaries of facts," observed Berkson (1968, p. 79). The scientific method can be applied to almost any subject., including evaluation.

Regardless of the possibilities of defining "science", this paper will make the assumption that "science" is a narrow, mechanistic form of evaluation.

Assumptions of Science

Eichelberger (1989) states that three assumptions are fundamental to all empirical researchers who are based in the positivist tradition. They are as follow.

1. There exists an external universe that human beings can know.
2. Events in the universe are determined by a finite set of causes.
3. The essential elements of events will recur.

He goes on to say that the reasons for these assumptions should be apparent. If nothing exists in the universe, or if the researcher cannot observe it in the universe, the researcher would be wasting his time because he would not be able to describe the external reality even if it did exist.

Researchers working in the scientific areas usually proceed on the basis of some or all of the following basic assumptions (Titus, 1964).

1. The principle of causality is the belief that every event has a cause and that, in identical situations, the same cause always produces the same effect.
2. The principle of predictive uniformity states that a group of events will show the same degree of interconnection or relationship in the future as they showed in the past or do show in the present.

3. The principle of objectivity requires the investigator to be impartial with regard to the data before him. The facts must be such that they can be experienced in exactly the same way by all normal people. The aim is to eliminate all subjective and personal elements insofar as possible and to concentrate on the object being studied.
4. The principle of empiricism lets the investigator assume that his sense impressions are reliable and that he may test truth by an appeal to the "experienced facts." Knowing is the result of observation, experience, and experiment, as opposed to authority, intuition, or reason alone.
5. The principle of parsimony suggests that, other things being equal, a person takes the simplest explanation as the most valid one. This principle is a check on unnecessary intricacy. It cautions against complicated explanations. It is sometimes called "Occam's razor," since William of Occam, a fourteenth-century English philosopher, said that "entities should not be multiplied beyond necessity."
6. The principle of isolation, or segregation, requires that the phenomenon under investigation be segregated so that it can be studied by itself.
7. The principle of control emphasizes controls as essential, at least for experimentation. Otherwise, many factors may vary at the same time, and the experiment could not be repeated in the same way. If the conditions change while the experiment is being conducted, the results may be invalid.
8. The principle of exact measurement requires results to be such that they can be stated in quantitative or mathematical terms. This is the goal, at least of the physical sciences.

Elements of the Scientific Method

There are five established basic elements of the scientific method (Bigge & Hunt, 1980; Dewey, 1933).

The first element is becoming involved with a problem. If the problem is personal and relevant, the problem solvers will seek the answer by themselves. Obstacles will be seen as insignificant.

The second element of the scientific method is gathering all possible data. The data consist of facts and logical constructions that are relevant to the problem under investigation. Three qualifications of judging data are internal consistency, completeness, and factual accuracy.

The third element is making the hypotheses. A hypothesis is an assertion that is taken to be true in order for the study to take place. Hypotheses are tested with factual data and logical constructs. If the data correspond with one another and are relevant to the hypothesis, then the hypothesis is deemed true.

The fourth element is testing the hypotheses. This element involves the review of all facts about the hypotheses to see if they all support the hypotheses. If all but one hypothesis agrees with the data, then that hypothesis is not true. In this case, the hypothesis is qualified even more removed from the list of hypotheses. All propositions must be held as true in order for the hypotheses to be taken as true and valid.

The last element is drawing conclusions. The tested hypotheses are the conclusion if all the data fall into place around the assumptions of the hypotheses.

Assumptions of Mechanistic Psychology

Mechanistic psychology is only one way to describe a characteristic of human life. This form of psychology dates back to René Descartes (1569-1650) and has continued to the 1970s. Deci (1975) places all the associationistic or behavioristic psychologies under the general category of mechanistic positions. Bigge and Hunt (1980) write:

> Mechanistic psychology was an outgrowth of the intellectual spirit of the seventeenth through the nineteenth centuries. The intellectual cast of these three centuries was profoundly influenced by the natural sciences, first astronomy and physics, and later chemistry, and in the nineteenth century by biology as exemplified in Darwinism. During these three centuries, certain primary, cosmological assumptions were widely accepted in the Western world. Cosmology refers to a branch of philosophy that deals with the origin and structure of the universe. Mechanistic psychology cannot be understood apart from its dominating cosmological assumptions about nature and the relation of its parts (p. 13).

These assumptions taken as a whole are known as classical mechanics (Holton, Toulman, Goodfield, and Lowry, 1975).

Classical mechanics states that the universe is made up of a collection of isolated material bodies. These bodies range in size from the smallest atom to the largest known object. Forces react upon these bodies according to the mechanical principles of attraction and repulsion. Motion is considered to be linear and constant unless it is disrupted by forces from other bodies. Every event can be explained. Classical mechanics also stipulates that everything can be described quantitatively by mathematics (Bigge & Hunt, 1980). The observer and the observed are always separate because the laws of nature operate independently of the human observer.

Assumptions of Classical Mechanics
About Human Nature

Classical mechanics led to three subdivisions of psychology, all tied together by the assumptions of classical mechanics. The three areas are the mental, the physiological, and the behavioral mechanisms.

Mental mechanisms were the first "scientific" psychology (Bigge & Hunt, 1980, p. 14). In this view, human beings are seen as passive entities and receive the contents of the environment around them. No ideas are inborn or innate. Ideas are abstract sensations that are perceived by the individual, and these perceptions are totally determined by the environment.

Physiological mechanisms are explained through the laws of chemistry and physics. The human is reduced to particles in motion that are responsive to the environment. Again, there are no innate or inborn actions to direct, only responses to the environment.

> Physiological mechanistic thought could – it was believed – at last be regarded as an "exact science", similar to physics, and susceptible to laboratory study with quantifiable results capable of statistical description. It followed that, once physiological psychologists knew enough, it should be possible to manufacture life in the laboratory (Bigge and Hunt, 1980, p. 16).

The behavioral mechanism represents the last subdivision of mechanistic psychology. The principles of the behavioral mechanism are as follow.

1. The purpose of psychology is to learn how we as humans can change, direct or modify the behavior of others.
2. The only things innately predetermined about human behavior are biological drives and the urge to reduce them. These drives may include sex, hunger, thirst, and freedom from unpleasurable experiences.
3. Psychological processes come from evolutionary demands. These demands take whatever form will help a species survive.
4. Adaptive behavior can be explained by stimuli and responses. Stimuli consist of physical excitement or aggravation from within the environment. The response is a reaction to the stimuli.
5. All human interactions can be explained by behaviors. These behaviors can be explained without reference to a consciousness, mental construction or any other bodily phenomena. These behaviors are passive in relation to the environment. Hence, behaviors are environmentally determined.

All that needs to be known about adaptive human behavior can be explained without reference to consciousness, mind, purposiveness, or any other mentalistic construct, or to neurological or other bodily phenomena.

Since behavior is adaptive (or adjustive), it is also passive in relation to environmental forces. Like other mechanisms, the behavioral mechanism assumes environmental determinism.

Measurement in the Dominant Paradigm

Measurement is the prime system of obtaining data or information for the purpose of improving programs of any type. When an evaluation is considered, the assumption is usually made that the results will be in the form of numbers. Kerlinger (1986) states that measurement is the assignment of numerals to objectives or events according to rules. Whether it is evaluation in the school on a specific subject or evaluation of a program, numbers play their part in the present day school.

One of the first recorded incidences of written examinations (tests) for the sake of evaluation was in the Boston public schools in 1845 (Caldwell & Courtis, 1924). The examinations (tests) were given to disclaim weaknesses within the schools. Usually these examinations were in the form of oral questioning, but that time they were to be written exams so that the results would be evident and clear. These charges of weaknesses in the schools came from the Secretary of the Massachusetts State Board of Education, Horace Mann. Based upon the results of the examinations, Mann was proven to be correct (Nunnally, 1972).

Gustav Fechner was also active in the early testing movement during the middle of the nineteenth century. Fechner laid the logical foundation of an area known as psychophysics (Nunnally, 1972, p. 14). Fechner saw in psychophysics "an exact science of the functional relations of the dependency between the mind and body" (Guilford, 1954, p. 3). Fechner conducted research in the area of human judgment, specifically studies on lifting weights, visual brightness, and the sensation of touch. Fechner illustrated how the logic and methods of the scientific world could be used in psychological measurement.

In the late nineteenth century, Joseph M. Rice (1897) sought to "prove that the first step toward placing elementary education on a scientific basis must necessarily lie in determining what results may reasonable be expected at the end of a given period of instruction" (p. 163). Rice scientifically evaluated the spelling curricula of 21 school districts. In these districts, he measured the spelling achievement of 33,000 students using standardized tests.

The work of Rice was advanced by the behavioral psychologist, Edward L. Thorndike (DuBois, 1970). Thorndike suggested that once outcomes were formulated, they should be constructed in the form of objectives for students' behaviors. Thorndike purported that only behavioral outcomes were reliable indicates of learning (Seguel, 1966). He also recommended the use of behavioral outcomes as the standard of assessing the effectiveness of the curriculum (Pereles, 1987).

Along with Thorndike, Bobbitt (1924) and Charters (1923) are also responsible for furthering the behavioral-objectives curriculum evaluation model that dominates the present day field of educational evaluation (Unruh & Unruh, 1984).

Measurement in the dominant paradigm of evaluation involves the compilation, administration, and grading of tests. Following are the descriptions and methodology of testing.

Standardized achievement tests are the main data gathering instruments in the dominant paradigm. Gronlund (1985) states that standardized achievement tests are typically norm-referenced tests that measure the pupils' level of achievement in various content and skill areas by comparing their test performance with the performance of other pupils in some general reference group (for example, a nation-wide sample of pupils at the same grade level).

Gronlund (1985) also states that a norm-referenced test is designed to provide a measure of performance that is interpretable in terms of an individual's relative standing in some known group. In other words, a norm-referenced test determines how an individual's performance compares with that of others in that same group. Standardized norm-referenced tests are administered to selected groups to establish the normal scores. These scores are called norms (Martuza, 1977). These norms provide standards for comparison and interpretation for groups to which the standardized norm-referenced tests are subsequently administered.

Angoff (1971) contends that two meanings have been attached to the word "norms." One definition is associated with the notions of acceptable, desired, or required standards or clinical ideals. The other meaning is a statistical meaning and is expressed in the terms in which educational and psychological measurements are most often interpreted. Hence, a test score is said to be high or low in relation to a defined group of other individuals and only in relation to the pre-set standards.

Norm-referenced tests interpret scores in terms of their relative position with respect to the norms. There are four types of relative positions. They are percentile ranks, normal curve equivalents, grade equivalents, and standard scores.

The percentile rank of a particular raw score in a specific score distribution is the percentage of area in the histogram located to the left of the raw score in question (Martuza, 1977, p. 32).

Normal curve equivalents are normalized standard scores developed mainly for Federal Title I evaluations (Tallmadge & Wood, 1976). Normal curve equivalents are normalized standard scores which range from a score of 1 to 99 with an average score of 50.

Grade equivalents were invented by B. R. Buckingham (1920) and referred to as grade scores (Nitko, 1983). Grade equivalent scores are reported as a decimal fraction (such as 8.1 or 12.1). The whole number refers to the grade level while the decimal part refers to the month of the school year within that grade level.

Standard scores, unlike percentile ranks, represent measurements on an interval scale. Standard score norms are converted scores having any desired mean and standard deviation (Aiken, 1988, p. 87). There are several kinds of standard scores: z scores, Z scores, stanine scores, T scores, and deviation IQ scores.

Standardized norm-referenced tests assume that scores are distributed evenly along a normal bell-shaped curve with 34 percent of the scores falling between the mean and +1 standard deviation (SD), 14 percent between +1 and +2 standard deviations, 2 percent between +2 and +3 standard deviations, and .13 percent between the +3 and +4 standard deviations (Gronlund, 1985, p. 358). These same proportions apply to scores below the mean as well. Gay (1980) explains:

> Norm-referenced standards are based on the assumption that measured traits involve normal curve properties. . . . The idea is that a measured trait, let us say math aptitude, exists in different amounts in different people. Some have a lot of it, some have a little of it, and most have some amount called an "average" amount (p. 140).

According to this notion, it is expected that the average group will obtain about 68 percent of the norm-referenced test scores (-1 to +1 SD). The areas above the +1 SD and below the -1 SD will be distributed along the remaining 32 percent of the normal bell shaped curve.

While standardized norm-referenced tests evaluate student against student, criterion-referenced tests evaluate individual students against a set of pre-determined criteria. Specifically, Quinn and Hennelly (1981, p. 151) state that criterion-referenced tests are tests whose scores are interpreted by referral to specifically defined performances rather than to the performance of some comparable group of people. Baker (1959) says that the intention of criterion-referenced tests is to emphasize mastery and to focus on what has been taught.

Types of Designs

Evaluation designs are based on research designs (Flagg, 1990). According to Stufflebeam et al. (1971), the purpose of research is to provide new knowledge that is universally valid. The purpose of evaluation is to delineate, obtain, and provide information for the making of educational decisions. Evaluation methodology is designed to be specific, valid, and useful within a decision-making context. In the practical applications, evaluators often use the tools and methods of research. There is a fine line between evaluation and research; thus, many prefer the compromising name, evaluation research.

Experimental Designs

The true experimental design is the only design that is characteristically different from all other designs (specifically, it is different from quasi-experimental, pre-experimental, and ex post facto designs). The true experiment is the only design that has randomly selected and assigned (subjects) participants (Gay, 1980).

As a sub-group under experimental designs, there is the pretest and post-test control groups formed by random assignment. Both groups are pretested, one group receives a new or unusual treatment, and then both groups are post-tested (Gay, 1980, p. 336). In this design, both groups are receiving treatments. The control group receives the traditional treatment while the program group receives the usual or new treatment. In this design, the random assignment and the presence of a pretest and control group provide internal validity.

A second sub-group under experimental design is the one which involves a posttest-only group. This design is basically the same as the above-mentioned design with the exception of the pretest. There is no pretest, and both groups receive treatments. One group gets the unusual treatment, and the other group (known as the control group) gets the traditional treatment.

Quasi-Experimental Designs

The nonequivalent control group design looks like a pretest-posttest control group design. The only difference is that this design does not involve random assignment of participants to groups. Two given groups are pretested. Both groups are then given the treatment. Afterward, both of the groups are posttested. Gay (1980) states:

> We might take 10 classrooms and randomly assign 5 of them to be treatment classes and 5 of them to be control classes. The lack of random assignment adds sources of invalidity not associated with the pretest-posttest control group design--possible regression and interaction between selection and variables such as maturation, history, and testing (p. 340).

Another design considered quasi-experimental is the time series design. In this design one group is repeatedly pretested. Then, a treatment is given. After the treatment, repeated posttesting is done to see if there are any changes. If the members of the group eventually score the same on the pretests, receive the treatment, and show consistent improvement in their scores on the posttests, then we have some degree of confidence in the effectiveness of the treatment.

Pre-Experimental Designs

The one-shot case study is a pre-experimental design that involves giving a group a treatment and then giving that same group a posttest. If the group scores high on the posttest, one cannot attribute this score to the treatment because the unknown is that the group knew before the treatment. In other words, if one has not determined what the students knew beforehand, it is hard to say that the treatment had anything to do with the high score on the posttest.

Another design in the pre-experimental group is the one-group pretest-posttest design. This design takes a group, gives the group a pretest, exposes the group to a treatment, and then gives the group a posttest. Gay (1980) contends that this is not a very good procedure to adhere to because many additional factors are not controlled for in this case. Specifically, this design does not control for maturation and history. Gay also states that the testing and instrumentation are not controlled. Campbell and Stanley (1963) give at least eight threats to validity or causes of invalidity. They are as follow.

Unplanned events refer to the occurrence of any event that was not planned for but would affect the posttest scores.

Maturation is any physical or mental change that would take place over a long period of time. For example, when the pretest and posttest would be several months apart.

Test recall refers to the improved scores on the posttest because the subject has already taken the same test as a pretest.

Instrumentation can occur when the pretest and the posttest are not the same. If data is being taken by a machine, the machine may malfunction and record data in a less consistent manner.

Statistical regression occurs when subjects are chosen on the basis of their extreme test scores, whether the scores are very high or very low.

Differential selection occurs when the groups are already formed and may even be at different levels before the implementation of the test.

Mortality usually occurs in long and extended studies. Mortality may happen if over an extended period of time several of the students or subjects drop out of the program due to unforeseen circumstances.

Selection-maturation interaction occurs with pre-formed groups in testing. This may happen if one group profits more from the testing than the others do.

The third design in the pre-experimental realm is called the static-group comparison design. This design involves at least two groups; one group receives the new or unusual treatment, and the other group receives the usual treatment. The second group that receives the usual treatment is referred to as the control group. After both groups have been given the treatments, they are given the posttest.

Ex Post Facto Designs

With ex post facto designs, the independent variable is not manipulated, and there is no pretest. The treatment has already occurred. No control was given in selecting the participants. A comparison is made between the posttest performance of the groups to see which had a change.

Title I Models

Title I programs are federally funded programs to meet the scholastic needs of the poor and disadvantaged students. According to Gay (1980), the RMC Corporation developed three basic alternative evaluation models to test students in specific federally funded programs; Model A, the norm-referenced design; Model B, the control group design; and Model C, the special regression design. The primary purpose of Title I evaluation is to provide evidence that the Title I student achievement is higher with the program than without the program.

Model A involves the pretesting of students in a particular program. After the pretest, a treatment is given to the students. Then, a posttest is given and the Model A norm-referenced design determines whether and to what degree the percentile position changed. If the percentile position changes positively, then the change is assumed to be due to the treatment. These changes are considered valid if three requirements are met: (1) a different test is used to initially select the students and to pretest the students; (2) the same test is used for pretesting and posttesting; and (3) only the scores of the students who took the pretest and posttest can be considered valid for the results.

Model B, the pretest-posttest control group design, involves the random assignment of subjects to groups. This model is not used very much because it is not practical. Furthermore, this design is not conducive to the Title I program objectives because some students who need the program would not be able to participate. This model would withhold from the program students who demonstrated a need for Title I programs.

Model C, the special regression design, conforms to the situations in which all members of an identified population must participate within a given program. This special regression model is usually applied when the circumstance require that the participants be selected by given test scores. Potential participants must score below a certain cut-off point, while those above the cut-off score cannot participate.

The testing model of evaluation must always be concerned with two characters of testing: validity and reliability. Tuckman (1975, p. 11) states that validity is defined as "whether the test measures what it is supposed to measure". He said that reliability refers to the tests' consistency. That is, a reliability test measures the same characteristic on each occasion it is used.

Test Interpretations

In the dominant paradigm of evaluation, tests are interpreted with statistics. There are two kinds of statistical data: descriptive and inferential. Statistics is defined by Kerlinger (1986) as "the theory and method of analyzing quantitative data obtained from samples of observations in order to study and compare sources of variance of phenomena, to help make decisions to accept or reject hypothesized relations between phenomena, and to aid in making reliable inferences from empirical observations" (p. 175).

Descriptive Data Interpretation

Standardized tests and achievement tests are analyzed by descriptions of the data that has been produced. There are four major types of descriptive statistics: (1) measures of average performance (Nunnally, 1972), (2) score variability (Nitko, 1983), (3) norms (Tuckman, 1975), and (4) measures of relations (Kerlinger, 1986).

Measures of Average Performance

The measures of average performance (known by other authors as measures of central tendency) determine the average for a particular group of scores. The three major measures of average performance are the mode, median, and mean.

The model is usually the easiest of the three to understand. Simply, the mode is the score that is made most frequently within a group of scores.

The median (which is not necessarily an actual score) is figured by finding the point at which one-half of the scores are above and one-half of the scores are below. That is, the students are ranked from the highest score to the lowest score, and the median is the score that is exactly in the middle.

The mean is the average of scores figured by adding up all of the scores and then dividing by the number of tests or scores that were taken in the group.

Score Variability

Score variability, the second type of descriptive statistic, tells how wide and dispersed the scores are on a given treatment. There are three indices of score variability: the range, the mean deviation, and the standard deviation (Nitko, 1983).

The range is calculated by simply subtracting the lowest score from the highest score (Popham, 1990). The range is used to describe the distance on the scale over which the scores are reported.

The deviation is the distance between a student's score and the group's mean. The mean deviation is the average of the absolute values of these deviations for the group (Nitko, 1983).

The standard deviation is the most frequently used index of variability. The standard deviation is the square root of the average squared mean deviation.

Norms

Norms are based on the test results of an external or reference Group. This standardization group provides comparative data for the purpose of interpretation.

> We may represent norms as (1) standard scores, which reflect the deviation of test scores from the mean score of the norm group; as (2) percentile ranks, which tell us what percent of the norming group scored at or below a particular score on the test; or as (3) grade equivalents, which tell us the school grade at which the given score is typical, or average, for members of the norming group. Each of these represents a way of expressing relative scores, that is of transforming the raw or obtained scores based on the distribution of scores of the norming group (Tuckman, 1975, p. 280).

Measures of Relations

There are several measures of relations. Kerlinger (1986) mentions five of them: the product-moment coefficient of correlation (r), the rank order coefficient of correlation (rho), the distance measure (D), the coefficient of contingency (C), and the coefficient of multiple correlation (R). All of the aforementioned measures of relations do essentially the same thing. Remmers, Gage, and Rummel (1965, p. 371) state that correlation is a measure of the degree of relationship between two sets of measures either for the same group of individuals or for ordered paired individuals. Also, the correlation tells the researcher the direction and magnitude of the relation.

Measures of relations will vary from -1.00 through 0 and on up to +1.00. The -1.00 represents a perfect negative correlation, while the +1.00 represents a perfect positive correlation. The correlation of 0 represents no relation whatsoever.

Inferential Statistics

Inferential statistics is basically concerned with inferences or generalizations about populations based on the behavior of the sample groups. If a posttest shows a difference between the means of two groups, it is questioned whether a similar difference would exist in the population from which those two samples were taken. Inferences that concern populations are nothing more than probability statements or what one may consider possible explanations.

The notion of a "null hypothesis" is the main thrust of inferential statistics. A null hypothesis states that no difference exists between or among groups. For example, a null hypothesis may be stated: There is no significant difference between the mean English achievement of high school students who participate in the Southwood curriculum and the mean English achievement of high school students who participate in the Stillwater curriculum. If there is a difference, it could have been caused by the independent treatment or by chance. If the difference was caused by chance, that would be considered a random sampling error.

The null hypothesis (that there is no difference) is accepted or rejected, depending upon a level of significance. Usually, in evaluation of the hypothesis, .05 is used as a standard for rejection. Rejecting the null hypothesis at the .05 level says that the difference in means would likely have resulted from chance or sampling error no more than five times out of 100 that the experiment was replicated. If the level of significance of .01 is used, then one could be more confident that the difference between the two means would be left to chance only one out of every 100 times.

There are several tests of significance that one could use for evaluation situations. Some of the tests are the t-test, simple analysis of variance (ANOVA), and analysis of covariance (ANCOVA).

Limitations of the Testing Paradigm

Testing is very common, and the main evaluation instrument of our schools today. The technology of testing has far exceeded the main purpose of test development (DuBois, 1970). Stake (1971) has reminded us that errors in testing are very dangerous when we are trying to test the higher cognitive processes. This is known as measurement error. Along with measurement error, another danger of testing is misrepresentation of the scores themselves. Many people that rely on tests do not fully understand the technical aspects of the test itself and therefore misread, misinterpret and misuse the test scores.

Sanders and Worthen (1973) give eight of the most serious problems associated with tests of standardized measures. They are as follow.

1. Selection of inappropriate or inadequate tests. Many programs and projects fail because the testing instrument does not measure what it is supposed to measure. A second type of selection error is that of choosing a test that is unacceptable as far as validity, reliability, and interpretability are concerned.
2. Content validity of the test. What is measured by the test should reflect the objectives of the program. It is hard to find a standardized test that is appropriate for general testing procedures in the classroom. Usually a criterion-referenced test is better for a content-specific program.

Such tests are usually made by the teacher or specific program planners.

3. The urge to teach to the test. All too often, the test can influence the direction of the educational program or of what is presented in the classroom.
4. Measuring of cognitive behaviors. It is very simple to test lower level cognitive skills. Higher level cognitive skills, for example, are much harder to test because of the format of the test. The format of most standardized tests is multiple choice.
5. Unreliable gain scores. The accuracy of standardized instruments is not perfect. The gain scores will be inaccurate on pretest and posttest instruments. Stake and Waldrop (1971) demonstrated that if one hundred students were tested four times over one year, there would be better than a fifty-fifty chance that two-thirds of the group would show a "one year gain", even though no instruction occurred within the one year period. The so-called gain would be the result of the unreliability of the gain score.
6. Errors of measurement. This is the problem at the very root of the unreliability of gain scores. Every test has some form of error involved with producing a score on a given attribute. The less reliable a test is, the larger the error measurements will be and the less sure one can be of the test itself.
7. The use of norms. Many standardized tests report scores on a grade equivalent or age equivalent scale. Only three or four more correct responses for a particular child could result in an increase of one grade equivalent on certain tests. If the test is not completely reliable in the first place, this score could be the result of measurement error

and not due to any increase in knowledge or change of behavior. A child who scores at the 8.0 grade equivalent score is not necessarily any more ready to enter the eighth grade than any other child that is entering the eighth grade. Furthermore, some grade equivalent scores go as high as 13.0 or 14.0, while the actual maximum grade level advancement is only 12.0.

8. The common habit of only testing cognitive measures. Many standardized tests only measure cognitive gains. Although relatively few tests measure the psychomotor and affective domains of learning, attitudes and values are important aspects of evaluation to record.

Titus (1964) has six critiques of limitations of the scientific method. By the phrase "scientific", Titus connotates the way in which humans try to interpret the world quantitatively and mathematically through testing.

The first critique is of the instruments that one uses in testing. One can only find that which the methods and instruments are designed to find. Even though there is more to what the instruments can tell, one is forced to claim scientifically only what the instruments and methods are designed to find. Anything else is considered not valid.

The second critique is of scientific classification. No single classification includes everything in the subject that is being classified. Separation by classification is one of the fundamental basics of scientific knowledge. If something cannot be critically analyzed, it evades science. Science states that we cannot know a thing until we classify it. Classification of people and objects is justified for asserting that all of those in a single classification have certain qualities and that generalizations can be made from them. However, Titus goes on to say that the whole may have qualities that are absent in the separate parts. The scientific method is concerned with breaking down objects into their own separate parts. Some believe that the sum of the whole is greater than the parts. No one can interpret adequately any situation without considering it as a whole and not just its parts.

There may be many interpretations of the same thing or event, and each can be considered true. Scientific methods consider only one reality and one answer. Three professors who see a movie and tell in their own words what happened will all tell a different story, but each professor will be correct because each explains the story in relation to himself.

When we consider anything in the process of development, the early stages are just as important as the later stages. The scientific method only seeks to find out information in a segment or fraction of time, like cutting an oak tree down and getting a cross section of the tree. Such a cross section, like tests, only represents a small fragment of the life of the oak tree. Even though only one section of time is represented, all development aspects of a child are important.

Titus also discusses, as a limitation of testing, man's sense organs and his general intellectual development. Many sometimes has a tendency to see what he is trained to see or what he expects to see. We as humans always have an "interest" in what we are observing. Scientific methods are among man's most useful tools, but they can be misused. This "interest" sometimes can be a bias in what we are observing, testing or experimenting.

The dominant paradigm has been discussed along with the rationale and the limitations. The next part of this chapter will be concerned with the experimental paradigm (design B) and the humanistic paradigm (design C) (Dobson, Dobson, & Koetting, 1985).

Both the experimental and humanistic themes are based in the experiential field of learning. Melamed (1985) states:

> Two main themes can be identified in current research in the field of experiential learning, based on the definition of experience and the context in which it is being examined: pragmatic-institutional and individual-existential. Several approaches are distinguishable within each theme, each with distinct implications for the design, facilitation, and evaluation of learning (p. 1798).

The first, pragmatism (experimentalism), is a Western philosophy of thought coined by a well-known chemist and scientist, Charles Sanders Peirce (Dejnozka & Kapel, 1982). The pragmatic theme focuses on the participation of the learner in acquiring or mastering concrete skills based on a sequence of learning events specified in advance (Melamed, 1985, p. 1798). Pragmatism is considered to have an institutional context of learning. Thus, the learner participates within a formal school (learning) environment.

The second theme, humanistic (existentialism) is a system of philosophy that is a revolt against traditional metaphysics. As a theory, it is an approach to highlight the existence of being, and the process of becoming (Mohan & Daste, 1985, p. 1778). Existentialism is considered to have an individual context of learning. The learners are not necessarily in a formal school setting, but they are totally free and are responsible to themselves.

As stated earlier, since both of these themes have roots in the field of experiential learning, a closer look into the field of experiential learning is given.

Experiential Learning

Experiential learning has beginnings back in the medieval time period. The university as we know it today evolved from experiential learning centers such as cathedral schools and specialized centers for professional training

(Houle, 1976). Four more systems of formal experiential learning as given by Houle (1976) are: (1) apprenticeship training centers carried out by craft guilds. These centers and training facilities catered to occupations such as masonry, carpentry, barbers, clothiers, and blacksmiths. (2) The second system would be that of chivalry. Boys would learn about life from the ladies of the court until they were about seven. Then the youngster would act as a personal servant to his father, learning all he could about language and life of the country. The young lad would learn of the battlefield, forest, and the tourney-ground from his father. Thus, competency based assessment was very clear. (3) The third system was a sporadic and unorganized type of learning. The system of learning continued throughout life and concerned monasteries, courts, priests, and private libraries. (4) The fourth system of learning was of God. It was believed that God could call whomever, for whatever services that were needed, not only in the religious sector but in the secular realm as well. It was God who inspired the great poets and composers of their time. What else could be the explanation for people like Mozart who could seemingly do the impossible and compose more than 200 masterpieces before the age of 18.

In the United States in 1776, the movement from the laboratory to lifelike experiences took place in the medical world. William Osler began teaching medical students the practical applications of knowledge (Houle, 1976). Osler not only took his students to see the performance of autopsies but also took them along to see him treat his patients. This was the birth of experiential learning for the training of physicians. From this era, the American society has guided simulations in medicine, teaching, dentistry, and numerous other occupations.

Assumptions of Experiential Curriculum

Hutchings and Wutzdorff (1988) state four assumptions that are inherent in all experiential learning situations. First, there is concreteness. Learning must be established in the student's own experience. Building experience into the student's environment is something that is done through science classes that have laboratories, English classes that have plays, and sociology classes that build theory on student's experience. Bigge (1971) would call this meaningfulness. Bigge states that meaningfulness consists between relations and fact - generalizations, rules, and principles for which students can see some use. Stephens (1965, p. 210) states, "If the material is sufficiently meaningful, there may be no forgetting whatever."

Next there is involvement. Students learn more and learn in more detail when they are involved in subjects that they care about. Kinesthetic learning is one area of involvement. Students learn more about the handicapped when they spend a day or two in a wheelchair.

The third assumption is dissonance. Dissonance is throwing learners temporarily out of balance to move them to deeper understanding. Frick (1977) states that quantitative experience is the sum of newer experiences added to the older experiences. Qualitative experiences are new information crashing in on the old ignorance.

The fourth assumption of experiential learning is reflection. That is the ability for the student to step back and ponder one's own experiences. Students tend to learn better when they can step back and think about what just transpired.

Similarly, Kolb (1984) gives six characteristics of experiential learning. Kolb states that the first characteristic is that learning is best conceived as a process, not in terms of outcomes to be achieved. Ideas are not fixed as in the behavioral context, but are formed and reformed through experience.

Second, learning is not a lock-step notion but is a continuous process grounded in experience. William James and John Dewey surmise that the consciousness is a continuous process and never stops. When one wakes in the morning, he has the same consciousness that he had the evening before. Hence, learning should be a continuous process.

Third, the process of learning requires the resolution of conflicts between directly opposed modes of adaptation to the world. Most experiential proponents (Dewey, Lewin, Piaget) adhere to the notion that learning is a tension- and conflict-filled process. Kolb goes on to state that if learners are to be effective in confrontation they need four different kinds of abilities: (1) concrete experience abilities, (2) reflective observation abilities, (3) abstract conceptualization abilities, and (4) active experimentation abilities.

Fourth, learning is a holistic process of adaptation to the world. Learning is a whole concept describing the process of human adaptation to the social and physical environment. When learning is conceived as a holistic adaptive process, it is a continuous process that spans across life.

Fifth, learning involves transactions between the person (learner) and the environment. Experience shapes the formation of attitudes of desire and purpose. Given this experience, each real experience has a positive side to it that changes the reality under which the experiences are had.

The last characteristic of experiential learning is that learning is the process of creating knowledge. Knowledge is created by the interaction of personal knowledge and social knowledge.

Cognitive Development

Piaget's cognitive development theory is one of the most important and widely recognized theories in intellectual development. Piaget's concept of action includes both overt motor behavior and internal mental processes (Hohmann, Banet, & Weikart, 1979).

Crain (1985) gives a good overview of Piaget's theories.

Piaget's first period of development is the Sensori Motor Intelligence period. This is the period from birth to about two years of age. Babies organize their physical action schemes which are made up of grasping, sucking, and small motor movements. In this stage, they can only deal with the immediate world.

Stage one in this period is the use of reflexes. The age grouping for this stage is about birth to one month (Ginsburg & Opper, 1979). Babies develop what is referred to as a schema, a pattern for dealing with their environment. Most of the reflexes in this stage are inborn reflexes (Crain, 1985).

Stage two in this period is that of primary circular reactions, exemplified when the baby has a new experience and tries to repeat it. This stage involves coordination and movement of the baby's own body. This stage occurs when the infant is from one to four months old (Ginsburg & Opper, 1979).

Stage three is that of secondary circular reactions. This stage occurs at about four to ten months when a baby discovers an interesting event outside his or her body (Ginsburg & Opper, 1979).

The fourth stage, at approximately ten to twelve months, involves the coordination of the secondary schemes. In this stage the baby performs a single action to get a result (Ginsburg & Opper, 1979).

Stage five, tertiary circular reactions, occurs when a baby experiments with different actions and observes the different outcomes. The age of the baby in this stage is about twelve to eighteen months (Ginsburg & Opper, 1979).

The last stage, from about eighteen months to two years of age, is the beginnings of thought. Children are like little scientists, making various actions and observing the results.

Piaget's second period is that of Preoperational Thought. The period lasts from age two until age seven. During this time children learn to think and to use symbols and internal images. However, their thinking is illogical, very different from adult thinking.

About age seven, children enter the third period, the Concrete Operations period. It lasts until they are about eleven years of age. In this stage, children begin to think systematically, but only when they refer to concrete activities and objects.

The last period is referred to as the Formal Operations stage. The age grouping is from age eleven to adulthood. In this last stage of development, individuals learn to think systematically in a purely abstract form. This last stage also represents the level at which one can think hypothetically.

In addition to the above developmental periods, Piaget characterized children's behavior in terms of biological tendencies found in all organisms. Piaget organized them as follows.

"Assimilation" is eating or taking in, as in digestion. Intellectually, all people need to assimilate objects of information into their intellectual systems. Assimilation is the act of reading books or, as a baby, just trying to grab objects.

"Accommodation" means making changes in intellectual systems to fit new objects into existing structures.

The third tendency is organization. Humans are always trying to organize ideas and information into coherent systems (Crain, 1985).

Wadsworth (1978) states that children learn three kinds of knowledge. First, there is physical knowledge which is learned by the active participation of touching, tasting, lifting, throwing, smelling, biting, looking at and listening to, etc. Physical knowledge does not require feedback from another human being. Next, there is logical-mathematical knowledge which comes from the child in the form of a child's actions as they are related to objects. Piaget (1970) states that logical-mathematical knowledge is always the result of the coordination of actions. Kamii (1973) asserts that while physical knowledge is discovered by the child, logical-mathematical knowledge is invented by the child. The last type of knowledge, Wadsworth says, is social-arbitrary knowledge. Social-arbitrary knowledge is learned from other people, specifically from action or interactions with other people.

Although Piaget's theories are more widely known, Kurt Lewin offers another experiential learning theory. Lewin's theory is called the Lewinian Model of Action Research and Laboratory Training. His model concentrates on learning, change, and growth facilitated by an integrated process that begins with the here and now experience. This experience is followed by a collection of data and observations about that experience. The data are then analyzed and fed back to the actors in the experience for their use in modifying their behavior and choosing new experiences. According to Kolb (1984), two aspects make this model unique. First, it focuses on the here and now to validate and test abstract concepts. Second, the action research and laboratory training are based on a feedback process. This information feedback provides the basis for a continuous process of goal-directed action and evaluation of the consequences of that action (Kolb, 1984, p. 22).

John Dewey, another experiential learning theorist, suggests a process that is similar to Lewin's theory. Dewey, like Lewin, maintains that learning is a logical process integrating experience, concepts, observations, and action. The impulse of experience gives ideas their moving force, and ideas give direction to impulse (Kolb, 1984, p. 22).

Dewey states that the purposes in intellectual development involve the observation of surrounding conditions or environment, knowledge of what has happened in similar situations in the past, and judgment to put together what is observed and what is recalled to see if the two relate. Dewey also states that it is extremely important to postpone immediate action until the observation and the judgment processes have intervened.

Experiential Learning Curriculum

The experiential curriculum is different from the standard "traditional" curriculum. Following is an example of an experiential learning curriculum (Karlin & Berger, 1971).

While the usual environment is passive and individualistic, the experiential environment is active and cooperative. The students sometimes work in groups and take an active part in the group dynamics. Students should not think of "I" as an individual, but of "we" as a group.

Creativity is accentuated. The more creative a student is, the better. Children learn when their minds are engaged. The classroom is related to the children's personal experiences as much as possible. Creativity must be demonstrated by the teacher, as well as by the students.

The exchange of ideas and the freedom of expression is foremost in an experiential environment. Students must communicate with the teacher and other students. While all can express ideas, no child should be allowed to ridicule another. All students should feel comfortable in the classroom and be allowed to discuss subjects without disrespectful gestures and comments.

Democratic ideals are fostered in the experiential learning environment. To perpetuate/emphasize this idea, many teachers hold elections for class officers twice a year. The teacher should be seen as helpful and as a resource person when problems occur.

Problem solving is a very important part of growth and development in the experiential learning process (Hohmann, Banet, & Weikart, 1979). Problem solving requires thinking and is generally regarded as the most complex form of human intellectual activity (Klausmeier, Ghatala, & Frayer, 1974). Being able to solve problems helps a person adapt to the physical and social environment or change part of that environment. Analytical processes of thinking are part of the problem solving techniques in the experiential learning environment (Stice, 1987). It is not merely enough that students get the right answer, but they should know how and why they got the right answer. With problem solving skills, as children approach new situations and challenges, they gain confidence in their ability to create solutions for the problems presented. Rubinstein and Firstenberg (1987) offer six heuristics for problem solving:

Concentrate on what is at hand. They say to focus on the obstacles that one can overcome. Make sure all obstacles are identified.

Consider implementation. When implementation requires the cooperation of other people, it is very important to direct attention to the quality of the implementation and to the acceptance of the solution by those who will implement it.

Try to maintain group harmony at all times. It is very important to pay attention to the feelings of others.

Be a good listener. Try not to cut others off with the formulation of an answer before they have a chance to say what they want.

Focus on what the group can control. Exercise your control whenever possible. The more control that is exercised, the more probable the group goals will be met.

Use a mixed scanning strategy. This is the same strategy master chess players use in their games. Encompass the field of question and try to analyze the possible and probable steps in the problem.

Assessment of Experiential Learning

Evaluation techniques for the experiential learning paradigm vary, and all are grouped together for an overall look at performance, an integrated evaluation that emphasizes judgments and feelings.

Unlike the dominant paradigm, the experiential paradigm has several areas for evaluation and is not limited to testing. Testing is involved but to a lesser extent. Other concepts are considered when trying to evaluate a learner.

Evaluation of Design B Paradigm

The design B evaluation reflects three dimensions: quantitative measures, teachers' judgments, and the child's feelings (Dobson & Dobson, 1981).

Quantitative measures include tests. These tests are not the standardized tests discussed in the dominant paradigm, for those emphasized how each pupil related to the other, which is referred to as standardized testing (Wick, 1973).

Design B testing concerns itself with measuring what has been taught, rather than what may have or may not have been taught. This type of testing, considered criterion-referenced testing, focuses on what the student has learned. The learner is not evaluated in terms of the other students but in terms of how well the student performed against the criteria of the test.

Karlin and Berger (1971) give several characteristics and examples of testing that help the teacher determine the learning that has taken place. First, questions that start with "how" or "why" help the children think about what has taken place and explain what they have learned. Along with questioning, the teacher should ask very few rote memory questions and concentrate on other types of questioning for understanding and grasp of knowledge. At least 50 percent of the questions should be essay. Other categories should include true and false questions, changing a false question to make it true, multiple choice questions, and completion questions. Even questions that are made up by the students have a learning component that involves reasoning.

As stated earlier, teacher judgments are a form of evaluation for the design B. Part of the teacher's role is to figure out what the child already knows and then formulate activities for the child to stimulate his or her growth. What children say and do can cue the teacher in on what is taking place in the child's life regarding intelligence and thinking skills (Wadsworth, 1978).

The child's feelings are another part of evaluation. How the child feels about what he/she has learned and the feeling of achievement are important in the learning process (Wadsworth, 1971).

These feelings of the student can surface when the teacher and the student are both taking part in the evaluation process. A portfolio should be kept on each child so that the teacher and the child can participate in what has been learned and presented. Forrest, Knapp and Pendergrass (1976) suggest five areas as a holistic judgment process stemming from expertise and not included in typical psychometric approaches. The first, product assessment, pertains to the evaluation of pictures, compositions, writing samples, inventions and the like. The evaluator can observe all of the results of the student's efforts. Performance tests that require a specific kind of learning are applied. A performance test is nothing but a work sample requiring the accomplishment of specific tasks in a controlled setting but may consist of a situational observation of performance in a natural setting (Forrest, Knapp, & Pendergrass, 1976). Simulations and situational tests are used to monitor complex behaviors such as analytical thinking, goal setting, risk taking, interpersonal competence, decision making, sensitivity to the behaviors of others and oral communications (Forrest, Knapp, & Pendergrass, 1976). Essay examinations are used to keep a recorded or actual form of evaluation. The last area is that of face-to-face interviews. These interviews can provide rich details of the perceived learning outcomes.

The author has presented evaluation characteristics in the dominant paradigm and the experimental paradigm. A look into the third or alternative paradigm in evaluation will be given.

Existentialism

The humanistic paradigm (existentialism) is the third evaluation paradigm and is referred to as "Design C" by Dobson, Dobson, & Koetting (1981).

Existentialism derives its name from various philosophers from differing schools of thought. "Existential" refers to the body of philosophical doctrine developed primarily in Germany and France as an alternative description of "human nature and conduct" to that provided by the methods of scientific induction (Kaelin, 1974, p. 53). The original meaning Kierkegaard gave to existentialism was simple and straightforward; it is a rejection of all purely abstract thinking, of a purely logical and scientific philosophy, a rejection of the absoluteness of reason (Roubiczek, 1964). The original intent was that existentialism (philosophy) should be connected with the individual's own life and experience, with the historical situation in which he finds himself. In existentialism, what a man becomes is left up to him, for he is responsible for himself. Man will either choose for himself or let others choose and decide for him. Freedom in itself is neither a goal nor an ideal but is the potential for action (Buber, 1965, pp. 91-92). Man is nothing other than what he makes himself (Sartre, 1947, p. 18). For the existentialist, the physical universe and the world apart from man has neither meaning nor purpose (Kneller, 1971). The existential philosophy is not an interesting abstract speculation but a way of life, a philosophy that is fully capable of being lived. The existentialist philosopher insists that what he really knows is not the external world as such but his own experience (Roubiczek, 1964). The personal is the reality. He believes that philosophy should start from one's own experience, one's own inner knowledge, and that this inner knowledge should be qualified and enriched. Personal experience should be admitted as evidence. Morris (1966) states that existentialism is a theory of individual meaning which asks each man the reason for his existing in the world, and which makes one examine the very meaning of human life. In contrast with the experimentalist approach to knowledge which advocates the use of scientific methods for solving problems, the existentialist prefers solutions originating in the aesthetic, moral, and emotional self (Kneller, 1958, p. 61).

There are three major differences between existentialism and the other philosophies (Morris, 1966). First, existentialism is more interested in the particulars than in the universals. Existentialism is more interested in trying to conceive the importance of a single human life than to come into some grand "catch all" category which allegedly explains the "all" and the "one". Existentialism discusses the subjective. Since the subjective is not discussable, there is need to invoke the services of metaphor, allegory, and symbol. Lastly, existentialism discusses the individual. It seeks out the individual in a personal manner.

Morris (1966) gives three areas of understanding about men. This understanding does not come to us from metaphysics but from within ourselves and is known internally without any assistance from intellectual formulas or knowledge. It is with these three areas of understandings that existentialism gets its start. The three concerns are human subjectivity, paradox, and anxiety.

One way of gleaning meaning from existentialism is through human subjectivity; that is, the private and subjective awareness we each have of ourselves as we exist in the world. Every thought man thinks, every communication he serves, and every act he commits, derives its existence from man's prior existing. Most existentialists adhere to the metaphor that they were "thrown" into existence from whence they knew not. This is referred to as the dawn of consciousness, the consciousness of becoming aware of itself as part of or as a presence in the world.

Paradox consists in holding two contrary views of the significance of our own existing. There are two paradoxical situations that concern the existentialist. The first is, "I assign to myself, therefore--without any assistance from Christian doctrine or democratic preachments--an absolute value and an ultimate worth. I count, I matter in the scheme of things. My existing makes a difference; the cosmos wouldn't be quite the same without me" (p. 16).

The other side of the paradox is that "My existence is a big joke, a huge delusion!" According to this paradox, man continuously lives with himself in a matter fluctuation; that man is of no absolute value in the world or that man is of no value to this world whatsoever.

Anxiety, the third concern of existentialism, is a numbing feeling of being erased from existence without a trace. Tillich (1952) defines anxiety as "the state in which a being is aware of its possible nonbeing". This type of anxiety is not to be confused with the anxiety of Freud and other psychoanalysts, for this anxiety is existential anxiety. Existential anxiety does not mean alienation from one's fellow human beings but alienation from the world, from the very ground of existing.

Existentialism is a form of radical individualism according to which the individual's conduct may be conditioned and motivated but not determined (Kaelin, 1974, p. 57). The existential programs are not infiltrated with fixed objectives and desired behavioral outcomes for the entire class of students. The classes are not formed with socioeconomic classifications and future functions in society as predetermining factors. Students in the existential framework are seen as the most meaningful resources of their own educational aims. A program of this type is fitted to each individual in the educational process. Kaelin (1974) states that in an existential program, the students are concerned with an opening to experience, and an opening to make their own contributions to their personal educational process. One asset the teacher must have is the ability to turn the student's reaction into his own expression. The teacher's own reactions and comments should be limited to the experience of the student's work. The teacher should be in a position to suggest meaningful alternatives and possible ideas to the learner. The teacher can only be present to his learner, if he appeals to that learner's freedom. He can only be present himself if he is engaged in searching and choosing, if he is committed, and if he cares (Greene, 1974, p. 84). The learner should be able to make his own contributions to his education. He should be able to explore his own inner horizons and to reflect upon his own consciousness and his own knowing (Greene, 1974, p. 83). Any evaluation communications are requested by the student and are discussed between the student and the teacher. The criteria are set by the student and are referenced against himself only, though the teacher is considered as having a valid and useful part in the overall evaluation of the student. The learners are furnished with data and are encouraged to interpret the data themselves. The evaluation is a shared responsibility between the student and the teacher.

Values

Axiology, the study of values (Kneller, 1971), concerns itself with three main questions: (1) are values personal or impersonal; (2) are values changing or constant; (3) are there hierarchies of value? To imply that there are objective values, the values must exist in their own right regardless of human preferences. To say that there is goodness in the universe does not mean that everybody has the value of goodness. Values are absolute and eternal (Kneller, 1971). The value of honesty is as valid today as it was yesterday or the day before.

Values express a person's beliefs and ideas about what ought to be and the rules which people live by today (Anderson, 1965). Values are woven into specific beliefs by feelings and experiences. When the world gets as complex as it is today, fewer common values are agreed upon. The values of just a few years ago no longer hold true today as is seen in attitudes toward crime, rape and divorce.

The school is the value-laden socialization agent of our society today. The school is the perpetuator of our value system, as well as responsible for the improvement of these ideas. New values and beliefs come out of new experience and the cultural values of that particular social group. Frymier and Hawn (1970) state that values affect the behavior of people in various situations. All people are motivated by the value systems that they hold. Each individual's psychological system organizes values in a hierarchical fashion; these values are made from personal experience and from the environment in which the individual was raised. No one has ever valued anything without having chosen it freely for valuing (Raths, Harmin, & Simon, 1966). Raths and others (1966) also go on to say that real valuing has not occurred until the valuer has chosen that value from many alternatives. Real valuing involves choosing the value after considerable reflection, prizing and cherishing the value, a willingness to affirm its worth publicly, have the value incorporated into his or her own life space and pattern, and show allegiance to it by actual behavior on repeated occasions (Raths, Harmin, & Simons, 1966). Thus, values become a pattern of choice.

Charles Morris (1956) relates the distinction between what people say they value and what they actually do, in the sense of their actions. Conceived values are the values people say they have or that they think they believe in. Operative values are values that are implied by the way that those particular people behave. This distinction gives credit to the old saying, "Actions speak louder than words." Along these same lines, existentialists believe that values do not exist apart from the freely chosen acts of men (Kneller, 1958).

Knowledge and Facts

Knowledge is defined as the act of knowing. Hyman (1973) defines knowledge as facts, explanations, principles, and definitions. One of the obvious sources of the curriculum has been what man has accumulated, stored and organized. The simple answer to what man should teach in the schools is what man knows (Anderson, 1965). Knowledge is constantly changing and, up until the advent of the computer and data processing systems, teachers were fairly sure that the content of the textbooks was fairly recent. Not today. The proliferation of knowledge is occurring at an accelerating rate. This rapid production of knowledge creates a large amount of outdated content.

Taba (1962) has defined levels of knowledge in a way that helps sequence the acquisition of knowledge. The four levels are as follow:

1. Specific facts and descriptive ideas at a low level of abstraction and specific processes and skills.
2. Basic ideas and principles.
3. Concepts, such as the concept of democracy, which are complex systems of highly abstract ideas.
4. Thought systems and methods of inquiry.

Change

Three basic principles lie behind curriculum changes in today's schools (Frymier & Hawn, 1970). First, there are philosophical principles involving how schools exist to help children learn, the purpose of supervision (which is to improve curriculum), changing curriculum (which is to help change people), helping the supervisor change, and the importance of equalitarian relationships.

Second, the psychological principles involve behaviors and how they seem to function, values that affect behavior, working with people on their own levels, and working to reduce the halo effect.

Finally, there are the operational principles behind curriculum change. These principles include involvement of the individuals for which the change is desired, communication, working with issues that have no direct answer, noting that the best basis for change is the facts, and always remembering that success is important.

Concerning the psychological principles, behavior is determined by or is a function of how things seem to be. Frymier & Hawn (1970) state,

> One of the dilemmas of the educative process is that facts are important, but only to the extent to which they are so perceived by the people involved. What things really are is never as important as how things seem to be -- people act according to the facts as they understand them . . .
>
> It is one thing to deplore this situation and it is quite another to utilize this knowledge for more effective supervision. For example, even if all of the research evidence in the world indicated that heavy cigarette smokers will get lung cancer and die, this information will hardly influence behavior unless it has some personal significance for a given individual. People's behavior is a function of how they perceive, and perceptions involve attributing personal meaning to stimuli, regardless of the nature of the stimuli themselves. . .
>
> Facts alone, however, are not enough. Perceptions are influenced by many things, not the least of which are the individual's value structure and his basic needs; these aspects of human personality are not easily modified or altered. How an individual

> views himself and the importance he attaches to any isolated bit of information are distinctly related. Only those ideas and those pieces of information perceived as close to the self and personally meaningful affect behavior. Whether or not experiences are recognized as near or as far psychologically and are considered a part of apart from the self determine in large measure the extent to which influence the individual perceiver. It is more than a truism that people behave according to the way things seem to them. It is a demonstrated fact.

This very important principle concerning behavior and change relates to the energy awareness program, which attempted to change people's attitudes and behaviors regarding energy consumption and conservation. If individuals do not perceive an energy shortage, they will not act like there is one. People act in the way they perceive their world. If humans cannot personally see the danger of a particular behavior, they will not change. Regarding energy, that "personal relevance" would seem to be a shortage of petroleum products or a much higher price paid for the petroleum products.

It is hoped that the teachers who have participated in the energy awareness program would change their teaching patterns as well as their personal energy consumption practices. Guba (1965) maintains that educational change involves four stages: research, development, diffusion, and adoption. While the subject of adoption, Rogers (1962) states that there are five separate steps in the adoption process: first, there is awareness on the part of the individual; second is heightened interest; third is an evaluation of the adoption; fourth is a trial run with the new process; and finally, adoption takes place.

Though much change and improvement occurs in individuals, Doll (1986) also notes change often takes place in groups as well. Doll notes that when groups are at their best, they engage in a high quality process of problem solving. Change is believed to be created most readily by keeping problem solving open and experimental, cooperative, task oriented, and educational and/or therapeutic (Benne, 1961). People who work together express compliance, usually in an effort to keep or enhance their own reputations; next, they identify with one or more other persons in their group or organization to achieve; finally, they internalize the ideas and values in their environment, making these ideas and values part of themselves (Kelman, 1961).

Materials have also become a special avenue to change. Of the various kinds, some are packaged into learning programs (Doll, 1986), for example model building, laboratory experiments, independent studies, field trips, playing games, simulations, role-playing, and small group instruction. Also included in the packages are books, computers, instructional machines, telecasting equipment, models, filmstrips, transparencies, pictures and slides.

Personal Meaning

Personal meanings are derived from experience (Copleston, 1956). Underwood's analysis (1963) suggested that meaning is a critical variable influencing the extent to which an individual analyzes a stimulus and responds selectively to it (Gregg, 1972). Meaningfulness consists of relations between facts--generalizations, rules, principles--for which students see some use (Bigge, 1971, p. 290).

Audience of Evaluation

The audience of evaluation revolves around the purpose of and objectives surrounding an evaluation. Evaluations ranging from curriculum evaluations to higher education projects are often funded by outside agencies which demand an evaluation (House, 1977). The evaluations of any project are almost always carried out by or managed by people. Such evaluations should be considered political in context (Cohen, 1977).

One of the main problems is that evaluators stand to make a financial gain from their involvement with certain types of funded projects. Aside from that, the evaluator should be involved with the project from the outset (Renzulli, 1974). Good evaluational theory states that the evaluator should work with the project from the development stage all the way to the evaluation. An evaluation has political implications to the extent that it leads to decisions concerning reallocation of resources and influence.

The Joint Committee on Standards for Educational Evaluation gives details on how to effectively handle politically viable situations. First, the evaluation should be planned and conducted so that the different interest groups can take part at different levels of the evaluation. All parties involved must cooperate. Second, before any potentially controversial issues crop up, meet with as many of the interest groups as possible, giving them ample opportunity to voice concerns over any new or seemingly partial biases (Quinn & Hennlly, 1981).

The next step is to negotiate a contract which makes specific conditions that govern the evaluation, making sure that evaluators have access to the required data and editorial control of the final evaluational reports.

Clients should receive periodic updates on the evaluation through reports and newsletters. It is always good to report all the opposing positions of the different interest groups.

Lastly, the evaluation should be discontinued if political conflicts arise to the extent of constant unfavorable situations.

Interviewing

Interviews can be classified into three broad types (UNESCO, 1984): when the wording of the questionnaire is specific and the number, sequences, etc. are given and therefore cannot be altered; when the questions are in a specific order, but the interviewer can reword the questions for probing; and when there are no pre-set questions and the interviewer is free to ask any questions and formulate them as he progresses through the interview.

Interviewing is considered a qualitative analysis technique. Qualitative data can be collected in a variety of ways, such as observations, interviews, tape recordings, document analysis and telephone conversations (Miles & Huberman, 1984). These qualitative data analysis categories are usually processed or reduced before they are ready for use. These processes are usually in the form of transcriptions, editorials, and typing.

Data analysis consists of three different types of activities (Miles & Huberman, 1984). First, there is data reduction, selecting, focusing, simplifying, abstracting, and transforming the raw data that appear in field notes. Data display is an organized assembly of information that permits conclusion drawing and action taking. The most frequent form of qualitative data is the narrative text. The third type of activity is drawing and verifying conclusions.

Pragmatism

As stated earlier, pragmatism is an approach to experiential learning, and was the most influential philosophy during the first part of the twentieth century. Pragmatism is best understood as a rejection of the traditional academic philosophy, and it concerned itself with trying to establish positive aims (Thayer, 1967). Three men are responsible for the perpetuation of this philosophy, Charles Pierce, who developed the philosophy of pragmatism in the late 1870s; William James, who reformulated it in the late 1890s; and John Dewey, who further developed it in the early part of the twentieth century. According to Melamed (1985), the pragmatic theme of experiential learning focuses on the participation of the learner in acquiring or mastering concrete skills based on a sequence of learning events that have been specified in advance. This type of advance instruction is what separates the pragmatic (institutional) from the existential (individual).

Another theorist who is part of the experiential learning scheme is Jean Piaget. Piaget believed not only in the concept of action but also of internal mental processes. To Piaget, the use of the term "action" refers to both mental and physical activity.

CHAPTER III

RESEARCH DESIGN AND METHODOLOGY

Introduction

This chapter describes the procedures used to accomplish the purpose of this study and to answer the four research questions.

The purpose of this study was to evaluate the Energy Awareness Program for elementary and secondary teachers at Oklahoma State University by assessing the participants' personal attitudes and ways in which their attitudes and behaviors changed as a result of the program.

The four research questions that guided this study were:

1. What influence has the conference had on the participants' present energy consumption behavior, if any?
2. What areas have changed in the participants' personal life because of something presented in the energy program?
3. Is there any difference in the participants' energy units after attending the energy program compared to before the energy program?
4. Did the participants perceive the energy awareness program to direct awareness to all grade levels of the curriculum?

Description of the Population

This study evaluates the effectiveness of the Oklahoma State University Energy Awareness Program. The population consisted of the 357 participants in the energy awareness program. All participants performed an educational function in the state of Oklahoma: teachers, supervisors, principals, and superintendents. Some teachers were from private schools, though most were from public schools. Participants could range from kindergarten teachers through the instructors at the college level. The areas of specialization in teaching included science, math, elementary education, special education, English, reading, physical education, social studies, home economics, and other certifiable areas in the state of Oklahoma.

The participants that were interviewed were chosen for their accessibility to the researcher. The participants were not randomly selected.

The participants selected for the interview had to meet the following criteria:

1. Satisfactorily complete one of the fourteen yearly Energy Awareness Programs;
2. Reside in Stillwater, Oklahoma or the surrounding area (live within an hour's traveling distance from Stillwater);
3. Give permission to be interviewed.

Interviews were used in this study as the primary means of obtaining data. The interview was the best instrument for obtaining data because of the type of information sought and because it gave the researcher the flexibility to pursue, clarify, and discuss different meanings of several interviewees. According to Kerlinger (1986), "The interview is perhaps the most ubiquitous method of obtaining information from people . . . . It has been used in all kinds of practical situations . . . ." Kerlinger also states that interviews are quite direct and respondents can, and usually will, give information directly. He goes on to say that an interview can elicit a great deal of the information needed.

The interviews were structured using an interview guide to make certain all participants had a chance to explore the same areas and comment on each one. The interview guide is listed in Appendix E. Because an interview guide was used, the exploration of the questions was not limited. Patton (1987) states:

> An interview guide is a list of questions or issues that are to be explored in the course of an interview. An interview guide is prepared to make sure that essentially the same information is obtained from a number of people by covering the same material. The interview guide provides topics or subject areas about which the interviewer is free to explore, probe, ask questions that will elucidate and illuminate that particular subject. The issues in the outline need not be taken in any particular order and the actual working of questions to elicit responses about those issues not determined in advance. The interview guide simply serves as a basic checklist during the interview to make sure that all relevant topics are covered. The interviewer is thus required to adapt to both the working and sequence of questions to specific respondents in the context of the actual interview. The interviewer remains free to build a conversation within a particular subject area, to work questions spontaneously, and to establish a conversational style - but with the focus on a particular predetermined subject (p. 111).

The interview guide was also used to limit the rambling of participants and to keep them focused as much as possible. Since each interview was scheduled for an hour to an hour and a half, it was best to maintain consistency within the interviews and remain on topic as much as possible.

Construction of the Interview Guide

The interview guide elicited most of the information needed for this study. The content of the guide was determined by the researcher in consultation with his advisor and committee and centered around the ten objectives used for the energy program since the first year.

The seventeen questions in the interview guide were asked of each interviewee in the order in which they appear.

The questions in this study were based on the following seven criteria set forth by Kerlinger (1986):

1. Is the question related to the research problem and the research objectives?
2. Is the type of question appropriate?
3. Is the item clear and unambiguous?
4. Is the question a leading question?
5. Does the question demand knowledge and information that the respondent does not have?
6. Does the question demand personal or delicate material that the respondent may resist?
7. Is the question loaded with social desirability?

Establishing Initial Contacts

The participants were contacted by telephone after it was established they met the selection criteria, namely:

1. Satisfactorily completed one of the fourteen yearly Energy Awareness Programs.
2. Resided in Stillwater, Oklahoma, or the surrounding areas.

Once contact was made and the former participant gave permission to be interviewed, the interview site and time were established.

Method of Analyzing Data

The data gathered by this researcher was in the form of personal interviews. Interviews were conducted at an agreeable time and location selected by the interviewee. Each of the interviews was recorded by the researcher using a small portable tape recorder. After all twenty interviews were recorded, they were taken to a professional transcriptionist to be transcribed exactly as they were spoken. Afterward, the transcriptionist assigned all the responses to question one under that question. All seventeen questions were ordered and aligned in the same fashion. When finished, all seventeen responses to each question were listed under that question. This procedure made it easier for the researcher to identify themes and consistencies among the interviews (Miles & Huberman, 1984).

No elaborate statistical interpretations were made in this study since it is concerned with attitudes and changes. Answers to the seventeen questions asked in this study can be summarized and reported in a classification of total responses. It should be noted that the responses will be discussed fully and only summaries of the responses will be tabulated and presented in terms of numbers and percentages. The patterns that emerge from these percentages can be studied.

Miles (1983, p. 126) reports that Seiber (1979) suggested that good analysis of data is something like the following:

1. Formulating classes of phenomena -- essentially a categorizing process.

2. Identifying themes -- the process of making linkages between the concepts.
3. Provisional testing of the hypotheses -- looking for concomitant variation and trying to rule out confusing factors.

Patton (1987) states:

Evaluation is the systematic collection, analysis, and interpretation of information about the activities and outcomes of actual programs in order for interested persons to make judgements about specific aspects of what the program is doing and improve the program (p. 145).

The data received in this study was categorized into specific areas. The second step was to identify themes within the categories and then to evaluate the effectiveness of the program.

In summary, the purpose of this chapter has been to give a general description of the design of this study. The major areas covered were the purpose of the study and the four research questions, description of the population, participant selection, construction of the interview guide, establishing initial contacts, and the method of analyzing data.

CHAPTER IV

RESULTS OF THE STUDY

This chapter presents the findings from the seventeen questions asked during interviews with twenty former participants in the energy awareness program at Oklahoma State University. Thirteen females and seven males were interviewed. The data is classified according to the themes of the questions. As a summary, the data is presented in terms of percentages of participants' responses to items in the interviews. The following are the questions for which the interviewer collected information.

1. What interested the participants in attending the energy awareness program.
2. Why the participants attended the energy awareness program.
3. If energy conservation has always been a personal concern of the participants'.
4. The influence the energy awareness program had on the participants' present energy consumption behavior, if any.
5. The areas in which the participants' personal lives that changed because of something presented in the energy awareness program and specific instances of such.
6. If participants had taught a unit of instruction on energy education before attending the energy awareness program, since taking the energy awareness program, and whether there were any differences in the energy units after attending the energy awareness program,

compared to those before attending the energy awareness program, in content, the number of energy subjects, and the depth of those subjects. If so, what did the participants do differently.

7. If participants implemented any of the energy activities presented in the program into their classrooms.
8. If the participants use energy education concepts throughout the school year, and what subjects they present energy concepts in (i.e. just in science, or in other subjects as well).
9. Whether the participants used the resources of the energy awareness program in their classroom teachings (books, pamphlets, etc.).
10. Whether the participants have taken any field trips related to the subject of energy education since the energy awareness program.
11. Whether the participants invited a resource person to their classrooms for demonstrations, lectures, discussions, etc. since the energy awareness program.
12. Since the energy awareness program, whether the participants helped other teachers with the subject of energy education since the energy awareness program.
13. Whether the participants believe that the energy awareness program directed awareness to all grade levels of the curriculum.
14. The participants overall impression of the energy awareness program.
15. The one aspect of the energy awareness program that the participant would change and why.
16. Whether the participants believe energy education should be taught as a subject by itself or as part of an overall science course.
17. Whether educators have a moral responsibility to teach children about energy education.

As stated above, the researcher accepted the following assumptions:

1. The former participants that were interviewed in this study did so voluntarily.
2. The former participants provided honest and complete answers to the questions asked.
3. The former participants provided accurate evaluations regarding their experiences during the energy awareness programs.

The findings of this research will be arranged in the order in which the questions appeared in the interviews, that is, ordered from question one through question seventeen. Responses will be grouped and classified into themes and recurring comments as noted by the interviewer. The percentages reflect the percentage of responses for that question.

Question Analysis

Miles & Huberman (1984) state that one of the data analysis techniques of interviewing is that of data reduction and simplifying. This data reduction and simplifying is produced from the field notes (raw data) collected in the actual interviews. Following is the analysis of the data for this study.

QUESTION 1 - WHAT INTERESTED THE PARTICIPANTS IN ATTENDING THE ENERGY AWARENESS PROGRAM?

Three main reasons came out of this question: 1) professional development, 2) the course was recommended by someone who had taken the conference previously, and 3) this was a good course to take in order to get recertification points from the state of Oklahoma in science education.

The first thrust of the responses centered around professional development. Most of these respondents mentioned the need for further advancement within the field of energy education. Thirty-five percent of the respondents said that they wanted more information and projects to take back to the classroom. Even though 60 percent of the respondents were science teachers, they all said that they were deficient in the area of energy education. All of these respondents agreed that the energy conference would benefit them from the standpoint of professional enhancement.

The second theme in the responses was that the work conference had been recommended by an individual who had taken the program previously. People tended to recommend this program because most of those interviewed agreed that they had a good time and learned a lot about energy education. A common component to many of the participants' responses was that their spouses had taken the program the prior year or recently.

Lastly, along with spouses' recommending this program, many principals suggested that teachers taken the course to get a better understanding of energy concepts as well as three hours of credit for recertification in the area of science education.

QUESTION 2 - WHY DID THE PARTICIPANTS ATTEND THE ENERGY AWARENESS PROGRAM?

Three main reasons came to light in answer to this second question: 1) better understanding, 2) certification, and 3) a genuine interest in conservation.

To get more information and to obtain a better understanding of energy concepts was the reason that 40 percent of the participants attended the energy program. They had heard from other participants that teachers attending the program received a lot of information. Another standout was the hope of getting help with instruction and preparation for the following years' science and energy topics in the classroom. Still, 10 percent of the above mentioned teachers wanted to take the program to help widen their students' awareness of conservation of energy.

Certification was a point that the teachers mentioned quite frequently. Sixty-five percent of the teachers interviewed said that this was a good course to take in order to maintain science certification in the state of Oklahoma.

The third noteworthy reason for attending was concern about the conservation of energy. Thirty percent of the participants interviewed stated that a genuine concern for saving energy was their main purpose for taking the energy program. Topics such as saving fuel in vehicles, energy efficient windows and door systems, and determining how much insulation should be in the attic, concerned those that wanted a practical approach to the program.

For the first two questions, five topics emerged as to what interested the participants in attending and why they attended the program.

The first topic was simply "fun." After most teachers heard about what took place during the program, they realized that it would be a change of pace from the traditional academic classes.

The second area mentioned was that of no formal academic exams. Many mentioned that as one of the highlights of the program. Learning can take place without all the traditional testing, not to mention the anxiety associated with tests in most college classes.

Culminating these two areas was the feeling that the entire three-week program was relaxing. Days seemed to move at a fair pace with very few pressing deadlines. This was welcomed by almost all of the participants interviewed. Most seemed to say that the program "had a relaxed atmosphere," or mentioned something like "the three week program was relaxing."

The fourth area mentioned was the field trips. Many teachers were excited about the chance to go to a nuclear plant, tour an electrical generating station, or walk inside the bottom of a dam below the lake bed. Still another trip mentioned frequently was the trip to the Conoco Refinery. Many said that even though they lived in the area of the refinery, they had never had a chance to tour the facility until they took the energy program. All of these trips were considered "educational opportunities" to those who attended the energy program.

The last area mentioned by the respondents was the knowledge and literature they received during the three-week program. One hundred percent of those interviewed said that the packets they received during the conference were very helpful in the classroom. They also noted that it would take a lot of time to get the same materials individually.

QUESTION 3 - HAS ENERGY CONSERVATION ALWAYS BEEN A PERSONAL CONCERN OF THE PARTICIPANTS?

Seventy percent of those interviewed agreed that energy conservation was a personal concern. Forty-five percent of those responded that energy conservation was a "family concern" or a "family value" or just "ethics of the family." The thrust of the interviews centered around the "economics" of saving money. If energy was saved, then the electric and gas bills would be lower. The "saving money" theme was brought out in 85 percent of those interviewed. Five percent of those agreeing that energy conservation was a personal concern said, "You may not be so aware when you are a kid, but as you get older, you become more conscious of it." Another respondent said, "I think when you are young, you don't really give something running out that much thought. I think the older you get the more mature you get, the more you think about those type things." The respondents confirmed that when they were paying the bills, they gave more thought to saving money by saving energy whenever possible.

Thirty percent of those interviewed said that energy conservation was not a personal concern. The general consensus of this group was that after the energy shortage of the early 1970s, more attention was placed upon conservation. Fifteen percent of this group also agreed that energy conservation was not a concern until they reached adulthood. Only 5 percent of the respondents said that they have not been actively concerned with conservation, nor is it an extreme concern to them at the present time.

Eighty-five percent of those responding tied monetary values to the "conservation" of energy, whether it was or was not a concern.

QUESTION 4 - WHAT INFLUENCE DID THE ENERGY AWARENESS PROGRAM HAVE ON THE PARTICIPANT'S PRESENT ENERGY CONSUMPTION BEHAVIORS, IF ANY?

For 60 percent of the former participants, the energy program did not cause a reduction in personal consumption. Twenty percent of the former participants agreed that they were already energy conscious. They did however agree that they were much more aware after the energy program than before the program.

For 40 percent of the participants, the energy program did cause a change in their consumption behaviors. Some of the changes in consumption behaviors included recycling (in the home and at school), fewer trips to the store, keeping the thermostat at lower settings, and a conscious effort to keep the lights turned off.

QUESTION 5 - WHAT AREAS IN THE PARTICIPANT'S PERSONAL LIFE CHANGED BECAUSE OF SOMETHING PRESENTED IN THE ENERGY AWARENESS PROGRAM? CAN THEY GIVE ANY SPECIFIC INSTANCES OF SUCH?

Seventy-five percent of those interviewed said that they have made changes in their personal life as a direct result of the energy awareness program at Oklahoma State University. Twenty-five percent of those interviewed noted that the energy awareness program did not cause any changes in their personal lives.

Following is a summary of the events that have taken place in the lives of former participants because of something meaningful presented in the energy awareness program.

Five percent of those interviewed said that they quit heating their homes with wood. One of the main reasons was the high cost of the wood. Another reason was that it took too much time to go and cut the wood themselves. The most important reason they quit was that a lot of energy is wasted in wood heating systems. Once wood heating systems were abandoned, more energy efficient central heating and cooling systems were installed.

Ten percent of the interviewed participants said that they put more insulation in their homes, especially in the spaces above the ceilings. The reasons given were that the amount in the attic spaces was doing little to help insulate the home. They felt that energy was being wasted and that they could conserve on their heating and cooling bills.

Recycling was started by 15 percent of those interviewed. Also, 5 percent of those interviewed started a recycling program at their schools. They felt that a lot of energy was wasted by putting trash in landfills and that they wanted to help as much as they could.

Replacing old door and window systems was completed by 15 percent of the interviewed. Thermal windows were chosen along with steel insulated doors and thermal storm doors. The former participants felt that too much energy was being wasted and that new doors and windows would reduce that waste up to half. Along with replacing windows, five percent reported they also bought insulated drapes to compliment the new windows in the home. The insulated drapes would add protection by making an extra layer of air space.

Replacing old air conditioning systems was completed by 10 percent of those interviewed. New energy efficient systems replaced old window systems in their respective homes. Reasons given were to save money and to save wasted energy. Peak systems were installed by 10 percent of the former participants. The peak devices were described by one former participant as follows "the device would kick our heater off during certain periods of times through the day that we are gone, and you know kick it back on at a later time." These peak devices are designed to cycle on and off during peak usage times during the day.

Other things former participants changed were the following: 5 percent changed tractor engines from gas powered to compressed natural gas engines; fewer trips were made to and from stores by 5 percent of those interviewed; 5 percent reported consciously lowering thermostats; checking air pressure in car tires on a weekly basis was reported by 5 percent; 5 percent reported turning the gas off completely when the weather was warmer; rechargeable batteries were used at home and at school by 5 percent; and 10 percent bought smaller cars.

The justification for the changes taken by former participants can be summarized in the words of one interviewee: "My answer to that would have to be my own personal financial savings to try to conserve, of course, maybe eventually affecting the whole picture. But initially it is personal, saving my own money instead of spending it needlessly on wasted energy."

QUESTION 6 - DID PARTICIPANTS TEACH A UNIT OF INSTRUCTION ON ENERGY EDUCATION BEFORE THEY ATTENDED THE ENERGY AWARENESS PROGRAM?

Of those interviewed, 55 percent taught a unit of instruction on energy education. Five percent stressed that such a unit was in the curriculum guide and mandatory. Fifty-five percent taught some energy concepts, whether as a short part of an energy chapter on fossil fuels or as a whole unit devoted to energy and energy-related concepts.

Only 45 percent said that they did not teach an energy unit before they took the energy program. Five percent said that the energy chapter was one that they skipped because of a lack of knowledge.

QUESTION 6(A) - HAVE TEACHERS TAUGHT ENERGY EDUCATION IN THEIR CLASSROOMS SINCE TAKING THE ENERGY AWARENESS PROGRAM?

Seventy-five percent of the respondents reported that they did in fact teach a unit or pat of a unit on energy-related concerns. Of the 75 percent, 5 percent concentrated on recycling and environmental issues; 5 percent concentrated on coal and oil; and 5 percent said that though science was not their field, they taught energy-related concerns in reading.

Of those interviewed, 25 percent stated that they had not taught an energy unit or an energy-related topic since attending the energy awareness program.

QUESTIONS 6(B & C) - WAS THERE ANY DIFFERENCE IN THE ENERGY UNITS AFTER ATTENDING THE ENERGY AWARENESS PROGRAM, THAN BEFORE ATTENDING THE ENERGY AWARENESS PROGRAM? ARE THE UNITS ABOUT THE SAME REGARDING CONTENT, TIME, NUMBER OF ENERGY SUBJECTS, DEPTH OF THESE SUBJECTS? WHAT DID THE PARTICIPANTS DO DIFFERENTLY?

Of the 75 percent of the participants stating that they had taught an energy-related unit in their subjects following the energy program, the following is a summary of these changes: Increased confidence was a major factor in the changes in their classes after the energy program. The experiences in the energy program and the information they received helped the teachers supplement their textbooks. They reported a big change in time spent on the energy unit, chiefly because they felt more confident in the area of energy education.

Depth was another area that improved after the energy program. The teachers felt more knowledgeable and could cover each topic in much greater detail. They even had more materials to supplement the textbook and textbook aids. Overall, their knowledge base was broadened.

QUESTION 7 - OF ALL THE ENERGY ACTIVITIES THAT WERE PRESENTED IN THE ENERGY AWARENESS PROGRAM, DID PARTICIPANTS IMPLEMENT ANY OF THEM INTO THEIR CLASSROOMS?

For various reasons, 30 percent did not use any energy-related activities in their classrooms after taking the energy awareness program. Fifteen percent said that they were teaching non-science courses and it would be hard to implement these type of activities into their classrooms. Five percent did not remember any energy activities, and 10 percent just did not use any of the activities due to having already planned activities for their instructional time.

Seventy percent of those interviewed said that they did in fact use the activities that were presented in the energy program. Five percent used those activities in other workshops around the state of Oklahoma. Solar cooking units were specifically mentioned by 25 percent of those responding. A paper activity was used by 5 percent of the teachers to show how much energy is consumed every ten years.

Each of the following activities was mentioned by 5 percent of those interviewed: windmills that attach to basement storm doors, calorie experiments with different kinds of fuels, convection currents, conductivity from a battery to a light bulb, a power plant game that lets students decide whether to build a specific type of electric generating station, an experiment of trying to force oil through several types of rocks (representing different types of rock formations), building model homes to energy efficient standards, crossword puzzle activities on specific types of energy, a light activity using flashlights and windows o record the speed of light, burying trash for a length of time to see the decomposition of various waste products, and a get-acquainted game for first-time workshop and classroom meetings.

QUESTION 8 - DID PARTICIPANTS USE ENERGY EDUCATION CONCEPTS THROUGHOUT THE SCHOOL YEAR?

Only 10 percent of those interviewed said that they try to use energy education concepts throughout the year. Current events was one area in which they tried to integrate energy concepts with class discussions.

Ninety percent of the former participants did not use or integrate energy education concepts throughout the entire year.

QUESTION 8(B) - IN WHAT SUBJECTS DID THE ENERGY AWARENESS PARTICIPANTS PRESENT ENERGY EDUCATION CONCEPTS, OR WAS IT JUST IN SCIENCE?

Forty percent of the teachers interviewed stated that they tried to integrate energy education concepts in subjects other than science. The following is a list of the non-science course that energy education concepts were presented in: (1) social studies, (2) reading, (3) math, (4) creative writing, (5) writing classes, (6) English, (7) journalism, (8) family living, (9) life skills, (10) world cultures, and (11) American government.

Sixty percent of those interviewed considered themselves science teachers. They noted that energy concepts were included in just about every science course that the state of Oklahoma offers. The science courses that energy education concepts were found in were: (1) chemistry, (2) physical science, (3) earth science, (4) general science, (5) biology, (6) geology, (7) life science, and (8) human physiology.

QUESTION 9 - HAVE THE PARTICIPANTS USED THE RESOURCES OF THE ENERGY AWARENESS PROGRAM IN THEIR CLASSROOM TEACHINGS? (BOOKS, PAMPHLETS, ETC.)?

Twenty percent of those interviewed said that they did not use any of the resources of the energy awareness program. Five percent of the former participants were working for the state department of education at the time; 5 percent of the teachers used other sources for their activities in the classrooms; 5 percent gave the energy awareness resource book away to another teacher who moved; and 5 percent of those interviewed said that they just didn't use any of the resources of the energy awareness program.

Eighty percent of the past participants interviewed said that they did use the resources of the energy awareness program at Oklahoma State University.

Twenty-five percent of those responding that they did use the resources stated they used the energy resource book on numerous occasions. Five percent reported using the pamphlets on electrical energy. The teaching master file was used by 5 percent of those interviewed. Various booklets on solar and nuclear energy were used in the classrooms by 10 percent of the participants. Handouts on energy conservation, general curriculum activities, different energy sources, and math concepts with energy were all used by 5 percent of those responding.

Even though many of the participants used what was given to them in the energy program, they felt a need for more hands-on activities. Forty percent would like to have had more hands-on activities during the three-week program.

The participants wanted more "make and take" activities that they could use in the classroom.

QUESTION 10 - SINCE THE ENERGY AWARENESS PROGRAM, HAVE THE PARTICIPANTS TAKEN THEIR STUDENTS ON ANY FIELD TRIPS RELATED TO THE SUBJECT OF ENERGY EDUCATION?

Despite cutbacks in education, 45 percent of those interviewed have taken their students on field trips related to energy education. Most trips were taken by specific classes while a few involved whole grades in certain schools. These schools were small and could handle taking complete grades.

The most popular place to take field trips was to the Keystone Dam just outside of Tulsa, Oklahoma. Twenty percent of those taking field trips went to the electrical generating facility at Keystone Dam. One of the reasons mentioned was that it was close to the school, and it could be seen in one day.

Fifteen percent of those responding took students to the Sooner Generating Plant in Morrison, Oklahoma. The advantage to the generating facility was that it, too, was close to the schools wanting to tour the facility.

Other facilities that were toured by the participants and their classes were a live producing oil well, 5 percent; Phillips Petroleum Company, 5 percent; Conoco Refinery and administrative offices, 5 percent; the Oklahoma Generating facility in Oklahoma City, 5 percent; the Illinois River conservation rip, 5 percent; Oklahoma State University Energy Center, 5 percent; Oberlin Press waste management procedures, 5 percent; Enterprise Square, 5 percent; the Omniplex, 5 percent; and some lead and zinc mines in northeast Oklahoma, 5 percent.

Fifty-five percent of those interviewed said they had not taken any field trips since attending the energy awareness program. Of those that had not taken any field trips, 35 percent cited the reason as monetary considerations. The main reason was that the county could not afford to pay for the field trips. Substitute teachers were expensive, as were bus drivers and the fee for taking the buses. After those considerations, the teachers still had to come up with admission fees, money for lunches, and money for fuel to run the busses. One county school chose not to take field trips because they were trying to obtain money for new equipment since the school was only in its first year of operation. Five percent of the teachers reported that they did not take field trips for personal reasons, mainly, liability for the students on the field trip.

QUESTION 11 - SINCE THE ENERGY AWARENESS PROGRAM, HAVE THE PARTICIPANTS INVITED A RESOURCE PERSON TO THEIR CLASSROOMS FOR A DEMONSTRATION, LECTURE, DISCUSSION, ETC.?

Several teachers brought outside resource people into their classrooms to talk on energy-related subjects. Of those responding, 45 percent said that an outside resource person came in at least once. A wide variety of resource people in the field of energy education were brought in.

Some of the resource professionals obtained were representatives of Oklahoma Natural Gas; spokespersons from Oklahoma Natural Gas; a man from the United States Department of Agriculture/Soil Conservation Service discussing the reclaiming of violated lands in strip mining operations; a geologist teaching students about rock formations; a water conservationist; one student's father who talked on alternative energy sources; representatives from BIRP, an industrial recycling program; and respected energy specialists from Oklahoma State University.

Those who did not obtain resource people in the energy education field made up 55 percent of the sample. Fifteen percent said they invited resource people into their classes, but it was not for energy education. Five percent admitted it was difficult to obtain a resource person in energy education for a math class. Ten percent reflected and admitted a resource person should have been obtained by that time, but they had not done so. Twenty percent of those interviewed said they had not used a resource person in their classrooms, but would not elaborate.

QUESTION 12 - SINCE THE ENERGY AWARENESS PROGRAM, HAVE THE PARTICIPANTS HELPED OTHER TEACHERS WITH THE SUBJECT OF ENERGY EDUCATION?

Seventy percent of the participants have helped at least one other faculty member with materials received at the Oklahoma State University Energy Awareness Program. Several teachers reflected about what had been accomplished at their schools and they said, "Yes. Anytime we had new teachers come into our system, I was department chair, so I worked with them and things like that", "I think any time you come back from a new conference, or most people I hope would do this, you know, you are all pumped up and so anxious to do all those things you learned, and then those things that work, that were successful and go students' attention, you tend to repeat them."

Twenty-five percent of those who said they helped other teachers actually gave the materials to other faculty members at their respective schools. One participant donated everything he received at the energy awareness program to the library. The person thought that it would help the teachers more if everybody had access to the materials. One participant said that if other faculty members found out that someone went to the energy awareness program, the participant would be visited to see what was new and different.

Thirty percent of the participants said that they did not help others with the subject of energy education. Five percent said that they recommended the energy program to others but did not actually help with lessons or curriculum.

One participant said, "Everybody in my building has taken the energy awareness conference, so of course I did not help anyone else with energy related topics, they had just as much as I did."

QUESTION 13 - DID THE PARTICIPANTS PERCEIVE THE ENERGY AWARENESS PROGRAM TO DIRECT AWARENESS TO ALL GRADE LEVELS OF THE CURRICULUM?

Eighty-five percent responded they felt the energy awareness program was directed to all areas of the curriculum, grades 1 through 12. Following are remarks by some of the participants:

"You had to kind of improvise a little bit or change a little bit to fit your particular -- but I had to do that every year for everything I did because you have a different group every year, you know."

"It was pretty open." "They say here's the materials; now, as a teacher, adjust them up or down in accordance to your grade level."

"It's very easily adapted."

"There was a broad range there and we went back I mean there was something to pull for each grade level."

"They had a large variety of different kinds of sets of information and so forth that you could use as far as different levels from up like first grade on through there."

"I perceived it as the main goal was to have something that the first grade teachers could go back to and use with their kids and junior high and high school."

"I feel sure that everyone was able to take something back that they could use."

"I really think it targeted all areas."

"Those workshops give people what they choose to take away from it."

Those that did not believe the energy program directed awareness to all grade levels made up 15 percent of those interviewed. Several of their comments follow:

"It was targeted for the older kids."

"I just cannot see second graders understanding and comprehending some of this."

"I remember thinking I am glad I work with ten, eleven, and twelve year olds because I don't think any younger than that would catch it."

The 15 percent of the participants that did not think the energy program directed awareness to all of the areas of the curriculum was split: 5 percent thought it was geared for elementary, 5 percent thought it was directed to the junior high, and 5 percent thought it was targeted for the high school age group.

QUESTION 14 - WHAT WAS THE PARTICIPANTS' OVERALL IMPRESSION OF THE ENERGY AWARENESS PROGRAM?

The overall impression of the energy awareness program was excellent. Some areas of concern were expressed by those that were interviewed.

One participant said, "The classroom stuff . . . that wasn't too good. Although I enjoyed the speakers that came in and that sort of thing. So that part was good. But as far as hands-on activities, I would have liked to have had a lot more." Following are some of the summaries of the conversations that took place during the interviews: "Good", "Well informed afterward", "Excellent", "Good variety, good pace for each day", "speakers were very well prepared", "I really enjoyed it, well planned", "Great program", "I would recommend it for all teachers", "Well organized", "Well presented, enjoyed the field trips", "Relaxed atmosphere, approach of 'How can we help?'", "Did not feel under the gun at all", "A lot of fun, sorry to see the three weeks end", "Fast moving", "Great, but hot in temperature", "They knew what they were doing, they were focused and had current information", "I liked it a lot", "Still think about the program, even now", "Very informative", "As far as personal growth, it really helped me a lot", "Very helpful".

QUESTION 15 - IF THE PARTICIPANTS COULD CHANGE ONE ASPECT OF THE ENERGY AWARENESS PROGRAM, WHAT WOULD IT BE?

The following remarks will center around what type of changes would be made during the three-week energy awareness program. As interviewees stated, "Looking back in retrospect of what happened then which was very good", "I would have put more hands-on type of things that we could have actually carried to the classroom", "I would demonstrate several more activities during the program, and let the participants do it" "It would be have been neat to have some former participants come back and show us what they did in the classroom and how that worked out with the students", "Cut the three-week program down to two weeks", "Have a balance of teachers from the different grades, primary, intermediate, middle level, and high school", "Have a set of activities for the four groups that deal with the same concepts you are trying to develop", "Probably more hands-on activities and more of them as an elementary teacher", "If there had been some way to see the excavations [of strip mining] without the long trip", "It probably would be a little better to have more hands-on stuff", "I suppose making activities where kids could do things", "More information on a lower level", "Require all the participants to stay in the dorms", "Delete the computers; they were too hard to work with", "Have someone talk more on nuclear energy", "Probably just do more hands-on things to try to see if there's other ways that they could introduce some hands-on ideas to it", "We were often given time to work on things together. I would have rather had some of that time for instructional ideas and techniques", "For instance, the pretest, and there were questions on there that I don't know if we ever talked about during the three weeks. The questions, I would have loved to of had the answer to it. I know I would of liked to even had an answer to the test because even though we were given the test at the end, I still did not know the answer to some of them. I would have liked to of had that information from the test more and to inform the - maybe a study sheet or something - for my students or myself", "I'm thinking activities in the classroom that could have been changed or added or whatever", "An if that workshop could provide things to take back with you to the classroom", "It would have been nice to have some people who were kind of impartial [about heat pumps] to get us both sides of the view instead of hearing one from one person and one from the other person", "More on coal, nuclear, electricity, and the problems with using fossil fuels".

QUESTION 16 - DO THE PARTICIPANTS BELIEVE ENERGY EDUCATION SHOULD BE TAUGHT AS A SUBJECT BY ITSELF OR AS PART OF AN OVERALL SCIENCE COURSE?

Thirty-five percent of those interviewed said that energy education should be taught as a class by itself. The class should be taught in the middle school as a related arts class and be treated as an elective course (along with art, industrial technology, music, physical education, and home economics). Another idea was that energy education should be taught as an option in high school. This optional course would be offered as a science elective. The course would either be offered as a single subject (meaning a one-semester class) or as a course for the whole year.

Twenty-five percent thought energy education should be integrated into existing subjects. The belief was that the educational system is already overloaded with required courses and one more separate subject would be too many at the junior high as well as at the high school level.

Forty percent agreed that energy education should be taught as a unit of instruction in the science courses. One of the beliefs was that energy education would be boring in a course by itself. Also, the addition of another course would be an overload to the subjects already offered.

QUESTION 17 - DO EDUCATORS HAVE A MORAL RESPONSIBILITY TO TEACH CHILDREN ABOUT ENERGY EDUCATION?

All twenty participants agreed that our society should teach our children about energy education. One main theme that came up over and over was values clarification. If the society is to teach the younger generations, it is because the society values energy resources and respects the use of those energy sources.

The purpose of this chapter was to present the data collected from the twenty former participants of the Oklahoma State University Energy Awareness Program. The data was gathered from seven males and thirteen females. This chapter reported the findings from all twenty interviews in order to assess the energy awareness program at Oklahoma State University.

The data from all twenty interviews will be analyzed in Chapter V and summarized in order to answer the four research questions.

CHAPTER V

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

As previously stated, the major purpose of this study was to evaluate the Energy Awareness Program at Oklahoma State University by assessing the participants' personal attitudes and the ways in which their attitudes and actions changed as a result of the program. The major research questions which guided this study were: (1) what influence did the energy program have on the participants' present energy consumption behavior, if any? (2) what areas have changed in the participants' personal life because of something presented in the energy program? Can the participants give examples of such? (3) is there any difference in the participants' energy units after attending the energy program, and before the energy program? and (4) did the participants perceive the energy awareness program to direct awareness to all grade levels of the curriculum?

Each question contained in the interviews will be analyzed and summarized by presenting the findings of those interviews.

After summarizing the seventeen interview questions, recommendations for future considerations will be given. These recommendations arise from the themes that evolved from the interviews.

Conclusions

Question 1 - WHAT INTERESTED THE PARTICIPANTS IN ATTENDING THE ENERGY AWARENESS PROGRAM. - Three main themes came from the first question: professional development, being recommended by someone who had previously taken the energy program, and that the energy program was a good course to obtain recertification points from the state of Oklahoma in science education.

Question 2 - WHY THE PARTICIPANTS ATTENDED THE ENERGY AWARENESS PROGRAM. - Three main concerns surfaced: a better foundation in energy education, maintaining certification, and a genuine interest in conservation.

Question 3 - IF ENERGY CONSERVATION HAS ALWAYS BEEN A PERSONAL CONCERN OF THE PARTICIPANTS. - For 70 percent of those interviewed, energy conservation was a personal concern. "Family values," "family ethics," and "family concerns" were words used to describe how the participants felt about conservation. The main thrust behind conservation of energy was saving money and secondly saving energy.

Question 4 - THE INFLUENCE THE ENERGY AWARENESS PROGRAM HAD ON THE PARTICIPANTS' PRESENT ENERGY CONSUMPTION BEHAVIOR, IF ANY. - For 60 percent of those interviewed, the energy program did not cause a reduction of personal consumption. A change in personal consumption behavior was reported by 40 percent of those being interviewed. Those personal changes included recycling, fewer trips in the car, and making conscious efforts to keep the lights off and the thermostat a lower settings in the home.

Question 5 - THE AREAS IN WHICH THE PARTICIPANTS' PERSONAL LIVES THAT CHANGED BECAUSE OF SOMETHING PRESENTED IN THE ENERGY AWARENESS PROGRAM AND SPECIFIC INSTANCES OF SUCH. - Seventy-five percent of those interviewed stated there was a change in their personal life as a direct result of the energy awareness program. Five percent quit heating their homes with wood; 10 percent put more insulation in their homes; recycling was started by 15 percent; 15 percent replaced door and window systems in their homes; 10 percent changed to or added efficient central cooling and heating systems in their homes; and 10 percent installed PEAK usage devices in their homes.

Question 6 - IF PARTICIPANTS HAD TAUGHT A UNIT OF INSTRUCTION ON ENERGY EDUCATION BEFORE ATTENDING THE ENERGY AWARENESS PROGRAM, SINCE TAKING THE ENERGY AWARENESS PROGRAM, AND WHETHER THERE WERE ANY DIFFERENCES IN THE ENERGY UNITS AFTER ATTENDING THE ENERGY AWARENESS PROGRAM, COMPARED TO THOSE BEFORE ATTENDING THE ENERGY AWARENESS PROGRAM, IN CONTENT, THE NUMBER OF ENERGY SUBJECTS, AND THE DEPTH OF THOSE SUBJECTS. IF SO, WHAT DID THE PARTICIPANTS DO DIFFERENTLY. - Fifty-five percent of the respondents said they did teach a unit of energy education before they attended the energy awareness program.

Question 6 (a) - Seventy-five percent of those interviewed reported they had taught an energy education unit since taking the energy awareness program.

Question 6 (b & c) - The respondents reported that after attending the energy program their confidence was higher in the energy field, experiences and information gained helped them supplement their textbooks, they spent more time on the subject of energy education, and their depth of knowledge was greater and more detailed.

Question 7 - IF PARTICIPANTS IMPLEMENTED ANY OF THE ENERGY ACTIVITIES PRESENTED IN THE PROGRAM INTO THEIR CLASSROOMS. - Seventy percent of those interviewed reported they did in fact use the activities that were presented in the energy program.

Question 8 - IF THE PARTICIPANTS USE ENERGY EDUCATION CONCEPTS THROUGHOUT THE SCHOOL YEAR, AND WHAT SUBJECTS THEY PRESENT ENERGY CONCEPTS IN (I.E. JUST IN SCIENCE, OR IN OTHER SUBJECTS AS WELL). - Ten percent of those interviewed said they tried to implement and use energy education concepts throughout the entire school year.

Question 8 (a) - Participants use energy education concepts in social studies, reading, math, creative writing, writing classes. English, journalism, family living, life skills, world culture, and American government.

Question 9 - WHETHER THE PARTICIPANTS USED THE RESOURCES OF THE ENERGY AWARENESS PROGRAM IN THEIR CLASSROOM TEACHINGS (BOOKS, PAMPHLETS, ETC.). - Eighty percent of the participants used the resources of the energy awareness program in their classrooms at school.

Question 10 - WHETHER THE PARTICIPANTS HAVE TAKEN ANY FIELD TRIPS RELATED TO THE SUBJECT OF ENERGY EDUCATION SINCE THE ENERGY AWARENESS PROGRAM. - Forty-five percent of the former participants had taken students on field trips that concerned energy education.

Question 11 - WHETHER THE PARTICIPANTS INVITED A RESOURCE PERSON TO THEIR CLASSROOMS FOR DEMONSTRATIONS, LECTURES, DISCUSSIONS, ETC. SINCE THE ENERGY AWARENESS PROGRAM. - Forty-five percent of the former participants had invited a resource person into their classrooms to discuss various topics in energy education.

Question 12 - SINCE THE ENERGY AWARENESS PROGRAM, WHETHER THE PARTICIPANTS HELPED OTHER TEACHERS WITH THE SUBJECT OF ENERGY EDUCATION SINCE THE ENERGY AWARENESS PROGRAM. - Seventy percent of the participants had helped at least one other faculty member with materials and lessons obtained in the energy awareness program at Oklahoma State University.

Question 13 - WHETHER THE PARTICIPANTS BELIEVE THAT THE ENERGY AWARENESS PROGRAM DIRECTED AWARENESS TO ALL GRADE LEVELS OF THE CURRICULUM. - Eighty-five percent of the participants interviewed stated they thought the energy program did promote energy awareness to all grade levels, first grade through twelfth grade.

Question 14 - THE PARTICIPANTS OVERALL IMPRESSION OF THE ENERGY AWARENESS PROGRAM. - The overall impression of the energy awareness program was excellent. Many positive and constructive remarks were made.

Question 15 - THE ONE ASPECT OF THE ENERGY AWARENESS PROGRAM THAT THE PARTICIPANT WOULD CHANGE AND WHY. - More hands-on activities were suggested along with more time for the participants to demonstrate various activities. It was also suggested that the energy program be offered in four groups with four to five teachers in each group. Each group would consist of primary, elementary, middle and high schools.

Question 16 - WHETHER THE PARTICIPANTS BELIEVE ENERGY EDUCATION SHOULD BE TAUGHT AS A SUBJECT BY ITSELF OR AS PART OF AN OVERALL SCIENCE COURSE. - Thirty-five percent thought energy education should be taught as a class by itself, 25 percent thought energy education should be integrated into subjects already being taught, and 40 percent thought that energy education should be taught as a unit in an existing science course.

Question 17 - WHETHER EDUCATORS HAVE A MORAL RESPONSIBILITY TO TEACH CHILDREN ABOUT ENERGY EDUCATION. - One hundred percent of the respondents agreed that educators should teach children about energy education. Values clarification was noted by the participants. If the societies of the world respect the energy resources the earth has, they will educate the younger generations to respect those resources.

This study was undertaken to determine answers to the following research questions:

1. What influence did the energy awareness program have on the participants' present energy consumption behaviors?
2. What areas have changed in the participants' personal life because of something presented in the energy awareness program?
3. Was there any difference in the participants' energy units after attending the energy awareness program than before the energy awareness program?
4. Did the participants perceive the energy awareness program to direct awareness to all grade levels of the curriculum?

Based on the findings of this study, only 40 percent of those interviewed stated that the energy awareness program had an effect on their energy consumption behaviors. Even though 60 percent stated no change in consumption behaviors, they reported being much more aware after the energy program than before.

Based on the findings of this study, 75 percent of those interviewed said they have made changes in their personal life and that it was a direct result of the energy awareness program at Oklahoma State University. Twenty-five percent of those interviewed stated they have done nothing in their personal lives because of the Oklahoma State University Energy Awareness Program.

Based on the findings of this study, participants noted several changes in their classroom behaviors concerning energy education. The teachers' confidence was heightened, the time allotted for energy-related units was increased, the depth of their knowledge about energy-related subjects was greater, they had more energy materials to supplement the textbook, and they believed their personal knowledge base was broadened.

Based on the findings of this study, 85 percent felt the energy awareness program did, in fact, direct awareness to all areas of the curriculum.

Recommendations

The following recommendations are based on the interviews conducted with twenty former participants in the Oklahoma State University Energy Awareness Program for the years 1976 through 1989. These recommendations are based on the results of the interviews and the perception of the interviewer.

1. A larger sample size should be used in future studies of the Energy Awareness Program at Oklahoma State University.
2. Studies such as this one which further educate the teachers in Oklahoma about the energy concerns that face our state, nation, and world should be continued.
3. The funding to continue this energy program should be increased.
4. The energy program should be divided into four groups: primary teachers, elementary teachers, middle school teachers, and high school teachers.

5. Teachers should present mini-lessons and show how they integrate a hands-on activity with the objective of the lesson.
6. Numerous "make and take" activities that teachers can make at the energy program and take to the classroom to use in explaining various energy concepts should be part of the program.
7. The information and presentations should correlate with the four groups of participants: primary, elementary, middle, and high school, with specific activities for each group.

With the above findings, this researcher hopes the energy awareness program continues to be a success with educators throughout the state of Oklahoma.

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APPENDIXES

APPENDIX A

BRIEF HISTORY OF ENERGY

Each of the various energy sources is presented in a separate section for simplicity and comprehension of the total energy picture. Only the major relevant sources are discussed.

For a study of this type, one must appreciate where they have been, what they are doing and where they are going. As Healy (1976) stated:

> Our present uses of energy have much in common with the first human uses. From a study of the past we understand better the present, and these lessons must help us shape our futures (p. 3).

Energy Defined

Energy is defined as the capacity to do work and overcome resistance (Guralnik, 1978). For centuries, man has been trying to make work a little easier for himself by using energy advantageously.

The first energy source man used was food, by which he sustained his own life. He later learned to use fire to keep himself warm and for cooking food. As time passed, man learned new ways of putting energy to work. Domesticated animals were helpful in planting crops and for moving large and heavy objects.

Through the centuries, man's definition of energy has differed although the end result of energy is always the same: the harnessing of sources to produce desired outcomes, whether to move a large rock or to supply electricity to an entire city.

The Sun

Four and a half billion years ago a star died (Washburn, 1981), releasing an enormous amount of energy. The remnants of this explosion led to what we know as the sun.

Since the beginning of time, the sun has been the source of energy for the entire universe. Man has used the sun for light by day and the reflection of the sun off of the moon for illumination by night. The sun, offering heat and warmth to man, is the source of the radiant heat that has supplied the energy for all life on earth.

Fire

It is not known exactly where or when fire was first used by man. It is believed that man encountered flame by accident. Lightning, volcanoes, and the friction of plants in windstorms may have been the first sources of flame (Iles, 1900). Once man learned what fire was, he learned what would burn and what would put the flame out completely. To keep the flame burning constantly was a chore until man finally learned to make fire when and where it was needed by rubbing two sticks together to get a warm friction which would finally ignite small leaves and twigs within the surrounding area. Fire became man's key to survival.

The flame became a protector at night. When man went to sleep, he built a fire in front of his rock shelter to ward off any wild animals that would wander by (Speir, 1970). Fire could also lure animals close to a hidden hunter. The hunter used the flames to arouse the natural curiosity of certain animals in the area. When deer, for example, went to look at the orange blaze, the hunter could spear them. Fish were also attracted to bright light at night. Early man learned to build fires close to the water and spear fish that were drawn to the light.

Coal

Coal was formed approximately 300 million years ago in the Carboniferous Period (Harter, 1979) by a process which started with dead plant matter. Plants died and fell into swamps where they decomposed. Over time, this process happened again and again. Immense forces of nature turned this decayed matter into peat. The peat, under still more pressure, would form lignite, then bituminous, and then anthracite coal. Scientists believe that it took twenty feet of compressed plant matter to make one foot of coal (Harter, 1979).

The use of coal has a very long history. The Greeks were the first people to mention coal. In one of the first written accounts of coal, in 370 B.C., a student of Aristotle's wrote an account of stones and mentioned a rock called coles "that kindle and burn" (Harter, 1979, p. 30). Britons used coal prior to the Roman invasion. In 852 A.D. it was recorded that a tenant gave twelve cart loads of coal for the payment of rent (Carlisle, Romney and Mott-Smith, 1960).

The first people to use coal in America were the Hope Indians in Arizona. The Hope Indian tribe used coal in the making of pottery in about the eleventh century (1000 A.D.) (Ehrlich, 1979).

Sea coles were being used in 1234 A.D. for the heating of English homes in parts of Northern England. The black rock at that time was called "sea cole" because the coal came from rich deposits in an area next to the sea (Cook, 1976).

Marco Polo visited China in about 1275 A.D. and made recordings about some "rocks that burn" (Carlisle, Romney, & Mott-Smith, 1960, p. 489).

Sebastian Cabot found coal in North America in 1498. The discovery was made on Cape Breton Island, but the coal was not used at that time.

England was producing coal for heating purposes in 1600, and in 1621 developed the first coal-fired blast furnace for iron smelting in England (Russell, 1984).

Father Louis Hennepin noticed coal along the Illinois River in 1673. Father Hennepin was on an exploration of the river. The coal that he noticed was on the high banks of the river (Kane, 1964).

The first coal mine in America was established near Richmond, Virginia in 1750. Slaves were the miners of this era because they were abundant and their labor was cheap. The type of coal recovered from this mine was bituminous. Just twenty years later, George Washington took note of the coal along the Ohio River, stating that the coal was plentiful and that the quality was good.

Phillip Ginter discovered a black rock in Carbon County, Pennsylvania. This black rock was anthracite coal. It was discovered by accident and was not really found useful since it was hard to light and when lit the heat was too intense for the stoves of that time, which were made for burning wood, not coal.

In 1792, William Murdock invented what was known as coal gas. This gas was not used until 1803 when it was used for lighting in Soho (Collison, 1962).

Judge Jesse Fell burned anthracite coal in his home on an experimental basis in 1808. Burning coal was considered experimental because to most people in that era, coal had little or no value for the home. Four years later, however, anthracite coal was used commercially to heat a furnace at White and Hazard's Fairmount Wire and Nail Company.

By the 1830s, several small coal mining companies had formed. The majority of the coal mines were along rivers, including the mighty Mississippi, the Ohio River, and the Illinois River. Coal was mined by hand but in 1877 the first cutting machine was in operation. This new invention made mining coal faster and easier, and coal was made more plentiful.

Coal dominated the energy market up to the year 1900 and continued to be a major energy source until about 1947. The reason for the decline was the cleaner burning fuels, like diesel, which were cheap and abundant. Another reason for the decline was that electric utilities were using more oil and natural gas instead of coal.

Today, with the uncertainty about oil and natural gas, the coal industry is seeing an increase in the number of utilities that are switching back to coal-powered generating stations. Many of the modern generating stations are being built near the coal mines. The reason for this is that the transportation charges for a truckload of coal often exceed the cost of the coal at the mine (Russell, 1984).

Electricity

Electricity has for centuries fascinated man and his understanding of how electrical current works. About 600 B.C. the Greek philosopher Thales rubbed two pieces of amber together producing what we know as static electricity and found that it drew itself to light objects such as lint and dust (Carlisle, Romney, & Mott-Smith, 1960). Thales coined the word "electric". Several centuries later, a physician by the name of William Gilbert tried the same experiments with amber and came up with the word "electricity".

Man's first experimentation with electricity was through electrical machines. The first machine devised to make electricity was Otto Von Guerickke's electrical machine. This simple machine consisted of a ball of brimstone that turned on an axle. While the brimstone turned on the axle, fabrics such as silk rubbed against the brimstone, producing small, insignificant amounts of electricity (Iles, 1900).

In 1746, a man by the name of Vahn Masschenbroek captured and stored electricity for the first time in history. This storage was confirmed when he got a shock from what was known as a Leyden Jar. The feat took place at the University of Leyden in Holland (Williams, 1940).

Ben Franklin (1752) thought that there was a connection between an electric spark and lightning. Franklin made a silk kite and flew it during an electrical storm. He attached a key to the kite string to see if it would get charged with electricity. Franklin saw that the thin threads on the string were standing out and sensed an electrical charge. He touched the key and got a shock. He charged a leydon jar and found that the static electricity produced by a glass rod was the same as that produced by lightning.

A man by the name of G.L. Lesage developed the first electric telegraphic device in 1774. His new device worked off of weak electric impulses (Leithauser, 1959). Lesage's telegraphic device, with 24 wires for transmission of electrical impulses, was the forerunner of the first electric telegraph that really came into practical use, built by Gauss and Weber in 1833.

In 1799, Alessandro Volta produced the first steadily flowing electrical current by taking silver coins and zinc disks and arranging them alternately in a stack, one coin on top of a zinc disk, etc. Between the pieces Volta had laid wet cloth. He then attached wiring to the bottom and the top of the stack. When he connected the two ends, there was a steady flow of electrical current.

The year 1831 was the year for the first generator. Michael Faraday built this first generator after experimenting with electricity from permanent magnets. Although Faraday invented the first generator, it was not until 1870 that the first practical generator was built. This more practical device was built by Gramme, a Belgian (Vanderbilt, 1974).

The first electric company, Edison Electric Light Company of New York, established in 1878, was not initially committed to producing electricity. It was established to promote Edison's incandescent lamp. Two years later, in 1880, the Edison Electric Illuminating Company was founded expressly to produce electricity for the City of New York. Another electric company in California was organized in 1879 was the first electric company to produce and sell electricity. This company was known as the California Electric Light Company Incorporated (Kane, 1964).

Edison worked hard at trying to supply electricity to all of New York. The first central electric power generating station supplied electricity to a vast majority of Manhattan. In September 1882 the Lower East Side of Manhattan had electric lights for the first time. The new electric lights that went inside of a building were a phenomena that Edison's critics were doubtful about. Edison's new type of interior lighting was possible because he could subdivide electricity from a single source, something that his critics could not accomplish.

George Westinghouse was responsible for the first hydroelectric generators at Niagra Falls. In 1893, inventors were pondering what type of electricity to generate, alternating current or direct current. Since alternating current could be broken down by transformers, the decision was made by Westinghouse to use alternating current. The first hydroelectric generators at Niagra Falls produced alternating current (Derry, Williams, 1961).

In 1910, twelve cities were drawing electricity from the Niagra Falls generators. The maximum output was about 750 horsepower. In the 1940s, several hundred cities received electrical power from Niagra Falls with a maximum output of about 1,000,000 horsepower (Williams, 1940). Today, Niagra Falls produces in excess of 8,000,000 horsepower.

Advances in production of electricity were not limited to the early years. The 1940s, 1950s, and 1960s saw advancements in nuclear generated electrical power stations, while in the 1980s technology advanced with application of super conducting electrical transmission.

Natural Gas

Natural gas has been around for almost three centuries. As early as 1000 years before Christ, the Chinese were known to have used natural gas for fuel in salt mining activities (Hart, 1978). The Chinese transported the gas by a network of bamboo tubes from the source of the natural gas to the destination point.

It is also noted that in 615 A.D., Japan was using natural gas.

In 1618, Jean Tardin studied a burning natural gas seepage from within the ground. He concluded that the flames were very similar to the flames given off from the burning of coal and oil.

Several years later, in 1667, Thomas Shirly described a well at Wigan from which the water burned when he approached the area with a flame or lighted object (Kaempffert, 1924).

In 1730, James Lawther vented the air from coal mines to the surface. This venting process was made possible by a piping system that was devised by Lawther. Once the air was at the surface it burned continuously (Elton, 1958). At the same time, Carlisle Spedding offered to light Whitehaven, England with the gasses vented from local coal mines. The gas would be transported by pipes laid under the streets. He was turned down because the public thought that it would be dangerous.

In 1797, Phillipe Lebon noticed that when coal was heated it gave off an inflammable gas. Lebon tried to produce this same gas from the burning of wood, tar and oil. Two years later, Lebon got a patent for his design of a gas lamp used domestically for lighting purposes (Forbes, 1958). He was the first person to try to extract gas from the burning of tar, oil and wood.

Gas was shown to be practical when the first known public exhibition for the promotion of gas lighting took place at the Hotel Seignelay in Paris, France in 1801. The gas was produced by the burning of wood in two thermo lamps invented by Phillipe Lebon. This demonstration, held weekly for several months, showed the people of that time that lighting by gas was a practical possibility. Also to show the practicality of gas, Zachaus Winzler gave dinner parties where the food was prepared and cooked on a gas stove to prove that gas was safe and that more uses could be found for gas other than for heating purposes.

In 1806, some of the first gas street lamps were installed by David Melville of New Port, Rhode Island (Kane, 1964). He had a patent for an appliance that produced goal gas.

With the increase in the popularity of gas, 1814 marked the turning point of street lights that were being changed from oil lamps to gas lamps. Along with the increased usage of gas came an increase in the number of miles of pipeline; by May of 1815 an estimated 15 miles of pipelines transported gas. By December of that same year, the number of miles of pipes was estimated at 26. Westminister, England was well on its way to becoming a city with totally gas powered street lamps.

At the urging of Rembrandt Peale, Baltimore was the first American city to totally accept gas lighting on a large scale.

About this same time, T.S. Peckston wrote the first modern textbook on gas (Elton, 1958). The principles he wrote about and the subjects he covered influenced the manufacturing of gas for the next seven decades. The year 1823 was the first year that a house in New York City, the home of Samuel Leggett at Number 7 Cherry Street, was totally illuminated by gas (Kaempffert, 1924).

One of the main drawbacks of gas was the horrible sulphur smell it left. Many purification experiments were undertaken but failed to take the odor out of the gas. However, in 1841, Leming discovered that passing coal gas through iron oxide eliminated the foul smelling sulphur compounds.

The Bunsen burner, invented by Robert Wilhelm von Bunsen in 1855, made it possible to burn coal gas with a very hot but smokeless flame. His burner is used today in modern gas ranges and ovens.

The first long distance gas pipeline was completed in 1872. The pipe was two inches around and was constructed to a length of five miles. The pipeline connected Newton Wells to Titusville, Pennsylvania.

Gas use for heating, lighting and other energy-related concerns continued to increase from the last part of the nineteenth century well up into the twentieth century. In 1920, the world's energy supply from gas was three percent, rising to six percent by 1938. In 1950, the gas industry supplied eleven percent of all energy produced (Thirring, 1958).

In 1940, the first liquid natural gas was commercially produced in America. Starting in 1959, America was exporting liquefied natural gas to other countries.

During the 1960s and 1970s many regions of the world let gas burn off (or flare) because it was not readily recoverable. The 1970s saw a new direction for producing many multi-billion dollar gas gathering and transportation systems. Gas is no longer being burned off at the well in many locations. Natural gas has been an important part of our energy past, and it will play a major role in our future.

Geothermal Energy

Geothermal energy is not very prevalent compared to other forms of energy. Thirring (1958b) states two reasons for this. First, there is an absence of technological recovery techniques. The heat is trapped under the crust of the earth in geometric configurations that inhibit hot steam from rising to the surface. Even today, scientists are unable to recover much of the vast energy resources stored within the earth. The second reason is that the cost of research and development far outweighs the benefits because the world has an ample supply of other low cost energy sources.

The earliest known geothermal installation is in Italy. In 1818, F. de Larderel made use of vapors that rose naturally out of the ground as a heat source in order to produce boric acid (Anobile, 1986).

In 1955, the first American drilling for commercial geothermal steam was at a location 90 miles north of San Francisco known as the "Geyser" (Kaylor, 1986). The commercial installation began producing electricity from the steam in 1960. There are very few geothermal installations worldwide. One large coal fired power plant produces the same amount of electricity as all geothermal installations in existence.

Nuclear Energy

Nuclear energy use began around the turn of the 20th Century. Albert Einstein published his Theory of Relativity in 1905. This new theory stated that matter could be converted into energy (Larsen, 1961) and explained that one can get great amounts of energy from a small amount of matter. Only six years later, Lord Rutherford and his assistant, Neils Bohr, developed their theory about what the atom was really like. Since that time, scientists have added to, and elaborated on, the atom to understand it more in depth.

Eleven years later, in 1922, the first isotopic separation was performed in the laboratory. William Francis Aston used a spectograph (a machine for dispersing light radiation into a spectrum and recording the spectrum photographically) which has a magnetic field that sorts atoms.

Heavy water (water composed of isotopes of hydrogen of atomic weight greater than one) was obtained by Harold Clayton Urey in 1932 using the isotopic separation process invented by Aston (Anobile, 1986). Heavy water is used to slow down high energy neutrons in a nuclear reactor. Also in 1932, Dr. Walton and Sir John Cockcroft split the first atomic nucleus, and the atom's energy was released (Collinson, 1962).

In January of 1939, physicists in America first learned from Neils Bohr and Leon Rosenfield, while speaking at the Princeton Physics Club, that uranium undergoes fission. Thirteen days prior, Bohr had learned of the discovery from Otto Frisch (Barschall, 1987).

In the early days of nuclear energy, nuclear reactors were called piles. The first pile was constructed by Enrico Fermi in Chicago on December 2, 1942 (Lilley, 1965).

Formal recognition of the atomic age came in 1945 when the first nuclear explosion took place in New Mexico. After this explosion, the most important nonmilitary application of atomic energy was that of nuclear power development for America (Russell, 1984).

June 27, 1954 marked the beginning of a new generation of energy when the world's first nuclear power plant started production in Moscow. The reactor was only a pilot plant but demonstrated to the world that the production of electricity was a practical venture.

The first primary use of nuclear energy was in the production of plutonium. Electricity was a side or by-product of the war projects (bombs, missiles for self-defense) to help reduce the cost of the atomic bombs.

In 1955, the Nautilus nuclear powered submarine first set sail, the beginning of nuclear-powered armed services. The success of the Nautilus led to the first civilian nuclear power generating station in America. It was located about 25 miles outside of Pittsburgh, Pennsylvania and was named The Shipping Port Atomic Power Station.

Also in 1957 the world's first nuclear accident occurred (Dickson, 1988a). The accident happened in Windscale on Britain's northwest coast. The number of curies (a unit to measure radioactivity) released into the atmosphere was estimated to be about 20,000. Only about 30 curies were released at the Three Mile Island accident (Dickson, 1988b).

Two of the first civilian nuclear power stations began production in Britain in 1963. Up until this time, all nuclear power stations had military roles. The main function of nuclear stations before this time in Britain was for the production of plutonium for atomic bombs.

Another milestone of nuclear energy that occurred in 1963 was the start up of operations of the breeder reactor, which produces more fissionable matter than it consumes.

Accidents are a major drawback of nuclear generating plants. Two of the most frequently remembered accidents in the history of nuclear energy have happened within the last decade. In March of 1979, Three Mile Island was shut down due to problems within the reactor core. Very little if any radioactive material was reported as being released into the environment (Payne, 1989). The second and more recent accident happened at the Chernobyl Nuclear Reactor in the Soviet Union. This accident is regarded as the most destructive nuclear accident in history. As of December 12, 1987, 31 firemen had died as the result of the Chernobyl nuclear accident. Most died from the radioactive dust, radiation burns, and radiation sickness. Two were killed outright by explosions (Cohen, 1987).

Energy from Petroleum

Petroleum as we know it today, has been around since the dawn of civilization (Anobile, 1986). Petroleum is mentioned in the Bible in several locations (Exodus 27:20, Leviticus 24:1). Pitch was used to fill in the cracks on Noah's Ark (Genesis 6:14). The pitch, which is distilled from petroleum, made the ark impervious to water. Also, the mother of Moses used pitch to coat the bottom of her son's cradle before it was launched into the Nile River (Exodus 2:3).

Crude oil was also used in ancient times in Europe as a medicine. The medicine was applied to swollen joints, headaches, and abrasions.

In America, the first spring of oil was noted around 1627. This free-flowing spring of oil was located near what is now called Cuba, New York. This spring is the earliest mention of free-flowing oil anywhere on the North American Continent.

The first known drilling to strike oil occurred in 1818 in Kentucky (Kane, 1964). The drillers were looking for brine. The depth of the five inch wide hole was about 530 feet. The oil that came up from the well had no known use at that time so the hole was plugged up with sand.

Another salt well that produced brine also produced oil in 1829 in Kentucky. The drillers pumped more petroleum out of the well than they did the sought-after brine. Still no widespread use of petroleum was known at that time, so the oil was bottled and sold as medicine (Rowe, 1984). The estimated oil production from this well was about 1,000 barrels per day.

The modern petroleum industry had its beginnings in the mid-1850s. A major pre-beginning of the modern petroleum industry was the formation of the first oil company in 1854, the Pennsylvania Rock Oil Company.

The refinery business also started in the mid-1850s. Dr. Samuel Kier, a druggist, was the first to refine oil for medicinal purposes. Before this time, petroleum was used straight out of the ground for various medical problems. Dr. Kier distilled the oil and found that the lighter fractions of the oil would burn and the heavier parts were useful for cleaning wood.

In 1859, Edwin L. Drake was the first person in America to drill specifically for oil and find it. This feat officially marked the beginning of what is known as the modern petroleum industry. The well was only 60 feet deep but produced 300 barrels of oil per day.

Not long after man began drilling for oil, he noticed that drilling had its dangers. A well that produced about 3,000 barrels per day caught fire in 1861. The blaze started shortly after the well gushed and burned for three days; 19 people lost their lives.

Technology for drilling slowly began to improve, and in 1896, the first offshore oil well was drilled at Summerland, Santa Barbra County, California.

In 1912, the earliest known college course in oil production was given at the University of Pittsburgh in Pittsburgh, Pennsylvania in the School of

Engineering. The course covered most of the oil and gas production technology that was known at that time.

During the first half of the 1900s, oil consumption grew because of the availability of petroleum, the technology for finding and retrieving oil, and because petroleum was rather inexpensive. Petroleum was considered an unlimited resource. In 1957 the total production of petroleum in the world exceeded 913 million tons (Gartmann, 1960).

It was not until the early 1970s that America felt the energy crisis when the Arabs instituted an oil boycott of America. Even though the boycott cut off less than five percent of our energy supply, America knew how much it depended on petroleum.

In 1980, Americans consumed more than a fourth of the worldwide production of 60 million barrels of oil per day (Garrett, 1981). The majority is used for transportation. The total oil reserves are limited. The world must treat the natural resources we have with care before it's too late.

Solar Energy

All energy comes from the sun. The energy falling on the earth every 15 minutes is considerably greater than the annual energy consumption of mankind (Thirring, 1958). Only about 46 percent of the energy emitted by the sun ever reaches the earth's surface. Thirty-five percent of the energy is reflected away from the earth's surface by the clouds and atmosphere covering of earth. About 19 percent of the solar energy is absorbed by the atmosphere (Miller, Pinelli, & Pinelli, 1976).

Solar energy has fascinated man for centuries. In 212 B.C., Archimedes was said to have developed a solar device that used mirrors to channel solar rays to the sails of ships. After a short period of time, the ship's sails would catch fire and the craft would be disabled (Miller, Pinelli, & Pinelli, 1976). In 1558, Giambattista della Porta wrote a book titled Natural Magick which covered many unusual subjects, including writings on solar energy. For example, della Porta mentioned the telescope and the microscope in his book (Perlin, 1985) even though both of these devices had yet to be built.

The first recorded accounts of solar power actually doing work occurred in the early 1600s. Soloman de Caux, in 1615, was a Frenchman who developed one of the first solar-activated machines which, through the expansion of air by solar heat, pumped water. One of the first solar furnaces was developed by A.L. Lavoisier in 1774 using the concentrated rays of the sun to burn diamonds in an oxygen atmosphere.

Photovoltaic cells, first produced by Antoine Becquerel in 1839, are solar photocells which transform light directly into electricity. Solar cells are known for their ability to turn sunlight into electricity. About 50 years later, August Mouchant built a solar boiler for a power plant located in Paris, France, the earliest attempt at solar mechanical power conversion.

During the first decade of the 1900s, William J. Bailey developed, patented, and successfully marketed the flat-plate collector for domestic water heating. Bailey is known in the solar industry as the first solar entrepreneur (Perlin & Butti, 1985). He also developed the first closed-loop water heating system. Bailey's company, called the Day and Night Solar Heating Company, sold thousands of these water heaters in the early 1900s. In the early 1920s, Bailey sold out to a Florida company since natural gas was very cheap and abundant. The natural gas industry at that time took over the solar industry.

Solar housing was an interesting concept of the late 1920s and early 1930s. The Massachusetts Institute of Technology built and tested Solar House

1 in 1939. Their system used triple glazed - copper tube/flat-plate water collectors and was designed by Hottel and Woertz (Chreene, 1975).

In 1954, a small battery fed by solar energy rather than electricity was used in America for a telephone conversation. The solar cell efficiency in this experiment was about six percent. These same solar cells saw their first application on Vanguard 1, a U.S. satellite launched in 1958 (Jewell & Ramakumar, 1988).

Solar power plants are relatively recent. The first solar thermal power plant was built in Ashkhabad, the capitol of Turkmen Soviet Socialist Republic, in 1960. In a solar thermal power plant, the sun's rays are concentrated on a stream boiler by mirrors. At Ashkhabad, there are 1293 flat mirrors arranged in circles. In 1982, the most powerful solar thermal power plant was put into service in Barstow, California. The power rating of this plant is ten megawatts.

Solar energy is used today in many applications, from experiments for children in high school to the power sources of space satellites. Advances in solar energy use have been slow because of storage constraints and high capital cost requirements. Also, the relatively low cost of alternative fuels seems to put high cost experimental energy alternatives over to the side until they are deemed cost effective.

History of Steam

The first steam engine was nothing more than a novelty. Today, steam power is considered a necessity. Hero of Alexandria invented what is referred to as the aeolipyle, which was nothing more than a round ball with two bent tubes protruding from the side 180° apart. The ball (or sphere) was attached to holders which allowed steam to enter the sphere. When enough steam would enter the sphere, it would exit the bent tubes and make the ball spin. A kettle underneath the device was filled with water, supplying the steam (Landels, 1978).

Giovanni Branca, in 1629, was the earliest person to realize that a jet of steam could turn a wheel by acting on blades in a circular pattern. Branca invented an impulse-turbine that attempted this principle but was rather crude and did not work.

In 1675, Denis Papin invented a "bone digester", the forerunner of today's pressure cooker. Papin noticed that when water boils in a hermetically sealed vessel, the pressure increases so much that the steam is heated far beyond the boiling point of water (Larsen, 1961). The superheated steam cooked food faster and more thoroughly. Along with the bone digester, Papin also invented the safety valve. This safety valve was simply a stopper with a weight attached to it. If the pressure in the vessel was too great, the stopper would blow open and relieve the pressure before the vessel was in danger of exploding. Papin's safety valve is used today on many steam and air compressed machines. His steam bone digester was a concept that led to the description and designing of his steam powered engine.

In 1705, the first steam engine was made by Thomas Newcomen and Thomas Savery. This steam engine was the key to the Industrial Revolution. In 1698, Thomas Savery had patented a similar engine, but it lacked a safety valve. Lacking a safety valve, the engine was susceptible to blowing up at any time. The newer steam engine was much safer and more reliable. James Watt, in 1765 and 1783, improved upon the Newcomen machine by using a condenser that increased the steam engine's power and efficiency but the first practical steam engine was not made until 1804 by Richard Trevithick. This steam engine had its applications in the coal industry (Cook, 1976).

During the first decade of the 1800s, many developments in steam power were made. As steam boilers were improved, higher pressures could be reached. In 1807, Fulton applied the principles of steam to his steamboat, the Cleremont. A few years later, in 1819, the Savannah steamed across the Atlantic (Bowen & Kettering, 1954). Smoke tube boilers were built around 1827 to increase the power and reduce the weight of boilers. Soon use of steam power spread to land transportation. The year 1829 was the year for the first successful steam locomotive. It was built by a man named Stephenson and was called the Rocket.

In 1859, J. Macquoron Ran Kine published a book titled Manual of the Steam Engine. This book marked a new beginning for the steam engine because it gave inventors something from which to advance its development.

Through the remainder of the 1800s and early into the Twentieth Century, the energy from steam has been used to advance industry and the standard of living for mankind. Even today, steam is used to produce electricity. Many nuclear and coal-fired electric generating stations use steam to turn the turbines to pull the generators to produce electricity.

Tidal and Ocean Energy

Tidal and ocean power have had little commercial success, compared to other sources of energy. One of the main reasons for this is the same as that for other alternative energy sources: lack of money to develop its uses. The cost per kilowatt hour is two to four times that of 46 mills/kwwh that America paid for electricity in 1984 (Carmichael & Feher, 1987). Another reason is that fossil and nuclear fuels are still in plentiful supply at present.

Using tidal and ocean energy sources is not a new idea, however. The first recorded patent for this type of energy production was given in 1799 (Ross, 1981) to a father and son team by the name of Girard. At the time, they lived in Paris, France. No other information can be found on the patent, and no outcomes were ever published.

In 1962, the world's largest and oldest demonstration/pilot/operational plant was built on the Rance River in France. It has a total generating capacity of 240 megawatts (ms) of power. Electricité de France (EDF) put into service the first tide-powered electric plant in the world in 1966. (This plant was not a pilot operation.) This plant is also along the Rance River in France.

Two more pilot demonstration plants were built in the late 1970s. One, a 50 gross kilowatt plant, was built off of Keahole Point, Hawaii. The other, a 100 kilowatt plant, was installed off Nauru Island in the South Pacific by a Japanese firm. In both of these units, about 66 percent of the electricity generated goes back into the plant for operation output.

In 1984, a tidal power station was built at Annapolis Royal in the Bay of Fundy. This station, just north of the Maine border, is the only tidal power station in operation in North America. This particular plant is an 18 milliwatt facility and cost $46 million to build.

If solutions can be found for corrosion protection in ocean tidal plants, the cost of maintenance among power plants will be much lower. With the lower maintenance costs, the cost per kilowatt hour should be reduced to where this type of energy is more affordable for the future.

Water

Energy from water goes back to the time before the birth of Christ. The earliest and oldest description of a water mill came from Vitruvius in 27 B.C. (Usher, 1954). Vitruvius is credited with the invention of the water wheel because there are no earlier recordings of such. But from the records it seems that some related mechanical devices were written about previously.

During the late Third Century, Great Britain used water mills as a source of energy for grinding corn. It is believed that the Romans used water mills because of the shortage of human power.

The Saxons used water mills extensively and more than 5,000 have been recorded as being used in England around the year 1185. About this same time, the water mill that was used as a corn mill was also used for fulling (Hudson, 1964).

By the end of the 1500s, water power was pumping water from ore mines in Britain. The water wheel was also used for ore-crushing around the mines of Cornwall and the Lake District.

In the 1600s and 1700s, adequate water supplies became a problem. As man's technology increased, he needed more water, bigger wheels, and better materials to make the water mills. By 1750, both the overshot water wheel and the undershot water wheels were in use. Most were made of wood and used waterfalls ranging from three feet to about 20 feet. The taller the waterfall, the more force the water wheel had against it.

In 1752, John Smeaton experimented and formulated the fact that overshot water wheels are more efficient than undershot wheels. Smeaton made better water wheels than had been in production up to that time. He made the shafts and gears of the water wheel system from cast iron and produced buckets for the wheels made of wrought iron. By the end of the eighteenth century, water wheels were being made entirely of cast or wrought iron.

In the mid-1800s, water wheels up to 71 feet in diameter were being built in the United Kingdom. These giant wheels could develop 231 Brake horsepower (Hudson, 1964).

In the late 1800s, the first hydroelectric power plant was build in Godalming, England. Since that time, hydroelectric power has advanced fairly rapidly.

Today, hydroelectric power is considered a renewable energy source and is relatively pollution-free. Besides being a clean source of energy, most hydroelectric power stations have a life of about 400 years. As long as the rivers flow, energy from our water sources will continue to be produced.

Wind

Energy from the wind comes mainly from windmills. The idea for windmills came from the Orientals, who made very small (hand-held) windmills that were used as prayer wheels (Gras, 1930). They were also thought of as toys.

Windmills developed much more slowly than water wheels, probably because windmills have a more complex gear and shaft mechanism. Water mills were much simpler.

The first windmills were used around the Seventh Century. There was use of the mills at this time, but an actual drawing of the mills date back to about the 10th Century (Anobile, 1986).

Two Arab geographers by the names of Mas'udi and Al Farsi al Istakri made journeys about 928 A.D. and noted windmills in their writings.

Windmills were used in the 1400s for pumping water from wells and low lying areas. Windmills were also used at this time to grind corn, a tedious job made easier by the mill (Lilley, 1965).

In the 1430s, the follow post mill was invented. The size of the rotating structure was reduced. Also, a shaft went through the center of the middle post to drive machinery below (Derry & Williams, 1961).

Workers in Holland in the late 1580s resisted windmills because of the fear of the windmill taking away jobs from the local townspeople. In fact, some windmills were burned because riots got out of control. Just ten years later, windmills found a new use in the mining industry. Windmills were used to hoist heavy materials out of the mines.

In 1745, another development became patented. This new invention, described by Derry and Williams (1961), allowed the windmill to have maneuverability. When the wind changed directions, the windmill would automatically shift to always face the wind.

Almost a century and a half later, electricity was produced by the actions of the windmill. Since that time, man has been intrigued by the making of electricity with the help of naturally-occurring currents of air. Making electricity with windmills is one of the most pollution-free ways of obtaining electricity.

From the early 1930s to the 1950s, windmills used as a means to make energy from wind power were quite prevalent. These systems ranged from a few watts up to three kilowatts.

The beginnings of the current small wind energy conversion systems go back to the early 1970s (Nelson, 1984). Oil prices started to climb upward and the startup costs of windmills were reasonable at that time.

In the 1980s, areas like California were building more wind parks and in 1987 generated more than 1.7 billion kWh of electricity (Cruver, 1988). If the current projections are correct, ten percent of America's electricity will be generated by wind power in the year 2000.

APPENDIX B

A BRIEF HISTORY OF THE OKLAHOMA STATE UNIVERSITY ENERGY AWARENESS PROGRAM

The Oklahoma State University Energy Awareness Program was the concept of Dr. Kenneth Wiggins, Professor and Head, Aviation and Space Education, Oklahoma State University. The Oklahoma Energy Awareness Program is conducted for the benefit of elementary and secondary teachers in the field of energy education.

The energy program has been held for the last seventeen consecutive years. As far as this researcher can tell, the Oklahoma State University Energy Awareness Program is the longest consecutively running energy awareness work conference in the nation. Most other energy awareness programs throughout the nation are "one-time only" energy workshops or seminars (Schiff, 1981), conducted for one day or a weekend for the general public. Very few of these programs are directed towards educators. The majority are sponsored by electric companies, the Department of Energy, and other energy-related concerns. Most programs promote energy conservation in specific areas rather than promoting many areas of energy education.

The Oklahoma State University Energy Awareness Program is a formal program that offers three weeks of intensive studies in all phases of energy. Within these three weeks, participants hear various speakers and participate in field trips and other activities. Three hours of graduate credit are awarded and can be applied to the master's or doctoral degree programs in Education at Oklahoma State University.

An interview was conducted with Dr. Kenneth Wiggins on October 23, 1989, in which he relates how the Energy Awareness Program was started, its rationale, and what the program tries to achieve with the participants. He stated:

"This all started in the early 1970s when we had the first energy crisis. And, of course, science education is my area and there was a lot of information and mis-information floating in the press as well as . . . kids would go to school and ask their teacher, 'What about this. . .'. Teachers really didn't have a good understanding, so again, as I said by . . . all of this is science education related as well as political science and economics and . . . it just looked to me like that this problem cut across all the spectrum of the curriculum for teachers in public schools.

"So, we decided to develop a program, a staff-development or summer workshop for teachers to try to give them correct and accurate information so that they could transmit this to their students and ultimately to their parents. What is it? Do we indeed have an energy crisis? All of the petroleum companies really lobbied to . . . in other words, put some curriculum materials in their [teachers] hands that they could honestly and intelligently deal with their students because they [students] were asking all kinds of questions . . . All right, so we talked to our colleagues on campus including Arts and Sciences, like people in geology and economics and even engineering, like petroleum engineering, for example. We decided to propose a summer workshop for teachers patterned after our aerospace workshops. It was very political and controversial. The oil companies are the bad guys. Frankly, I didn't believe that was true. So we put together a proposal to do a three week energy conference. We call it a work conference as opposed to a workshop because what we were trying to do was to make sure that we would bring people from industry in and tell their side of the story and then we would like at that and after they left we would evaluate it and try to develop some instructional materials that these teachers could take back into their classrooms, regardless of the subjects they taught . . . to try to get out some accurate information.

"So we did, and we identified some of the major companies here in the state, such as Conoco, Phillips Petroleum, Kerr McGee, Gulf, at that time which is now Chevron. We decided . . . the first company I talked to said, 'Yes, we will give you whatever money you need' for the workshop. I said, 'No, I don't want you to give me all of it because I am going to approach ten to twelve or fifteen companies and ask them for a small support so that nobody could say that we are a paid spokesman for, let's say X Oil Company.' So I just got in my car and started calling these people and visiting and explained what we were trying to do to make sure that teachers had accurate information about the crisis at the time . . . this type of thing. So I did this and all of the companies agreed with my philosophy about not getting a big grant from one company but getting enough from each one so that we could bring the teachers in, free room and board, free tuition and give them three hours of graduate credit in a science workshop environment. I worked very heavily through the Oklahoma Petroleum Council at the time, and they arranged for me to meet with the Board of Directors to present the program that we wanted to do, and they unanimously bought the concept. So that's how it got started.

"We have had . . . The workshop still continues. We have developed pre- and post-tests for the workshop to try to assess the level of understanding and awareness on the part of teachers and then we did one at the end of the workshop to try to see if we were having an impact, and all of this has been summarized in annual reports which we have sent to the contributing companies. Based on that, they continue to contribute money to the development foundation for this purpose.

"Our only reason for doing this is that we saw a problem we thought that teachers could . . . It was crucial that teachers understood the true facts of the situation then as well as now. If you analyze the workshop agenda, you can see that we take them to a drilling rig which most teachers in this state have not actually been to . . . power plants . . . We have taken them to strip mining operations so that they could see that industries are indeed reclaiming the land and putting it back into a usable situation. So basically that's how we got into it . . .. It's just that we recognized there is a great deal of misunderstanding on the part of teachers because no one had ever taken the time to give them accurate information, so over the years that has been the whole purpose of this workshop and that's why we still feel there is a continuing need for this information to be placed in the hands of teachers . . .

"In the earlier days during the crisis we did . . . we had several contracts with the Oklahoma Department of Energy where we did an outreach program in addition to the teacher workshops where we actually had professionals who would go in and do assembly programs and this type of thing. They were patterned very much like our space science education projects . . .. We rant that for two or three years at least. We would have exhibits at the State Fair and we would make presentations to civic clubs as well as schools. This was in addition to our teacher workshops. And, of course, one of the motivations for all of this was that energy, particularly petroleum, the petroleum industries are a very vital economy of this state.

"So the companies supported us very willingly. They all agreed, in fact. We don't even tell the teachers where the money comes from for their scholarships until the last day of the workshop. We say, 'Oh, by the way, in case you're interested, the following companies provided the funds for you to come to this three-week workshop.' We don't . . .. We're not paid spokesmen for the companies. There have been times when they would have preferred we say one thing but intellectually and professionally we say another. They have never argued with us about that. Well, basically that's how it got started.

"I think the first summer was a two-week workshop. That's where we got the term 'work conference' because when we brought them [teachers] in, we were asking their thoughts on how to structure a workshop in the coming years. We use the term 'work conference' also to imply to teachers that you are coming in here to . . .. We are going to give you information, but we expect you to help us generate projects that can be put in the hands of kids all over the state. The bottom line is that . . .. The initial premise was that there was a problem and we wanted to help teachers and students understand or have the real accurate facts and that all of these companies were very willing to support us because they were as willing as we were in the true accurate facts . . . you know, being placed in the hands of teachers and students. And not once in all of these years has any company ever said to me, 'I would like for you to tell the teachers this. . .'. Not once. I think it goes back to the fact that a lot of people don't realize that most corporations have a corporate responsibility and they have a corporate conscience and not once has anybody ever told me, 'Hey, I am giving you money and here is what I want you to say,' because if they had, I would've said, 'No.' That is why, rather than to get the several thousand dollars it takes to run the workshop each summer . . . I've refused to take it all from one company because I didn't want the workshop or we as professionals or the university or anybody to misconstrue and say well, you're just a paid spokesman for company X. Not once has anybody suggested that, and they all agree with me that if I have $2500 from ten contributors . . . it would put me in a position of not being looked upon as a paid spokesman of company X or whatever . . . and I think it is the right approach. And I think it was because the public does not perceive today that we have an energy crisis, but we do. I am still convinced of that. But the fact that they continue this I think they feel it is of benefit and again as part of their corporate responsibility or trying to be good corporate citizens and supporting education. I think it has worked well, and I think we can demonstrate that most teachers, for example, have never been on a drilling rig, and as I said, most teachers have never been through an electrical generating plant. Most teachers have never been to a coal mining operation where the reclamation work is being done. That is the whole purpose . . . is to let them know, for example, when they go up here to the Sooner Power Plant, how much money that company has to invest in that. So, I think it has worked well.

"Well, the thing about it is the energy, the whole concept of energy conservation, management, that whole spectrum, there are things in it [the conference] that can be included in every discipline that is taught in the public school from social studies to language arts to home economics. Not only but also math and science and that is what we are trying to say. There is something in here in this whole area of energy that we can place in your hands to enhance the curriculum. Whatever subject you are teaching. I think we have been successful . . . We have never confined it to math and science teachers. We have had . . . Our philosophy is we . . . The teachers come from all subject areas and all grade levels. We don't exclude the home economics teacher or the social studies teacher or the language arts teacher. If you look at the composition of all of our workshops, it has been pretty well spread throughout all of the curriculum that are taught in the public schools. And, again, our reason for doing that is that there is something in there that can enhance the teachings of all subject areas."

APPENDIX C

HISTORICAL OVERVIEW OF THE OKLAHOMA STATE UNIVERSITY ENERGY AWARENESS PROGRAM FOR THE YEARS 1976 - 1992

Gay (1987) states that historical research involves understanding and explaining past events. The purpose of historical research is to arrive at conclusions concerning trends of past occurrences that may help explain present events and anticipate future events.

This section encompasses the 17-year history of the Oklahoma State University Energy Awareness Program. An overall view of the Work Conference is needed in order to understand what has taken place through the years.

1976 Work Conference

The following information was taken from the 1976 Energy Awareness Leadership Work Conference Summary.

The first Energy Awareness Leadership Work Conference was held at the Oklahoma State University campus on August 2 through 13, 1976.

Since it was the first work conference, the participants formulated seven objectives for the program:

1) To develop an awareness of the energy problem.
2) To examine the constraints faced by industry in production, delivery, and regulatory areas.
3) To examine the cost factors (dollar and societal) in production and consumption of energy.
4) To examine conservation measures and their effect on society.
5) To develop an awareness of alternative sources of energy.
6) To examine possible occupational opportunities in the various energy industries.
7) To produce energy education materials for the classroom.

The 1976 work conference was a cooperative venture between Oklahoma State University and the Oklahoma State Department of Energy, the State Department of Education, the Oklahoma Petroleum Council, the Oil Marketers Association, and the State Chamber of Commerce.

At the first work conference, eleven speakers gave presentations. Five speakers, considered "in-house" speakers, were faculty and staff from Oklahoma State University. Of the six outside speakers, Hugh Watson came from Cities Services Company and gave a presentation on Energy Resources in the Future. A representative of Gulf Oil, Jeff Harris came and spoke on divestiture. Energy Production Costs was the title of a program presented by G.O. Brainard of ARCO. Oklahoma Gas and Electric sponsored Richard Day, and his presentation concerned Energy and a New Era. The last two speakers were from the Oklahoma State Department of Education, Larry McKinney and Howard Potts. Mr. McKinney's presentation was the Energy Simulator, and Mr. Potts gave pointers on Curriculum Development. These aforementioned topics dealt with the ethical, economic, moral, scientific, legal and aesthetic levels of the energy problem.

The sixteen participants in the first Energy Awareness Leadership Work Conference were sponsored by several energy-related companies and agencies. Financial resources came from the State Department of Education, Continental Oil Company, Oklahoma Gas and Electric, Phillips Petroleum Company, Kerr-McGee, ARCO, Cities Services Company, and the Gulf Oil Company.

In the first work conference, the participants prepared <u>Oklahoma Energy Awareness Education Resource Materials</u>. This provided teachers (K-12) with energy awareness materials and activities for the classroom. Issued to over 3,000 schools and teachers in the State of Oklahoma, it was the first energy education curriculum guide to be authorized for issue by Leslie Fisher, State Superintendent of Public Instruction.

1977 Work Conference

The following information was taken from the 1977 Energy Awareness Work Conference Summary:

The Second Energy Awareness Work Conference was held at Oklahoma State University from July 11 to 29, 1977.

The second conference addressed ten major objectives. (These objectives are the same for each work conference from 1977 to 1989 and will not be repeated hereafter.)

The objectives of the 1977-1989 work conferences are as follow:

1) To develop an awareness of the energy problem.
2) To stimulate a widespread awareness of energy education at all levels of the curriculum.
3) To encourage closer affiliation between educational institutions, energy producing industries, and governmental agencies.
4) To stimulate educators' and administrators' interest in energy education.
5) To train teachers and administrators in the application of energy education in the schools of Oklahoma.
6) To promote an understanding of the scientific, social, economic, and political implications of energy exploration, production, consumption, and conservation.
7) To make energy education materials available to students in all grade levels.

8) To stimulate an awareness of career opportunities in the energy industries.

9) To create a knowledge of the impact of energy consumption of international relationships.

10) To develop new in-service energy awareness workshop materials and activities.

The 1977 work conference was sponsored by Oklahoma State University, the Oklahoma Petroleum Council, the State Department of Education, and the State Energy Office.

Of the twenty speakers for this work conference, only eight were from Oklahoma State University. Included in the eight were Dr. Ken Wiggins, Dr. Carl Anderson, and Steve Marks. Also included were Dr. Wiebelt whose topic was Solar Research; Dr. Allison, who gave a presentation on Wind Research; Wayne Turner, who spoke on the Oklahoma Energy Conservation Plan; Dr. Charles Butler, speaking on Energy and the Environment; and Rick Webb, who presented the Energy - Environment Simulator.

Outside speakers included Perry Wimpey and Barbra Bevins, Oklahoma Natural Gas Company; Linda Knox, Oklahoma City Public Schools; Paula Baines from the Chelsea Public Schools; Ken Jacobs, Shell Oil Company; Bob Burk, Phillips Petroleum Company; and George Meese, also from the Phillips Petroleum Company, who spoke on the Free Enterprise System. Others included Ben Henneke, Arkoma Coal Corporation; Richard Day, from Oklahoma Gas and Electric Company, who spoke on Electrical Utilities; Jim Kemm of the Oklahoma Petroleum Council whose presentation was about services of the Oklahoma Petroleum Council to Educators; Paul Matthews from the Highway Users Federation, whose topic was Car Pooling; and Larry

McKinney from the State Department of Education, who spoke on Energy Education in Oklahoma Public Schools.

The twenty participants made field trips to Stillwater Airport to tour windmills; Ponca City to tour the Continental Oil Company Refinery; Keystone Dam to tour the hydroelectric generating plant; a Boddard and Hale drilling platform; Joplin, Missouri to tour the Jayhawk Chemical Plant; Manhattan, Kansas to tour the Gulf strip mining operations; and finally to Kansas State University to tour a nuclear reactor.

A requirement of the teachers of the 1977 work conference was to produce new activities for the Oklahoma Energy Awareness Education Resource Materials book. Also, each teacher made a slide presentation to take back to the classroom.

1978 Work Conference

The following information was taken from the 1978 Energy Awareness Work Conference Summary.

A total of 38 teachers and administrators participated in the third work conference. The work conference began on July 10th and ended on July 28th. Again, the location of the work conference was the Oklahoma State University campus.

This conference included eighteen formal presentations during the three-week conference. Seven of the presentations were by Oklahoma State University faculty and staff. Sue Williams talked about Home Energy Management, Nelson Ehrlich gave a presentation on Non-fossil Fuels, Dr. Bose discussed Underground Homes, and Ken Jones reported on Energy and Agriculture. Jim Jackson spoke on Life Cycle Cost, Ron Miller gave a presentation on Wildcat Activities, and Rich Webb discussed the Energy Simulator.

The third work conference also presented various outside speakers on energy topics. Ben Henneke talked about coal. Ben represented the Arkoma Coal Company. Wayne Tiller from Amoco Oil Company presented Energy and the Environment. Other speakers and topics included John West from Public Service Company on Nuclear Power; Governmental Relations by Ed Grigsby from Phillips Petroleum Company; Petroleum Marketing presented by Jim Matthews of Shell Oil Company; Utility Pricing by Dick Day of Oklahoma Gas and Electric; a seminar on Oklahoma's Natural Gas by Walt Radmilovich from Oklahoma Natural Gas Co.; Jim Kemm talking on services of the Oklahoma Petroleum Council; and Howard Potts from the State Department of Education with a presentation on Energy Conservation for Public Schools.

Participants in this work conference took several field trips. They toured a windmill factory and a solar home in Stillwater. The Conoco Refinery tour was welcomed by many of the participants. Other trips included visiting the Keystone Dam, the Gulf Oil Company's Jayhawk Chemical Plant, strip mines, the Muskogee Generating Plant, and a drilling rig.

An added feature of this work conference was a news release sent to several areas announcing the field trips and the companies sponsoring the tours.

Participants also added new activities to the Oklahoma Energy Awareness Education Resource Materials book and made slides to present in their classrooms.

The 1978 Work Conference marked the first year that the participants took the pre- and post-test energy awareness questionnaire designed by Nelson

Ehrlich, which has been used in each subsequent work conference to measure knowledge and attitudes before and after the work conference.

1979 Work Conference

The following information was taken from the 1979 Energy Awareness Work Conference Summary.

The fourth Energy Awareness Work Conference was held on the campus of Oklahoma State University July 9th through July 27, 1979. Attending the conference were 31 participants from Oklahoma schools.

The speakers came from various industries, agencies and departments at Oklahoma State University. From Oklahoma State University, Dr. Parker spoke on Solar Energy; Dr. Bose spoke on The Energy Efficient Home; Dr. Jackson spoke on Life Cycle Cost; Dr. Turner gave the Energy Simulator demonstration; and Sue Williams gave a presentation on Energy and the Family. Also, Dr. Bruneau addressed the topic of Biological Radiation, and Mr. Ken Jones, Energy and Agriculture.

Speakers from agencies or industries included Linda Knox speaking on Elementary Energy Education; Ms. Barbra Bevins from Oklahoma Natural Gas; Chuck Royston from the Department of Energy; Paul Matthews, Highway Users Federation; Steve Natenberg, Shell Oil Company; and Ed Pugh from the Oklahoma Department of Energy. Also giving presentations were Bob Burke, Phillips Petroleum; Bob Radebaugh, Kent Construction Company; Bob Sampson, Cities Services Company; Wayne Tiller, Standard Oil Company; Jim Kemm, Oklahoma Petroleum Council; and Larry McKinney from the Oklahoma State Department of Education.

Several field trips were part of the fourth work conference. The first field trip consisted of a tour of a new technology house in Stillwater and a tour of windmill manufacturing. The participants also visited the Oklahoma Gas and Electric Sooner Coal Fired Generating Plant. This was the first tour of the plant since the generating station began producing electricity. The participants also saw the Conoco Refinery, Keystone Dam, the Jayhawk Chemical Plant, Midway Mine, the Port of Catoosa, a drilling rig, and a natural gas storage facility operated by Oklahoma Natural Gas Company.

A unique characteristic of this work conference was the release of radio and television announcements prior to the field trips. Also, there were the usual newspaper announcements as well.

The participants added new activities to the Oklahoma Energy Awareness Education Resource Materials book and also made slide presentations to take back to the classroom.

The 1979 Work Conference was the first conference evaluated by drawing upon the information learned by the application of Dr. Nelson Ehrlich's dissertation entitled "A Descriptive Analysis of Teacher Awareness Concerning Energy Sources Use and Conservation". The evaluation of the 1979 Work Conference showed significant differences between teachers who had not taken an Energy Awareness Work Conference and those teachers who completed the 1979 Work Conference. The study involved 20 questions and dealt with attitudes and knowledge about the energy situation.

1980 Work Conference

The following information was taken from the 1980 Energy Awareness Work Conference Summary.

A total of 34 professionals made up the Fifth Energy Awareness Work Conference, held on the Oklahoma State University campus July 7 to July 25, 1980.

Speakers from Oklahoma State were Dr. Wayne Turner on Energy and Industry, Dr. Parker on Solar Energy, Ken Jones on Energy and Agriculture, and Dr. Bose on Energy-efficient Homes.

Presentations from business, industry, and government included jim Kemm, with a presentation of Oklahoma's Oil Historical Documents; Al Strecker from Oklahoma Gas and Electric; Ed Grigsby from Phillips Petroleum, speaking on the topic of Profits and Windfall Profits; Sam Hammons from the Oklahoma Department of Energy; Joe Payne of Stillwater Public Schools with Energy Projects; Dr. Larry McKinney with the State Department of Education on Energy Education in Oklahoma; Steve Natenberg from Shell Oil Company with a presentation on Marketing Petroleum; and Linda Knox from the Yukon Public School System.

Other lecturers included Bob Martin on Energy Conservation in Public Schools; Dr. Earl Schubert from the Department of Education; Clif McKnight from the Public Service Company on Nuclear Energy; Bob Sampson from Cities Service Company with Energy Perspectives; and Barbra Bevins from Oklahoma Natural Gas Company.

Trips were taken to the Conoco Refinery; the Sooner Power Generating Plant of OG&E; the Department of Energy facilities in Bartlesville, Oklahoma; the Keystone Dam; Jayhawk Chemical Plant; the Midway Mine; an active drilling rig owned and operated by Boddard and Hale; and the first oil well in Oklahoma. Also toured was a solar research facility near Stillwater, Oklahoma.

Participants also produced new energy activities to be assembled with the Oklahoma Energy Awareness Education Resource Materials book and made slides of various aspects of the field trips.

The evaluation of the work conference showed significant differences in knowledge and attitudes between the pre-conference and post-conference tests.

1981 Work Conference

The following information was taken from the 1981 Energy Awareness Work Conference Summary.

The Sixth Energy Awareness Work Conference was held at Oklahoma State University on July 6-24, 1981, with 35 teaching professionals attending.

Speakers from Oklahoma State University included Dr. Jim Bose speaking on Energy Efficient Heating and Cooling; Walter Grondzik on Underground Homes; Richard Thomas on Pedal Power; Dr. Wayne Turner on Industrial Energy Conservation; and Dr. Bobby Clary on Alcohol Research.

Speakers from the business, industry and government sectors included Gene Smith from the Department of Education, on Energy Education in Oklahoma; Bud Baker from Great Plains Wind Works, on Windmills; Barbra Bevins from Oklahoma Natural Gas, on Energy Problems; Steve Natenberg from Shell Oil Company, on Petroleum Marketing; Dick Day from Oklahoma Gas and Electric, on Electricity Considerations; and Walt Radmilovich from Oklahoma Natural Gas. Other presentations included Clifford McKnight from the Public Service Company who spoke on nuclear power; Paul Hale, who gave an orientation to drilling rigs; Jim Kern from the Oklahoma Petroleum

Council, who spoke on the History of Oil in Oklahoma; and James Collins from Cities Service, who presented Energy, Environment and Safety.

For the Work Conference of 1981, there were several field trips, both in and out of the state. The first trip was to see the Solar Applications Research Laboratory at Oklahoma State University and, also on the OSU campus, a tour of the University Power Plant. The Conoco Refinery and the Sooner Generating Plant owned by OG&E were toured the second week. Other tours included the General Motors Assembly Plant in Oklahoma City; the Black Fox Generating site, along with the General Electric simulator plant; the GRDA Pensacola Dam and hydroelectric dam; the Midway Mine owned by Gulf Oil Corporation; the Jayhawk Chemical Plant; a drilling rig owned by Paul Hale; and a tour of the Natural Gas Storage Facility in Tulsa owned by Oklahoma Natural Gas.

New activities were added to the Oklahoma Energy Awareness Education Resource Materials book.

The work conference was evaluated and, as in previous years, there were significant differences between the pre-conference tests and the post-conference tests.

1982 Work Conference

The following information was taken from the 1982 Energy Awareness Work Conference Summary.

The Seventh Energy Awareness Work Conference was held on the Oklahoma State University campus from July 5 to July 23, 1982. Twenty-nine participants attended.

Several new speakers were on the itinerary for the 1982 Work Conference. Speakers from the University included Walter Grondzik on Energy Conservation and Earth Sheltered Homes; Dr. Jim Bose on Energy Efficient Heating and Cooling; Dr. Milton Rhodes, Energy Conservation and the Automobile; Dave Hinkle on the OSU Energy Conservation Program; Dr. Bobby Clary on Alcohol Research; and Sue Williams on Energy in the Home.

Speakers from business, industry and government included Gene Smith from the State Department of Education speaking on Energy Education in Oklahoma; Bud Baker from Great Plains Wind Works on Windmills; Amanda Knight from Cities Service, presenting Energy Conservation from the Industry Point of View; Mr. Cassidy from Shell Oil Company with the topic of Petroleum Marketing; Jim Helton and Mike David from OG&E presenting Electrical Considerations; and Paul Matthews from the Highway Users Federation with a presentation on Car Pooling. Other speaking engagements included Walt Radmilovich and Barbra Bevins from Oklahoma Natural Gas presenting Natural Gas; Jerry Martin from the Quadrex Corporation speaking on Nuclear Power; Jim Kern from the Oklahoma-Kansas Oil and Gas Association presenting Oklahoma Oil History; Bob Springer with the Oklahoma Corporation Commission with the topic of Energy Conservation in Oklahoma; and Dr. Don Kellog from East Central State University with a presentation on Energy Education and the Microcomputer.

Field trips for the Seventh Work Conference included a tour of the OSU Solar Applications Research Laboratory; the OSU Power Plant; the Conoco Refinery in Ponca City; the Sooner Generating Power Plant; the Keystone Hydroelectric Dam; the first commercial oil well in Oklahoma; the Midway Mine; the Will Rogers Memorial; dinner at the Hammett House; a tour of a Boddard and Hale drilling rig; and a tour of the Oklahoma Capitol in Oklahoma City.

Additions made to the <u>Oklahoma Energy Awareness Education Resource Materials</u> book were sent to the State Department of Education as supplements.

Also, all participants were required to submit outlines of presentations on energy suitable for civic and social groups.

Evaluation of the Work Conference showed significant differences in attitudes and knowledge between the pre-conference and post-conference tests.

1983 Work Conference

The following information was taken from the 1983 Energy Awareness Work Conference Summary.

The Eighth Energy Awareness Work Conference was held on the Oklahoma State University campus from July 11 to 29, 1983. A total of 30 education professionals attended. Presentations from the Oklahoma State University faculty included Walter Grondzik on Energy Conservation and Earth Sheltered Homes; Dr. Bobby Clary on Alcohol Research; Dr. Jim Bose on Energy Efficient Heating and Cooling; Dr. Milton Rhodes on Energy Conservation and the Automobile; Dave Hinkle on the OSU Energy Conservation Program; and Sue Williams on Energy and the Home.

Speakers from the business, industry, and government sector included Ed Cassidy from Shell Oil Company presenting Petroleum Marketing; Mike Davis from OG&E on the topic of Electrical Considerations; Gene Smith from the State Department of Education on Energy Education in the State of Oklahoma; Linda Wimmer from the Center for Economic Education on Economics and Energy Education; Walt Radmilovich and Barbra Bevins from Oklahoma Natural Gas on Natural Gas; Dr. Marvin Baker from the University of Oklahoma on Energy and the Environment; a representative from Kansas Gas and Electric who spoke on Nuclear Power; Paul Hale who gave an orientation to drilling rigs;

Stan Williams and Bob Springer from the Oklahoma Corporation Commission who presented Energy Conservation in Oklahoma; and Jim Kern from the Oklahoma/Kansas Oil and Gas Association who presented Oklahoma Oil History.

Field trips for the Eighth Work Conference included a tour of the OSU Power Plant; a guided tour of the Sooner Generating Plant operated by OG&E in Morrison, Oklahoma; a tour of the Conoco Refinery facilities in Ponca City; a tour of the Keystone Dam facilities outside of Tulsa; Kansas Fish and Wildlife Refuge; a tour of the Midway Mine; dinner at the Hammett House in Claremore, Oklahoma; and a tour of an active drilling rig owned by Boddard and Hale.

The participants again produced activities for the Oklahoma Energy Awareness Education Resource Materials book which were sent to the State Department of Education to be added as supplements. The participants were also required to turn in an outline of a presentation that could be given to an interested civic or social group.

The work conference evaluations revealed significant differences between the pre-conference and the post-conference tests in attitudes and knowledge.

1984 Work Conference

The following information was taken from the 1984 Energy Awareness Work Conference Summary.

The Ninth Energy Awareness Work Conference was held in Stillwater at Oklahoma State University from July 9 to July 27, 1984. A total of 15 education professionals were admitted to the conference. The total number of participants was reduced to allow them increased usage of microcomputers.

Presentations about energy and related topics that came from Oklahoma State University personnel included Dr. Milton Rhodes speaking on Energy Conservation and the Automobile; Dr. James Knight on Energy Conservation and Earth Sheltered Homes; Tommy Bates on Energy Education and the Computer; Dr. Jim Bose on Energy Efficient Heating and Cooling; Dave Hinkle on Energy from Garbage; Dr. Bobby Clary on Alcohol Research; and Dr. Sue Williams on Energy in the Home.

Speakers and presentations from business, industry and government agencies included Ed Cassidy from Shell Oil Company on Petroleum Marketing; Mike Davis and Bill Scribner from OG&E on Electrical Considerations; Gene Smith from the State Department on Energy Education in Oklahoma; Linda Wimmer from the Center for Economic Education on Economics and Energy Education; Walt Radmilovich and Barbra Bevins from Oklahoma Natural Gas, who presented topics on Natural Gas; Ron Falkenstein from Kansas Gas and Electric who made a presentation on Nuclear Power; Jim Kemm who spoke on Oklahoma Oil History; Dr. Marvin Baker from the University of Oklahoma on Energy and the Environment; and Paul Hale with an Orientation to Drilling Rigs.

Field trips for the 1984 Work Conference included a tour of the Solar Applications Laboratory at OSU; a tour of the Sooner Generating Plant in Morrison, Oklahoma; a tour of the Conoco Refinery in Ponca City; a tour of the Keystone Dam; a tour of the Midway Mine; dinner at Hammett House in Claremore, Oklahoma; and a tour of an active drilling rig owned by Boddard and Hale of Shawnee, Oklahoma.

New activities produced for the Oklahoma Energy Awareness Education Resource Materials book were sent as a supplement to the State Department of Education.

An evaluation of the Work Conference showed significant differences between the pre-conference test and the post-conference test scores concerning knowledge and attitudes.

1985 Work Conference

The following information was taken from the 1985 Energy Awareness Work Conference Summary.

The Tenth Energy Awareness Work Conference took place on the Oklahoma State University campus from July 9 to July 25, 1985, with a total of 27 education professionals attending.

Speakers from Oklahoma State University presenting educational topics were Dr. Milton Rhodes on Energy Conservation and the Automobile; Linda Wimmer on Economics and Energy Education; Dr. James Knight on Energy Conversion and Earth Sheltered Homes; Dr. Bobby Clary on Alcohol Research; Dr. Sue Williams on Energy Management in the Home; Dr. Jim Bose on Energy Efficient Heating and Cooling; and Dr. Nelson Ehrlich on Fundamentals of the Energy Problem.

Presentations from business and governmental agencies included Gene Smith from the State Department of Education on Energy Education in Oklahoma; Ed Cassady from Shell Oil Company on Petroleum Marketing; Mike Davis from OG&E on Electrical Considerations; Walt Radmilovich and Barbra Bevins from Oklahoma Natural Gas with a presentation on Natural Gas; John Holt from Kansas Gas and Electric on Nuclear Power; and Paul Hale with an Orientation to Drilling Rigs.

Field trips for this work conference included a tour of the Solar Applications Research Laboratory at OSU; a tour of the Sooner Generating Plant owned by

OG&E in Morrison, Oklahoma; a tour of the Conoco Refinery in Ponca City; a tour of the Keystone Dam; a tour of the Midway Mine in Lacyne, Kansas; dinner at the Hammett House in Claremore, Oklahoma; a visit to the Woolaroc Museum in Bartlesville, Oklahoma; and a drilling rig tour in Shawnee, Oklahoma.

Additions to the Oklahoma Energy Awareness Education Resource Materials book were made and sent to the State Department of Education as supplements.

An evaluation of the 1985 Work Conference showed significance differences between the pre-conference and post-conference tests in knowledge and attitudes concerning energy.

1986 Work Conference

The following information was taken from the 1986 Energy Awareness Work Conference Summary.

The 1986 Energy Awareness Work Conference was held in Stillwater, Oklahoma at Oklahoma State University from June 2 through June 20. At the eleventh work conference, a total of 16 professional educators were in attendance. The emphasis of the 1986 Work Conference was to revise and update the Oklahoma Energy Awareness Education Resource Materials book. The original book had been developed by the first Work Conference in 1976. In order for the participants to accomplish the goals of the work conference, the following questions were asked of each speaker:

1) What services does your company offer to teachers on a national, state or local level (films, scholarships, contests, etc.)?

2) What energy education concepts do you feel the K-12 students should be taught in the schools?
3) What concepts does your company feel everyone should know?
4) What skills should students of today possess in entering the energy business?
5) What areas of knowledge do you feel the public lacks concerning the energy business?
6) What concepts are not included in the current Energy Awareness Work Conference program that you would like to see covered?

The editing of the resource book got underway, and at the completion of the revision, the book was to be submitted to the State Department of Education for distribution throughout the state. The final revised copy was to be completed by the end of the 1986-1987 academic year.

Another goal of the 1986 Work Conference was to establish a new direction for energy education in the public schools in Oklahoma. This new information was shared with educational leaders on the state and national levels.

The format for the 1986 Work Conference was changed in order to take new directions with the goals of the participants.

Speakers who came in from business and industry were Bill Rinehart from Chevron U.S.A. Inc.; Mike Bohrofen from Oklahoma Gas and Electric; Barbra Bevins, Donnell Green and Walt Radmilovich from Oklahoma Natural Gas; and Ed Cassidy from Shell Oil Company.

An extensive field trip schedule was undertaken, especially the last week of the work conference. The first trip was to Ponca City to the administrative offices of the Conoco Refinery. During the last week, the participants traveled to Port Arthur, Texas to tour the Port Arthur Refinery. From there, they toured the

Orange Chemical Plant, followed by a guided tour of the Lucas Terminal of the Chevron Pipeline Company. The participants then traveled to Mont Belvieu to tour the Warren Petroleum Company, where they saw the Mont Belvieu Fractionator. Before the group returned to Stillwater, they visited the Cedar Bayou Chemical Plant, the Galena Park Terminal, and Warren Gas.

1987 Work Conference

The following information was taken from the 1987 Energy Awareness Work Conference Summary.

The Twelfth Energy Awareness Work Conference was held on the Oklahoma State University campus in Stillwater, Oklahoma from June 24 to July 17, 1987. A total of 25 education professionals attended.

Presenters from Oklahoma State University included Dr. Milton Rhodes on Energy Conservation and the Automobile; Dr. Sue Williams on Energy Management in the Home; Dr. Bobby Clary on Alcohol Research; Dr. Jim Bose on Energy Efficient Heating and Cooling; and Dr. Nelson Ehrlich on Fundamentals of the Energy Problem.

Speakers from government, business, and industry included Ed Cassidy from the Shell Oil Company who spoke on Petroleum Marketing; Jim Stengle and Bill Wilkerson from OG&E who gave presentations on Electrical Considerations; Walt Radmilovich, Barbra Bevins and Sandra Flinton from Oklahoma Natural Gas Company who spoke on Natural Gas Usage; Paul Hale who gave an Orientation to Drilling Rigs; Dr. James Knight who presented Earth Sheltered Homes; and Dr. Doris Grigsby from the State Department of Education who presented Energy Education in Oklahoma.

Field trips for the 1987 Work Conference included a tour of the Solar Applications Research Laboratory at OSU; a walk-through of the OG&E Sooner Generating Plant in Morrison, Oklahoma; a guided tour of the Conoco Refinery and facilities in Ponca City, Oklahoma; a walking tour of the Keystone Dam outside of Tulsa, Oklahoma; a tour of one of the largest steam shovels ever built, Big Brutus, in Pittsburg, Kansas; a tour of the Midway Mine owned by Chevron U.S.A. located in Lacyne, Kansas; the Hammett House in Claremore, Oklahoma; and a tour of an active drilling rig in Shawnee, Oklahoma.

A course requirement was to update the Oklahoma Energy Awareness Education Resource Materials book prepared by the 1976 Work Conference and revised by the 1986 Work Conference.

An evaluation of the 1987 Work Conference showed significant differences between the pre-conference and post-conference tests in participants' knowledge and attitudes concerning energy.

1988 Work Conference

The following information was taken from the 1988 Energy Awareness Work Conference Summary.

The Thirteenth Energy Awareness Work Conference was held in Stillwater, Oklahoma on the Oklahoma State University campus from June 27 to July 15, 1988. A total of 18 education professionals attended.

Presentations from Oklahoma State University included Dr. Sue Williams presenting Energy Management in the Home; Dr. Milton Rhodes on Energy Conservation and the Automobile; Dr. Bobby Clary with the topic of Alcohol Research; Dr. Nelson Ehrlich speaking on Fundamentals of the Energy

Program; Linda Wimmer on Economics and Education; and Dr. James Knight on Earth Sheltered Homes.

Presentations from business, industry and government agencies included Ed Cassidy from Shell Oil Company speaking on Petroleum Marketing; Jim Stengle from OG&E who spoke on Electrical Considerations; Walt Radmilovich and Barbra Bevins from Oklahoma Natural Gas who spoke on Natural Gas; and Paul Hale who gave an Orientation on Drilling Rigs.

Field trips included Conoco and Refinery tours in Ponca City, Oklahoma; a tour of the Sooner Generating Plant owned by OG&E in Morrison, Oklahoma; a visit to the Keystone Dam outside of Tulsa, Oklahoma; a tour of Big Brutus in Pittsburg, Kansas; a tour of the Midway Mine in Lacyne, Kansas; and a tour of an active drilling rig owned by Boddard and Hale of Shawnee, Oklahoma.

A course requirement for the work conference was to review activities of the Exxon Energy Education manuals. Afterward, each participant had to make an outline of a presentation on energy education that he or she could use if called on by a civic or social club.

An evaluation of the 1988 Work Conference showed significant differences between the pre-conference and post-conference tests in participants' knowledge and attitudes concerning energy.

1989 Work Conference

The following information was taken from the 1989 Energy Awareness Work Conference Summary.

The Fourteenth Energy Awareness Work Conference was held in Stillwater, Oklahoma, on the Oklahoma State University campus from June 26 to July 14, 1989 with a total of 20 education professionals attending.

Presentations from Oklahoma State University personnel included Dr. Milton Rhodes speaking on Energy Conservation and the Automobile; Dr. Becky Johnson Energy and Biomass; Dr. Nelson Ehrlich on Fundamentals of the Energy Problem; Dr. Bobby Clary on Alcohol Research; Sue Lynn Sasser on Energy Economic Education; and Dr. Sue Williams on Energy Management in the Home.

Presentations from business, industry and government included Jim Stengle, Bill Wilkerson and Mike Davis from OG&E who spoke on Electrical Considerations; Walt Radmilovich and Barbra Bevins from Oklahoma Natural Gas who presented a Natural Gas lecture; Ed Cassidy from the Shell Oil Company who spoke on Petroleum Marketing; and Paul Hale on Orientation to Drilling.

Field trips included a tour of the Sooner Generating Plant owned by OG&E in Morrison, Oklahoma; a tour of the Conoco Refinery and administrative offices; a tour of the Keystone Dam outside of Tulsa, Oklahoma; a tour of Big Brutus in Pittsburg, Kansas; a tour of the Midway Mine in Lacyne, Kansas; a tour of a drilling rig owned by Boddard and Hale of Shawnee, Oklahoma; and a tour of Dr. Williams' energy-efficient house on the outskirts of Stillwater, Oklahoma.

One of the course requirements was for the participants to evaluate the Exxon Energy Education manuals. The participants also had to make an outline of a presentation on energy education that they could give if requested to do so by a civic organization.

An evaluation of the 1989 Work Conference showed significant differences between the pre-conference and post-conference tests in knowledge and attitudes concerning energy.

1990 Work Conference

The following information was taken from the 1990 Energy Awareness Work Conference Summary.

The Fifteenth Energy Awareness Work Conference was held in Stillwater, Oklahoma on the Oklahoma State University campus from June 25 to July 13, 1990, with a total of 15 education professionals attending.

Presentations from Oklahoma State University personnel included Dr. Milton Rhodes speaking on Energy Conservation and the Automobile; Dr. Bobby Clary on Alcohol Research; Dr. Nelson Ehrlich on Fundamentals of the Energy Problem; Dr. Jim Bose on Energy Efficient Heading and Cooling; Sue Lynn Sasser on Energy Economic Education; Dr. Gwen Brewer on Energy Management in the Home; and Dr. Milton Rhodes on Energy Conservation and the Automobile.

Presentations from business, industry and government included Jim Stengle and Bill Wilkerson from OG&E who spoke on Electrical Considerations; Walt Radmilovich and Barbra Bevins from Oklahoma Natural Gas who presented a natural gas lecture; Dr. Wei Chen from the Oklahoma School for Science and Mathematics who presented information on Nuclear Energy; Mr. Tom McPhail from the Shell Oil Company who spoke on Petroleum Marketing; and Paul Hale on an orientation to a drilling rig.

Field trips included a tour of the Sooner Generating Plant owned by OG&E in Morrison, Oklahoma; a tour of the Conoco Refinery and administrative offices in Ponca City, Oklahoma; a tour of the Keystone Dam outside of Tulsa, Oklahoma; a tour of Big Brutus in Pittsburg, Kansas; a tour of the Midway Mine in Lacyne, Kansas; a tour of a drilling rig owned by Boddard and Hale of

Shawnee, Oklahoma; and a tour of the Bartlett Lab on the campus of Oklahoma State University.

An evaluation of the 1990 Work Conference showed significant differences between the pre-conference and post-conference tests in knowledge and attitudes concerning energy.

1991 Work Conference

The following information was taken from the 1991 Energy Awareness Work Conference Summary.

The Sixteenth Energy Awareness Work Conference was held in Stillwater, Oklahoma, on the Oklahoma State University campus from July 1 to July 19, 1991. A total of 23 education professionals attended.

Presentations from Oklahoma State University included Eric Davis on Meter Reading and Sara Drummond on Energy Management in the Home.

Presentations from business, industry and government agencies included Jim Stengle and Bill Wilkerson from OG&E who spoke on Electrical Considerations; Walt Radmilovich and Barbra Bevins from Oklahoma Natural Gas who spoke on Natural Gas; Tom McPhail from the Shell Oil Company who presented Petroleum Marketing; and Paul Hale, who gave an orientation to Drilling Rigs.

Field trips included the Shell Credit Card Center in Tulsa, Oklahoma; a tour of the Sooner Generating Plant owned by OG&E in Morrison, Oklahoma; a tour of the Tulsa Public Schools Compressed Natural Gas Project in Tulsa, Oklahoma; a tour of the Conoco administrative offices and the Conoco Refinery in Ponca City, Oklahoma; a tour of Keystone Dam outside of Tulsa, Oklahoma; a tour of the Big Brutus Steam Shovel in Pittsburg, Kansas; a tour of the Wolf

Creek Generating Facility in Burlington, Kansas; and a tour of the Boddard and Hale drilling rig in Shawnee, Oklahoma.

An evaluation of the 1991 Work Conference showed significant differences between the pre-conference and post-conference tests in participants' knowledge and attitudes concerning energy.

1992 Work Conference

The following information was taken from the 1992 Energy Awareness Work Conference Summary.

The Seventeenth Energy Awareness Work Conference was held in Stillwater, Oklahoma on the Oklahoma State University campus from June 29-July 17, 1992. A total of 14 education professionals attended.

Presentations from Oklahoma State University included Dr. Sue Williams lecturing on Household Energy Use: The Environmental Link; Dr. Milton Rhodes on Energy Conservation and the Automobile; Dr. Kevin Allen on Solar Applications; and Dr. John Steinbrink on the Geography of Global Energy.

Presentations from business, industry and government agencies included Jim Stengle and Bill Wilkerson from OG&E who presented Electrical Considerations; Walt Radmilovich, Sandra Flint, and Barbra Bevins from Oklahoma Natural Gas who presented energy from natural gas; Paul Hale from Boddard and Hale Drilling gave an orientation to drilling rigs; and Tom McPhail from Shell Oil Company presented Petroleum Marketing.

Field trips included a tour of the Sooner Generating Plant in Morrison, Oklahoma; a tour of the Tulsa Public Schools Compressed Natural Gas Project in Tulsa, Oklahoma; a tour of the Shell Credit Card Center in Tulsa, Oklahoma; a tour of an active drilling rig in Shawnee, Oklahoma; a tour of the Keystone

Dam outside of Tulsa, Oklahoma; a tour of Big Brutus in Pittsburg, Kansas; a tour of the Wolf Creek Generating Facility in Burlington, Kansas; and a tour of the Conoco administrative offices and the Conoco Refinery in Ponca City, Oklahoma.

An evaluation of the 1992 Work Conference showed significant differences between the pre-conference and post-conference tests in participants' knowledge and attitudes concerning energy.

APPENDIX D

DISSERTATIONS ASSOCIATED WITH THE

ENERGY AWARENESS PROGRAM

During the seventeen year existence of the Energy Awareness Work Conference, four doctoral dissertations have been completed in conjunction with the conference. All four dissertations have been in the area of energy education.

In July 1978 John Pursell completed the dissertation entitled "An Evaluation of Activities Designed to Train Teachers and Materials Developed to Make Students Aware of the Energy Problem". The purpose of the dissertation was two-fold: first, to evaluate the Oklahoma Sate University Energy Awareness Work Conferences and secondly, to evaluate the materials and learning activity units the teachers developed during the energy work conferences.

The results of Pursell's study indicated that students taught by teachers who attended a work conference and used materials developed in a work conference had more success in terms of energy knowledge gained than students who were taught by teachers who used materials developed at the work conference but did not attend. Also, teachers who did not attend the work conferences and did not use work conference developed materials were the least successful in knowledge transfer to the students.

The second doctoral dissertation to be completed in association with the work conference was submitted by Johnnie Smith. The title of the dissertation was "An Evaluation of a Model of Energy Awareness and Conservation Inservice Program for Oklahoma Driver Education Teachers".

> The purpose of this study was to develop and evaluate an energy awareness and conservation inservice program for a select group of driver education teachers in Oklahoma. The energy program was evaluated to see if it was effective in causing a change in attitude and

knowledge toward energy awareness and conservation (Smith, 1978, p. 4).

The results of Smith's study indicated that the Oklahoma State University Energy Awareness Work Conference was effective in causing the participants to gain knowledge about energy conservation. It was found to be easier to change participants' knowledge about energy and conservation than to change their opinions and attitudes and prejudices about energy awareness.

The third doctoral dissertation completed in conjunction with the work conference was by Nelson Ehrlich, entitled "A Descriptive Analysis of Teacher Awareness Concerning Energy Sources, Use, and Conservation". The purpose of this 1979 dissertation was to assess teachers' general level of knowledge and attitudes concerning production, use, and conservation of energy.

Ehrlich's study concluded the following:

1) The teachers were deficient in energy awareness as revealed by the low cognitive mean score of less than fifty percent.
2) The teachers exhibited a moderately positive or favorable attitude concerning government energy-policies, energy sources, energy use, and energy conservation.
3) Male teachers were more knowledgeable of basic energy concepts than female teachers.
4) Male and female teachers displayed similar attitudes regarding the energy situation.
5) Secondary teachers were more knowledgeable of basic energy concepts than elementary teachers.
6) Elementary and secondary teachers portrayed similar attitudes regarding the energy situation.

7) Science teachers were more cognizant of basic energy concepts than non-science teachers.
8) Science teachers exhibited a more favorable attitude regarding the energy situations than did non-science teachers.
9) Nearly fifty percent of the teachers were in agreement that conservation measures are best motivated by savings of money resulting from said measures.
10) Nearly forty-eight percent of the teachers believed inflation is the most critical national issue. The energy situation ranked a close second with nearly forty-five percent of the teachers in agreement that it is the most critical national issue.

The most recent doctoral dissertation completed in association with the work conference was entitled "An Evaluation of the Oklahoma State Energy Awareness Program at the Seventh Grade Level" by Leon Kot in 1984. The purpose of the study was to evaluate the success of the Energy Awareness Demonstration Program in terms of measuring the knowledge retention rate concerning energy concepts of seventh graders who attended the lectures/ demonstrations.

The results of the study indicated that the Energy Awareness Demonstration Program resulted in an improvement of student knowledge concerning the energy situation. The demonstration/lecture program also improved student attitudes regarding the energy situation. There were no important differences on the part of male and female students in this study. Also, the results of this study indicated that it was easier to change student perceptions about energy facts and concepts than it was to change student attitudes about energy use and energy conservation

APPENDIX E

QUESTIONS IN INTERVIEWS

INTERVIEW GUIDE

1. What interested you in participating in the Energy Awareness Work Conference?
2. Why did you attend the Energy Awareness Work Conference?
3. Has energy conservation always been a personal concern of yours?
   3a. If not, did the work conference change your mind or maybe open up new areas of concern for you?
   3b. If yes, how did you feel about energy after the work conference? Any attitude changes? What are they?
4. What influence did the work conference have on your present energy consumption behaviors, if any?
5. What areas in your personal life have changed because of something presented in the work conference? What was meaningful to you that led you to change? Can you give me any specific instances of such?
   5a. What personal habits were carried over into your instruction?
6. Did you teach a unit of instruction on energy education?
   6a. Have you taught energy education in your classes since taking the work conference?
   6b. Is there any difference in your energy units before you took the work conference? Are they about the same? Time, content, number of energy subjects, depth of these subjects?
   6c. What did you do differently?
7. Of all the energy activities that were presented in the work conference, did you implement any of them into your classroom?
   7a. How did the students respond to these activities?
8. Do you use energy education concepts throughout the year?
   8a. In what subjects do you present energy concepts? Is it just in science?

9. Have you used the resources of the energy work conference in your classroom teachings (books, pamphlets, etc.)?
10. Since the work conference, has your class taken any field trips connected with the subject of energy education?
11. Since the energy work conference, have you had a resource person to your classrooms for demonstrations, talks, etc.?
12. Since the work conference, have you helped other teachers with the subject of energy?
13. Did you perceive the energy awareness work conference to direct awareness to all grade levels of the curriculum?
14. What was your overall impression of the work conference?
15. If you could change one aspect of the energy work conference, what would it be and why?
16. Do you believe energy education should be taught as a subject by itself or as part of an overall science course?
17. Do you think we have a moral responsibility to teach our children energy education?

VITA

Jonathan Eric Davis

Candidate for the Degree of

Doctor of Education

Thesis: AN EVALUATION OF THE OKLAHOMA STATE UNIVERSITY ENERGY AWARENESS PROGRAM FOR ELEMENTARY AND SECONDARY TEACHERS

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Biographical:

Personal Data: Born in Anderson, South Carolina, May 13, 1961, the son of John Thomas Davis Jr. and Carolyn Lee (Kelly) Davis.

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